学生手册 2026

生物分类真题与知识讲解

Cambridge IGCSE Co-ordinated Sciences · 0654 · Core / Extended · 2022–2026 真题

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[Biology] 专题 1 生命特征与辨认

1 生命特征与辨认

题型 1：将生命过程的定义与名称对应（考频★★★★☆）

知识点 排泄（excretion）是排出代谢废物、超过需要的物质和有毒物质的过程，名称为_____。
呼吸（respiration）是细胞内分解营养物质并释放能量的化学反应，名称为_____。
生长是大小和干质量的永久增加；灵敏性（sensitivity）是感知并响应环境变化的能力，后者名称为_____。
营养是摄取供能、生长和发育所需物质；生殖产生同种新个体；运动是生物体整体或局部位置的改变。
这些生命过程不表示物理量，均无单位。

答案：排泄；呼吸；灵敏性

怎么认 题目出现释放能量、永久增大、代谢废物或响应环境变化时，先把定义与生命过程名称对应。

例题 1

Which characteristic of living things is described as the removal of toxic materials and substances in excess of requirements?

A excretion

B homeostasis

C nutrition

D respiration

（2024 Oct/Nov · 0654/11 · Question 1 · Core）

解：题干中的有毒物质和超过需要的物质均属于排泄物。
排出这些物质的生命过程是排泄。
故选 A。

针对练习

1. Which characteristic of living organisms is described as the chemical reactions in cells that break down nutrient molecules and release energy?

A excretion

B nutrition

C photosynthesis

D respiration

（2025 Oct/Nov · 0654/11 · Question 1 · Core）

2. Which term is used to describe the removal of toxic materials from living organisms?

A excretion

B nutrition

C respiration

D secretion

（2023 May/Jun · 0654/23 · Question 1 · Extended）

3. Which term describes the ability to detect and respond to changes in the environment?

A excretion

B growth

C movement

D sensitivity

（2024 Oct/Nov · 0654/21 · Question 1 · Extended）

4. Which characteristic of a living organism releases energy for growth?

A excretion

B reproduction

C respiration

D sensitivity

（2023 Oct/Nov · 0654/11 · Question 1 · Core；同题：2023 Oct/Nov · 0654/21 · Question 1 · Extended）

5. Which characteristic of living organisms involves a permanent increase in size?

A excretion

B growth

C respiration

D sensitivity

（2025 May/Jun · 0654/11 · Question 1 · Core）

6. Which characteristic of living organisms involves chemical reactions that break down nutrient molecules to release energy?

A excretion

B nutrition

C reproduction

D respiration

（2022 Oct/Nov · 0654/11 · Question 1 · Core；同题：2022 Oct/Nov · 0654/12 · Question 1 · Core、2022 Oct/Nov · 0654/13 · Question 1 · Core）

7. Which term describes the removal of waste products?

A excretion

B growth

C metabolism

D mitosis

（2025 May/Jun · 0654/21 · Question 2 · Extended）

8. Which statement about the characteristics of living organisms is correct?

A Excretion is the chemical reactions in cells that release energy.

B Nutrition is the taking in of materials for energy, growth and development.

C Respiration is the process that makes more of the same kind.

D Sensitivity is the removal of toxic materials and excess substances.

（2022 May/Jun · 0654/12 · Question 1 · Core；同题：2022 May/Jun · 0654/13 · Question 1 · Core、2022 May/Jun · 0654/22 · Question 1 · Extended）

9. Which statement about one of the characteristics of living organisms is correct?

A Excretion is the removal of excess substances and toxic materials.

B Movement is the ability to detect and respond to changes in the environment.

C Nutrition is the maintenance of a constant internal environment.

D Respiration is the manufacture of nutrients from raw materials.

（2022 May/Jun · 0654/11 · Question 1 · Core；同题：2022 May/Jun · 0654/21 · Question 1 · Extended）

10. Which statement about the characteristics of living organisms is correct?

A Excretion is the removal of excess substances and toxic materials.

B Movement is the ability to detect and respond to environmental changes.

C Nutrition is the breaking down of molecules to release energy.

D Respiration is the manufacture of carbohydrates from raw materials.

（2023 Oct/Nov · 0654/12 · Question 1 · Core）

11. A scientist studies a living organism. The organism has the ability to remove the waste products of metabolism.

Which characteristic of living organisms does this show?

A excretion

B nutrition

C respiration

D reproduction

（2025 Feb/Mar · 0654/12 · Question 1 · Core）

12. Which row about characteristics of living things is correct?

	name of process	definition of process
A	excretion	the ability to detect and respond to changes in the environment
B	nutrition	the removal of excess substances and toxic materials
C	reproduction	the taking in of materials for energy, growth and development
D	respiration	the breakdown of substances to release energy

（2026 Feb/Mar · 0654/22 · Question 1 · Extended）

13. Which rows match characteristics of living things with their descriptions?

	characteristic	description
1	excretion	removal of waste products of metabolism and substances in excess of requirements
2	growth	processes that make more of the same kind of organism
3	nutrition	taking in of materials for energy, growth and development
4	respiration	chemical reactions in cells that break down nutrient molecules and release energy for metabolism

A 1, 2 and 4 **B** 1, 3 and 4 **C** 1 and 3 only **D** 2 and 4 only

（2025 Oct/Nov · 0654/23 · Question 1 · Extended）

题型 2：判断动物与植物共有的生命过程（考频★★★☆☆）

知识点 生物的生命特征包括运动、呼吸作用、感应、生长、繁殖、排泄和营养。

排泄是清除代谢废物、有毒物质和超过需要量的物质的过程，属于_____生物共有的生命过程。

动物和植物都能运动、进行呼吸作用和排泄，并能感受刺激；二者都需要_____以满足营养需要。

绿色植物能摄取二氧化碳、水和离子，并利用光能合成有机物；光合作用、摄食、排遗和某一种繁殖方式只属于_____生物。

判断某过程是否共有，成立条件是所列每一类生物均能进行该过程。

答案：所有；离子；部分

怎么认 题目出现所有生物、动物与植物共有或不共有的过程时，先判断各过程是否全部具有。

例题 1

Which characteristic occurs in **all** living organisms?

A egestion

B excretion

C photosynthesis

D plasmolysis

（2025 May/Jun · 0654/22 · Question 1 · Extended）

解：题干要求所有生物都具有的特征。生物的代谢会产生废物，并可能出现超过需要量或有毒的物质，这些物质需经排泄清除。

因此共同特征为排泄，故选 B。

针对练习

1. What is a characteristic of all living organisms?

A excretion

B digestion

C photosynthesis

D sexual reproduction

（2024 May/Jun · 0654/11 · Question 1 · Core）

2. Which is **not** a characteristic of all living organisms?

A excretion

B growth

C photosynthesis

D sensitivity

（2023 May/Jun · 0654/12 · Question 1 · Core；同题：2023 May/Jun · 0654/13 · Question 1 · Core、2023 May/Jun · 0654/22 · Question 1 · Extended）

3. Which process do all living organisms carry out?

A photosynthesis

B ingestion

C excretion

D asexual reproduction

（2026 May/Jun · 0654/11 · Question 1 · Core）

4. What are two of the characteristics of all living organisms?

A breathing and respiration

B egestion and excretion

C movement and sensitivity

D nutrition and photosynthesis

（2024 Oct/Nov · 0654/12 · Question 1 · Core；同题：2024 Oct/Nov · 0654/13 · Question 1 · Core）

5. Which processes occur in **both** animals **and** plants?

	excretion	movement	respiration
A	✓	✓	✓
B	✓	✓	✗
C	✓	✗	✓
D	✗	✓	✓

（2022 Feb/Mar · 0654/12 · Question 1 · Core）

6. What do both animals and plants need to meet their nutritional requirements?

A carbon dioxide

B ions

C light

D organic compounds

（2024 May/Jun · 0654/23 · Question 1 · Extended）

7. Which processes are done by green plants?

1 detect stimuli and make appropriate responses

2 break down nutrient molecules to release energy for metabolism

3 take in carbon dioxide, water and ions for energy, growth and development

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

（2024 May/Jun · 0654/21 · Question 1 · Extended）

题型 3：由行为或生长现象辨认生命特征（考频★★★★☆）

知识点 生命特征包括运动、呼吸、感应、生长、繁殖、排泄和营养。

运动是生物体或其一部分发生_____变化；感应是检测刺激并作出反应。

生长是体积和干物质的_____增加；繁殖是产生新个体。

营养是摄取用于供能、生长和发育的物质；绿色植物通过光合作用制造有机物。

排泄是清除代谢废物、不需要的物质和过量物质；呼吸是在细胞中分解营养物并释放_____的化学反应。

答案：位置；永久性；能量

怎么认 题目出现动物行为、植物弯曲生长、捕食或物质进出时，先分别对应位置变化、刺激反应、生长、营养或排泄。

例题 1

A person throws a ball which their dog runs after and brings back to them.

Which characteristics of living things is the dog showing by this action?

A growth and nutrition

B movement and nutrition

C movement and sensitivity

D sensitivity and growth

（2023 Oct/Nov · 0654/13 · Question 1 · Core；同题：2023 Oct/Nov · 0654/23 · Question 1 · Extended）

解：狗跑向球并把球带回，身体位置发生变化，表现运动。
狗检测到球被抛出的刺激并作出追逐反应，表现感应。
故选 C。

针对练习

1. Soya seeds contain a lot of protein and are often fed to farm animals.

Which characteristic of living things will benefit from the soya seeds?

A excretion

B growth

C movement

D sensitivity

（2024 Oct/Nov · 0654/23 · Question 1 · Extended）

2. Which two characteristics of living organisms are demonstrated by gravitropism?

A growth and nutrition

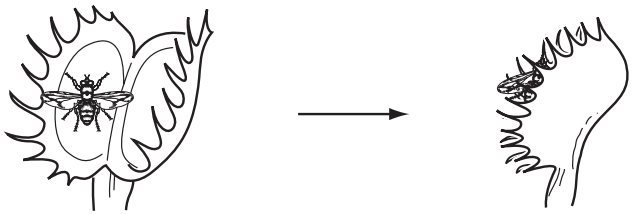
B growth and sensitivity

C respiration and nutrition

D respiration and sensitivity

（2024 May/Jun · 0654/12 · Question 1 · Core；同题：2024 May/Jun · 0654/13 · Question 1 · Core）

3. The Venus fly trap is a plant that catches insects.



Which characteristic of living organisms is shown in the diagram?

A excretion

B growth

C reproduction

D sensitivity

（2025 May/Jun · 0654/12 · Question 1 · Core；同题：2025 May/Jun · 0654/13 · Question 1 · Core）

4. Which characteristics of living things are demonstrated by phototropism?

1 growth

2 nutrition

3 reproduction

4 sensitivity

A 1 and 2 **B** 1 and 4 **C** 2 and 3 **D** 3 and 4

（2023 Oct/Nov · 0654/22 · Question 1 · Extended）

5. Which characteristic of living things is shown when a green plant absorbs light energy and produces glucose?

A excretion

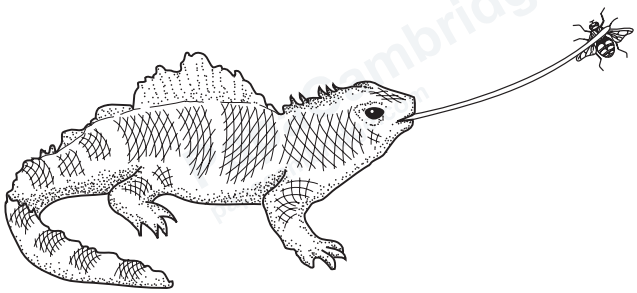
B growth

C nutrition

D respiration

（2024 Feb/Mar · 0654/22 · Question 1 · Extended）

6. The diagram shows a lizard that catches an insect by extending its tongue.



Which characteristics of living organisms are shown?

A growth and excretion

B growth and sensitivity

C movement and excretion

D movement and sensitivity

（2026 Feb/Mar · 0654/12 · Question 1 · Core）

7. Which processes are examples of excretion?

	release of energy from food	release of oxygen from photosynthesis
A	✗	✗
B	✗	✓
C	✓	✗
D	✓	✓

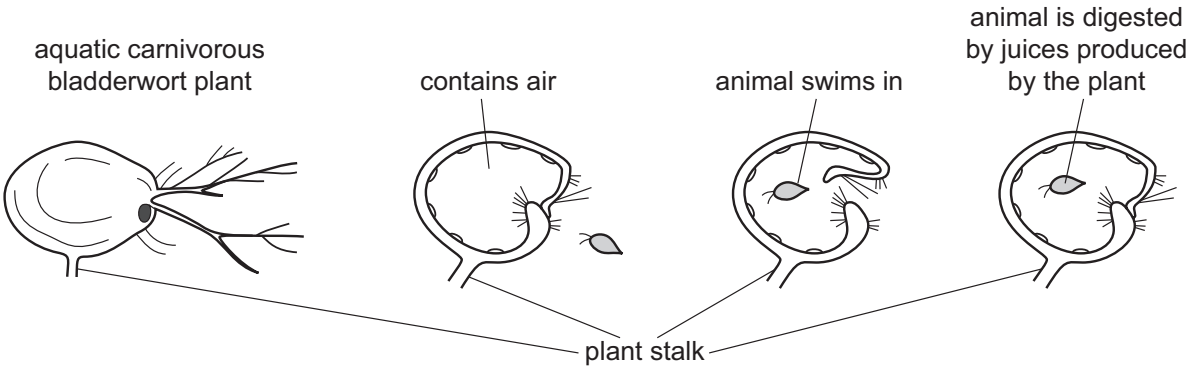
key

✓ = yes

✗ = no

（2024 May/Jun · 0654/22 · Question 1 · Extended）

8. The diagram shows how an aquatic carnivorous bladderwort plant reacts to tiny aquatic organisms that swim by.



Which characteristics of living organisms are shown by this plant?

A excretion and growth

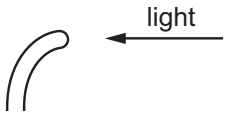
B growth and sensitivity

C nutrition and excretion

D nutrition and sensitivity

（2023 Feb/Mar · 0654/12 · Question 1 · Core；同题：2023 Feb/Mar · 0654/22 · Question 1 · Extended）

9. When light shines from one direction only, a plant shoot bends towards the light.



Which row gives the characteristics of living organisms shown by the plant shoot?

	growth	movement	sensitivity
A	no	yes	yes
B	yes	yes	no
C	yes	no	yes
D	yes	yes	yes

(2025 Oct/Nov · 0654/21 · Question 1 · Extended)

10. A plant is placed in front of a light source. After 24 hours, all of the plant's leaves face the light.

Which characteristics are displayed by this plant?

1 a permanent increase in size and dry mass

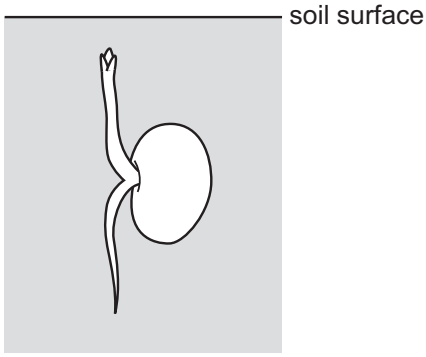
2 an action by part of an organism that causes a change of position

3 the ability to detect stimuli in the internal or external environment

A 1 and 2 **B** 1 only **C** 2 and 3 **D** 3 only

(2026 May/Jun · 0654/22 · Question 1 · Extended)

11. The diagram shows a germinating seed below the soil surface.



Which characteristic of living organisms ensures that the shoot grows upwards and the root grows downwards?

A excretion

B nutrition

C reproduction

D sensitivity

(2024 Feb/Mar · 0654/12 · Question 1 · Core)

12. During a sunny day, stomata are open to allow gas exchange. Oxygen moves out of the plant through the stomata.

Which characteristic of living things is described?

A excretion

B movement

C reproduction

D respiration

(2022 May/Jun · 0654/23 · Question 1 · Extended)

第 2 章 细胞结构、特化与放大倍数

2.1 细胞结构、特化与放大倍数

题型 1：辨认特化细胞并把结构连到功能（考频★★★★☆）

知识点 特化细胞具有与特定功能相适应的结构，辨认时依据形态、所在部位和功能建立对应关系。

根毛细胞具有长而细的突起，增大吸收面积，从土壤中吸收_____和_____。

红细胞运输氧；呼吸道中的纤毛细胞以纤毛摆动推动黏液；栅栏叶肉细胞含许多_____，进行光合作用。

精细胞有鞭毛并含单倍体细胞核，卵细胞也属于生殖细胞。

答案：水；无机盐离子；叶绿体

怎么认 题目出现特化细胞图、所在部位或功能时，先按形态与功能的对应关系确定细胞名称。

一. 由细胞形态或功能确定细胞名称

例题 1

Which substances are absorbed by root hair cells?

A mineral ions and starch

B mineral ions and water

C starch and sugars

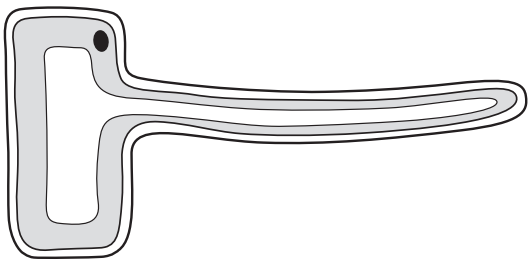
D water and sugars

（2026 May/Jun · 0654/13 · Question 4 · Core）

解：根毛细胞从土壤中吸收水和无机盐离子。
淀粉和糖不属于根毛细胞从土壤中吸收的物质。
故选 B。

针对练习

1. Which type of specialised cell is shown?



A ciliated cell

B palisade mesophyll cell

C root hair cell

D sperm cell

（2025 Oct/Nov · 0654/23 · Question 2 · Extended）

2. Which diagram shows a cell adapted to transport oxygen around the body?

A **B** **C** **D**



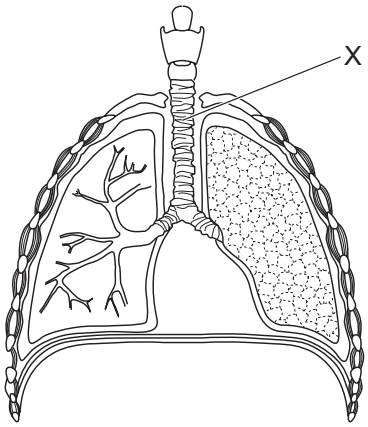
(2025 Feb/Mar · 0654/12 · Question 2 · Core)

3. Which row shows a specialised cell type matched with its function?

	cell type	function
A	ciliated	movement of mucus
B	egg	transport of oxygen
C	red blood	phagocytosis
D	root hair	photosynthesis

(2025 May/Jun · 0654/22 · Question 2 · Extended)

4. The diagram shows part of the breathing system in humans.



Which cell type makes up part of structure X?

A ciliated

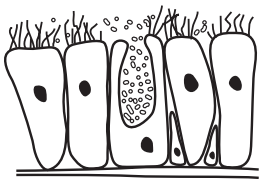
B gamete

C palisade mesophyll

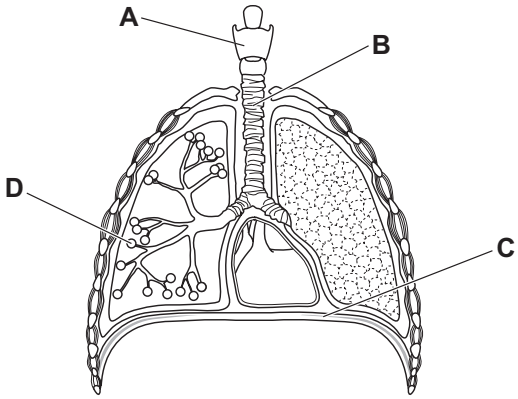
D phloem

(2025 Oct/Nov · 0654/11 · Question 2 · Core)

5. The diagram shows some cells in the gas exchange system.



Which label shows the part of the gas exchange system where these cells are found?



(2024 Oct/Nov · 0654/21 · Question 2 · Extended)

6. Which statement about the named cells is correct?

A Palisade mesophyll cells have many chloroplasts.

B Red blood cells have a haploid nucleus.

C Root hair cells have many chloroplasts.

D Sperm cells have a diploid nucleus.

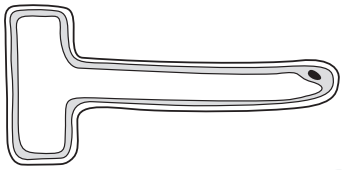
(2024 Oct/Nov · 0654/22 · Question 2 · Extended)

7. The diagram shows two cells.

cell 1



cell 2



Which row matches the name of each type of cell with its function?

	cell 1		cell 2	
	name	**function**	**name**	**function**
A	red blood	transport	root hair	absorption
B	red blood	reproduction	ciliated	photosynthesis
C	egg	transport	root hair	photosynthesis
D	egg	reproduction	ciliated	absorption

(2026 May/Jun · 0654/23 · Question 1 · Extended)

二. 说明大表面积怎样有利于物质交换

知识点 特化细胞具有与功能相适应的结构；根毛细胞是根表皮细胞特化形成的吸收细胞。

根毛突起使细胞的_____增大，增大与土壤溶液接触的面积，有利于吸收水和矿物离子。

在其他条件相同时，可供交换的表面积越_____，单位时间内通过细胞表面交换的物质通常越多。

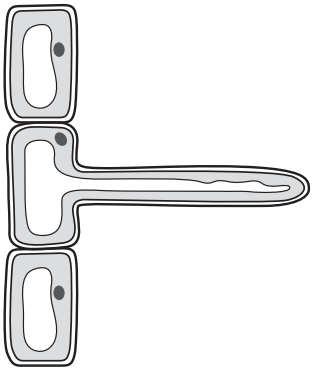
表面积使用面积单位，如 mm^2 或 μm^2。

答案：表面积；大

怎么认 题目出现特化细胞图并问结构与物质交换功能时，先比较表面积大小。

例题 2

The diagram shows a root hair cell and some of the adjacent cells.



Which statement about the root hair cell compared to the other cells in the diagram is correct?

A It has less cytoplasm.

B It has a smaller vacuole.

C It has a larger surface area.

D It has no nucleus.

（2025 Oct/Nov · 0654/12 · Question 6 · Core；同题：2025 Oct/Nov · 0654/13 · Question 6 · Core）

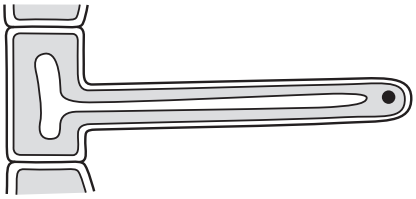
解：由图可见，根毛细胞具有细长的根毛突起。

根毛突起使细胞表面积增大，因此与相邻细胞相比，根毛细胞有较大的表面积。

故选 C。

针对练习

8. The diagram shows a section through a root hair cell.



Which statement describes how the structure of the root hair cell relates to its main function?

A The nucleus is **not** at the centre of the cell.

B The shape helps to support the plant.

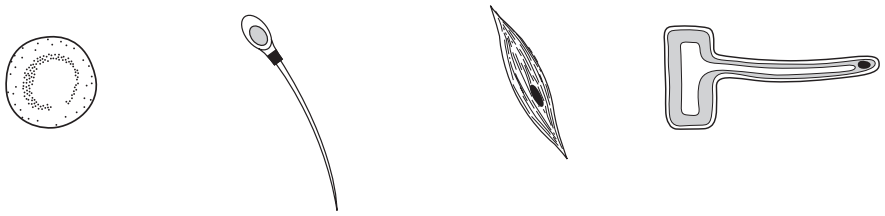
C The surface area is large.

D The volume of the vacuole is small.

（2025 Oct/Nov · 0654/21 · Question 2 · Extended）

9. The diagrams show four different cells found in living organisms.

1 2 3 4



Which cell types have a large surface area for diffusion?

A 1 and 2 **B** 1 and 4 **C** 2 and 3 **D** 3 and 4

（2023 May/Jun · 0654/23 · Question 2 · Extended）

题型 2：用放大倍数联系图像与实际尺寸（考频★★★☆☆）

知识点 放大倍数表示图像尺寸相对于实际尺寸扩大的倍数，等于_____除以_____。

$M = \frac{\text{image size}}{\text{actual size}}$。

图像尺寸与实际尺寸必须使用_____；单位相消，放大倍数没有单位。

答案：图像尺寸；实际尺寸；相同单位

怎么认 题目出现图像尺寸、实际尺寸和所求放大倍数时，先用图像尺寸除以实际尺寸。

一. 由两种尺寸求放大倍数

例题 1

What is the formula for magnification?

A $\frac{\text{actual size}}{\text{image size}}$

B $\frac{\text{actual size}}{\text{image size}} \times 100$

C $\frac{\text{image size}}{\text{actual size}}$

D $\frac{\text{image size}}{\text{actual size}}$ mm

（2022 Oct/Nov · 0654/11 · Question 2 · Core）

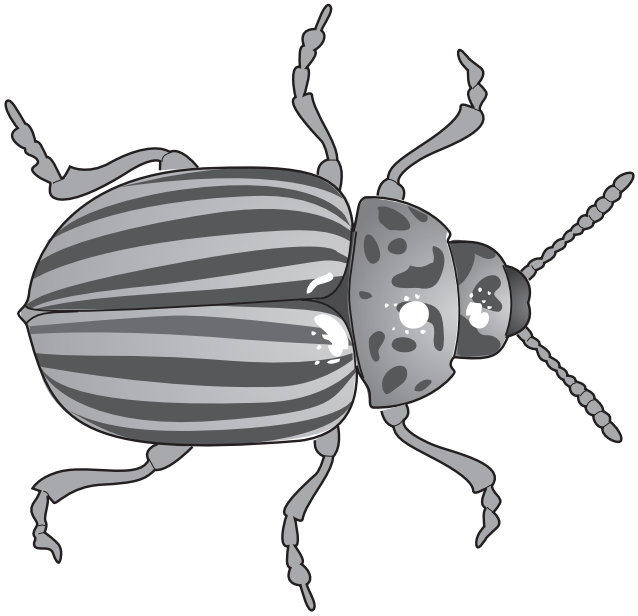
解： 由放大倍数定义得

$M = \frac{\text{image size}}{\text{actual size}}$。

该比值没有单位，故选 C。

针对练习

1. The diagram shows a beetle.



The length of the diagram is 75 mm.

The actual length of the beetle is 5 mm.

What is the magnification?

A ×5 **B** ×15 **C** ×80 **D** ×375

（2023 Oct/Nov · 0654/12 · Question 2 · Core）

2. The length of an insect in a photograph is measured as 17 mm.

The actual length of the insect is 12 mm.

What is the magnification of the insect in the photograph?

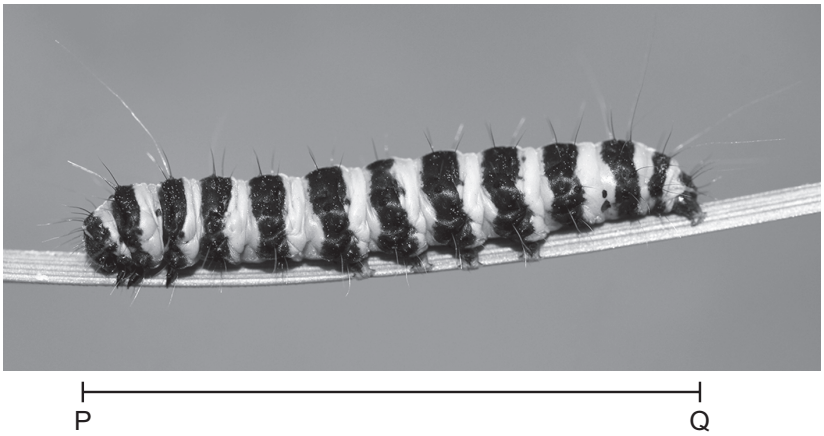
A ×0.7 **B** ×0.8 **C** ×1.4 **D** ×1.5

（2025 Oct/Nov · 0654/22 · Question 1 · Extended）

3. The photograph shows a caterpillar.

The length of line PQ is 90 mm.

The actual length of the caterpillar is 30 mm.



What is the magnification of the photograph?

A ×0.33 **B** ×3.0 **C** ×27 **D** ×2700

（2025 May/Jun · 0654/11 · Question 2 · Core）

二. 已知倍数反求实际尺寸

知识点 放大倍数 M 表示_____与_____的比，即 $M=\frac{\text{图像尺寸}}{\text{实际尺寸}}$。

由关系式得 实际尺寸 $=\frac{\text{图像尺寸}}{M}$。

计算前两种尺寸必须采用_____单位；放大倍数没有单位。

答案：图像尺寸；实际尺寸；相同

怎么认 题目出现图像尺寸和放大倍数，且求实际尺寸时，先统一尺寸单位。

例题 2

A plant cell is viewed using a microscope.

The cell image is measured at 4 mm. The magnification is ×100.

What is the actual size of the cell?

A 0.004 mm **B** 0.04 mm **C** 2.5 mm **D** 25 mm

（2026 May/Jun · 0654/12 · Question 1 · Core）

解： 由 $M=\frac{\text{图像尺寸}}{\text{实际尺寸}}$ 得

实际尺寸 $=\frac{\text{图像尺寸}}{M}$

$=4\frac{\text{mm}}{100}$

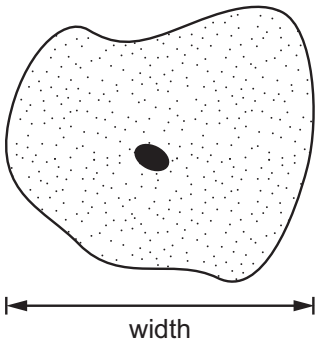
$=0.04\ \text{mm}$。

故选 B。

针对练习

4. The diagram shows a cell with a magnification of ×1000.

The width of the image is 45 mm.

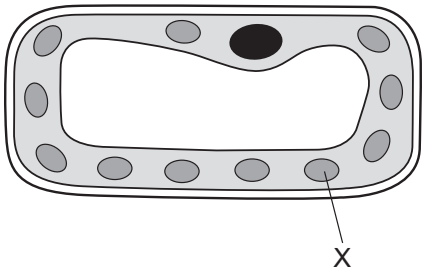


What is the actual width of the cell?

A 45 mm **B** 4.5 mm **C** 0.45 mm **D** 0.045 mm

（2023 May/Jun · 0654/11 · Question 2 · Core）

5. The diagram shows a palisade cell from a leaf magnified ×250.



The chloroplast labelled X measures 5 mm on the diagram.

What is its actual length?

A 0.25 mm **B** 0.05 mm **C** 0.02 mm **D** 0.01 mm

（2023 Oct/Nov · 0654/13 · Question 2 · Core）

6. A student draws a diagram of a chicken's egg and includes the magnification, m, of the drawing.

The student writes m = ×2.

The image length on the diagram is 140 mm.

What is the length of the actual chicken's egg?

A 35 mm **B** 70 mm **C** 140 mm **D** 280 mm

（2023 Oct/Nov · 0654/11 · Question 2 · Core）

题型 3：比较动物细胞与植物细胞的结构（考频★★★☆☆）

知识点 动物细胞和植物细胞都具有_____和细胞质，典型细胞还具有细胞核。

植物细胞还具有_____，动物细胞没有细胞壁。

活的植物细胞仍有细胞膜，细胞膜位于细胞壁内侧。

叶绿体存在于部分能进行光合作用的植物细胞中，动物细胞没有叶绿体。

答案：细胞膜；细胞壁

怎么认 题目出现动物细胞与植物细胞的结构比较时，先逐项核对细胞膜、细胞壁、细胞质、细胞核和叶绿体。

例题 1

Which statement about animal cells and plant cells is correct?

A Only animal cells possess cell membranes.

B Only animal cells possess cell walls.

C Only plant cells possess cell membranes.

D Only plant cells possess cell walls.

（2022 May/Jun · 0654/11 · Question 2 · Core）

解：动物细胞和植物细胞都有细胞膜，故 A、C 错。
动物细胞没有细胞壁，植物细胞有细胞壁，故 B 错，D 对。
故选 D。

针对练习

1. Which structure is found inside some living plant cells but **not** in animal cells?

A cell membrane

B chloroplast

C nucleus

D stomata

（2023 Feb/Mar · 0654/12 · Question 2 · Core）

2. What is found in plant cells but **not** in animal cells?

A cell membrane

B cell wall

C nucleus

D cytoplasm

（2022 Oct/Nov · 0654/12 · Question 2 · Core；同题：2022 Oct/Nov · 0654/22 · Question 2 · Extended）

3. Which statement about the structures found in animal and plant cells is correct?

A Both have cell walls.

B Only plant cells have a cell membrane.

C Both have cytoplasm.

D Only animal cells have a nucleus.

（2023 May/Jun · 0654/12 · Question 2 · Core；同题：2023 May/Jun · 0654/13 · Question 2 · Core）

4. Which statements about cell structure are correct?

1 Animal cells have cell membranes but no cell walls.

2 Animal cells have cell membranes and cell walls.

3 Plant cells have cell walls but no cell membranes.

4 Plant cells have cell membranes and cell walls.

A 1 and 3 **B** 1 and 4 **C** 2 and 3 **D** 2 and 4

（2024 Oct/Nov · 0654/12 · Question 2 · Core；同题：2024 Oct/Nov · 0654/13 · Question 2 · Core）

题型 4：辨认细胞结构并核对功能（考频★★★☆☆）

知识点 植物细胞的基本结构包括细胞膜、细胞质和细胞核；成熟植物细胞通常还有细胞壁和大液泡，绿色部位的细胞常有叶绿体。

图中最外层的厚边界是_____，其内侧的薄边界是_____，含细胞器的浅色区域是细胞质。

根毛细胞有细胞壁和大液泡，但通常没有_____。

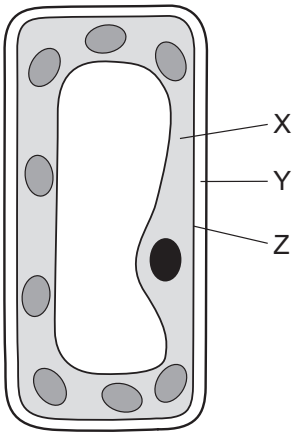
答案：细胞壁；细胞膜；叶绿体

怎么认 题目出现植物细胞图及结构标号或缺失结构时，先按外层边界、细胞质和大液泡确定各结构。

一. 按细胞图找结构

例题 1

The diagram shows a typical plant cell.



Which row is correct?

	cell membrane	cell wall	cytoplasm
A	X	Y	Z
B	X	Z	Y
C	Z	X	Y
D	Z	Y	X

（2024 May/Jun · 0654/11 · Question 2 · Core）

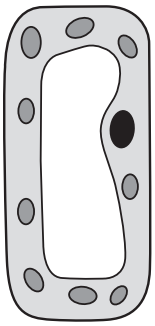
解： X 指向液泡与细胞膜之间含细胞器的灰色区域，故 X 为细胞质；

Y 指向最外层边界，故 Y 为细胞壁；Z 指向细胞壁内侧的薄膜，故 Z 为细胞膜。

对应细胞膜 Z、细胞壁 Y、细胞质 X。故选 D。

针对练习

1. The diagram shows an incomplete plant cell.



Which structure is **not** shown?

A nucleus

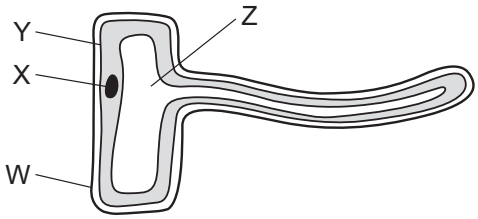
B cell wall

C chloroplast

D vacuole

（2025 May/Jun · 0654/23 · Question 1 · Extended）

2. The diagram shows a specialised cell from a plant.



Which structures **not** found in animal cells are shown in the diagram and which structure often found in other plant cells is missing?

	structures not found in animal cells	structure found in other plant cells
A	W and X	chloroplast
B	X and Y	nucleus
C	Y and Z	nucleus
D	Z and W	chloroplast

（2023 May/Jun · 0654/22 · Question 2 · Extended）

二. 结构名称与功能互相核对

知识点 _____包围细胞质，控制物质进入和离开细胞；细胞壁位于植物细胞最外层，支撑细胞并维持形状。

叶绿体含叶绿素，在有光条件下进行_____并合成碳水化合物；线粒体进行有氧呼吸并释放能量。

图中较厚的最外层边界是_____，其内侧薄层是细胞膜。

答案：细胞膜；光合作用；细胞壁

怎么认 题目出现细胞结构的功能描述或植物细胞箭头标注时，先确定结构，再核对其功能。

例题 2

Which part of a plant cell allows the movement of substances into and out of the cell?

A cell membrane

B cell wall

C nucleus

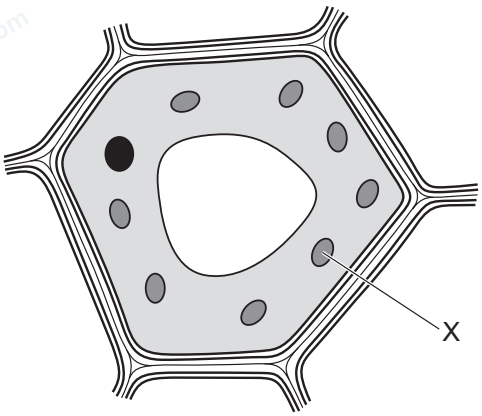
D vacuole

（2025 Oct/Nov · 0654/12 · Question 1 · Core；同题：2025 Oct/Nov · 0654/13 · Question 1 · Core）

解：由细胞膜控制物质进入和离开细胞，得题干所述结构为细胞膜。
故选 A。

针对练习

3. The diagram shows a plant cell.



What is the function of the part labelled X?

A It synthesises carbohydrates by photosynthesis.

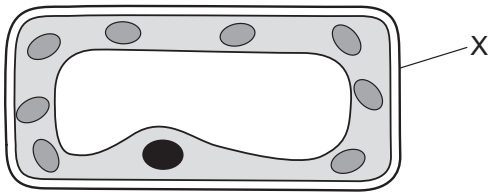
B It synthesises carbohydrates by respiration.

C It releases energy by photosynthesis.

D It uses energy for respiration.

（2026 Feb/Mar · 0654/12 · Question 2 · Core）

4. The diagram shows a plant cell.



Which row names X and describes its function?

	name	function
A	cell membrane	controls which substances enter or leave the cell
B	cell membrane	maintains cell shape
C	cell wall	controls which substances enter or leave the cell
D	cell wall	maintains cell shape

（2025 May/Jun · 0654/12 · Question 2 · Core；同题：2025 May/Jun · 0654/13 · Question 2 · Core）

题型 5：辨认细胞与组织的结构层级（考频★☆☆☆☆）

知识点 细胞是生物体结构和功能的_____，所有生物都由一个或多个细胞构成。
形态和功能相近的细胞可形成组织，多种组织可构成器官。
气孔是保卫细胞之间的_____，气孔本身不属于细胞或组织。

答案：基本单位；孔隙

怎么认 题目出现某结构是否由细胞构成时，先判断其是细胞、组织、器官还是孔隙。

例题 1

What are all living organisms made from?

A cells

B eggs

C mesophyll

D sperm

（2024 May/Jun · 0654/22 · Question 2 · Extended）

解：细胞是生物体结构和功能的基本单位。
所有生物都由一个或多个细胞构成。
故选 A。

针对练习

1. What is **not** made up of cells?

A the liver of an animal

B the wall of an artery

C the phloem of a plant

D the stomata of a leaf

（2026 May/Jun · 0654/11 · Question 2 · Core）

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题型 6：换算毫米与微米（考频★☆☆☆☆）

知识点 毫米和微米都是长度单位，1 mm = 1000μ m。

由毫米换算为微米时，数值乘以 _____；由微米换算为毫米时，数值除以 _____。

单位换算只改变数值和单位，不改变实际长度。

答案：1000；1000

怎么认 题目出现毫米与微米的单位换算时，先写出 1 mm = 1000μ m。

例题 1

How many micrometres are in one millimetre?

A 10 **B** 100 **C** 1000 **D** 10 000

（2026 Feb/Mar · 0654/22 · Question 8 · Extended）

解：由长度单位换算关系得

1 mm = 1000μ m

故选 C。

2.2 细胞结构、特化与放大倍数：结构题

题型 1：将特化细胞与其功能对应（考频★★★☆☆）

知识点 特化细胞具有与其功能相适应的结构，不同细胞承担不同功能。

植物的_____从土壤中吸收水和矿物离子；动物的_____随血液运输氧气。

叶片中含有较多叶绿体、适于高效光合作用的是_____。

答案：根毛细胞（root hair cell）；红细胞（red blood cell）；栅栏叶肉细胞（palisade mesophyll cell）

怎么认 题目出现吸收水、吸收矿物离子、运输氧气或高效光合作用时，先按功能对应特化细胞。

例题 1

(iv) State **one** function of root hair cells.

（2022 Feb/Mar 0654/32 第10题(a)(iv)）

解：由根毛细胞的功能知，其从土壤中吸收水和矿物离子。

答：吸收土壤中的水。

针对练习

1. **(ii)** State the name of the cell where mineral ions enter a plant.

（2022 May/Jun 0654/32 第10题(c)(ii)；同题：2022 May/Jun 0654/33 第10题(c)(ii)）

2. **(c)** State which type of animal cell transports oxygen.

（2022 Feb/Mar 0654/32 第10题(c)）

3. **(e)** State the name of the cell that absorbs mineral ions in a plant.

（2023 May/Jun 0654/31 第7题(e)）

4. **(c)** State the name of the type of plant cell that absorbs water from the soil.

（2023 Oct/Nov 0654/33 第10题(c)）

5. **(iii)** State the name of the type of plant cell specialised for absorption of water.

（2024 May/Jun 0654/42 第10题(c)(iii)）

6. **(ii)** State the name of the type of plant cell that is specialised for absorption of water.

（2023 May/Jun 0654/41 第10题(d)(ii)）

7. **(e)** Plants cells are adapted for their function.

State the name of the cells:

in the leaf that are adapted for efficient photosynthesis

that are adapted for absorption of water from the soil.

（2024 Oct/Nov 0654/42 第4题(e)）

题型 2：沿引线辨认植物细胞的结构（考频★★☆☆☆）

知识点 植物细胞的外层边界由外向内通常是_____和细胞膜；细胞质位于细胞膜以内。
成熟植物细胞中央常有较大的_____；细胞核通常画成较大的圆形或椭圆形结构。
叶绿体通常画成分布在细胞质中的多个椭圆小体；辨认时以引线末端接触的位置为准。

答案：细胞壁；液泡

怎么认 题目出现植物细胞图及字母引线，要求写出或连线结构名称时，先确定引线末端所指的位置。

例题 1

(a) Fig. 10.1 is a diagram of a plant cell.

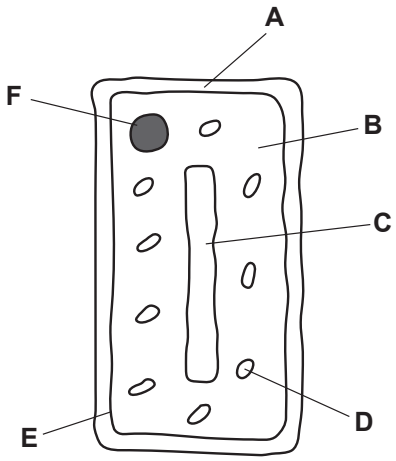


Fig. 10.1

(i) The boxes on the left show some labels from Fig. 10.1.

The boxes on the right show the names of some parts of a plant cell.

Draw lines to link each label with its correct name.

label from Fig. 10.1	name of part
	cell membrane
A	
	cell wall
C	
	chloroplast
D	
	vacuole

（2022 Feb/Mar 0654/32 第10题(a)(i)）

解：由引线末端的位置，A 落在细胞壁内侧的薄边界上，故 A 为细胞膜；
C 落在细胞中央的大型区域内，故 C 为液泡；
D 落在细胞质中的椭圆小体上，故 D 为叶绿体。
答：A：细胞膜；C：液泡；D：叶绿体。

针对练习

1. **(a)** Fig. 1.1 is a diagram of a plant cell.

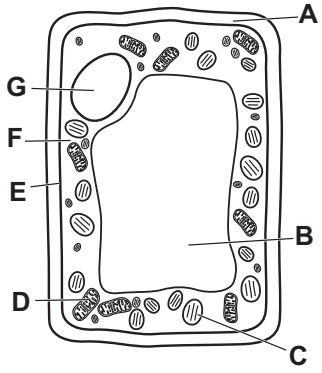


Fig. 1.1

(iii) State the name of the part labelled **C** in Fig. 1.1.

（2025 Feb/Mar 0654/32 第1题(a)(iii)）

2. **(a)** Fig. 1.1 is a diagram of a plant cell.

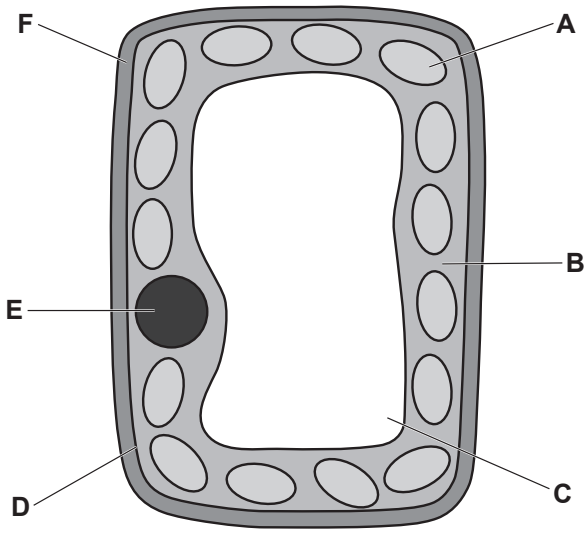


Fig. 1.1

(ii) State the name of the part labelled **B** in Fig. 1.1.

（2022 Oct/Nov 0654/32 第1题(a)(ii)）

第 3 章 扩散、渗透与主动运输

3.1 扩散、渗透与主动运输

题型 1：区分扩散与渗透的条件和净移动方向（考频★★★★☆）

知识点 扩散是粒子从_____区域向低浓度区域、沿浓度梯度的净移动。

判断某种分子的扩散方向时，只比较_____；存在浓度差时产生净移动。

渗透只描述水分子通过_____的净移动；主动运输由低浓度向高浓度进行并消耗能量。

浓度表示单位体积内某种粒子的数量；比较两处浓度时应采用相同的体积标准。

答案：高浓度；该种分子在两侧的浓度；部分透膜

怎么认 题目出现扩散定义、两侧浓度或气体交换时，先比较同种分子两侧浓度并判断移动方向。

一. 核对扩散定义

例题 1

What is the net movement of molecules during diffusion?

A from a higher concentration to a lower concentration down a concentration gradient

B from a higher concentration to a lower concentration up a concentration gradient

C from a lower concentration to a higher concentration down a concentration gradient

D from a lower concentration to a higher concentration up a concentration gradient

（2024 Feb/Mar · 0654/12 · Question 2 · Core）

解：扩散中分子的净移动方向为由高浓度区域到低浓度区域。

该方向为沿浓度梯度。

故选 A。

针对练习

1. What is a definition of diffusion?

A the net movement of molecules from a region of their higher concentration to a region of their lower concentration down a concentration gradient

B the net movement of molecules from a region of their higher concentration to a region of their lower concentration up a concentration gradient

C the net movement of molecules from a region of their lower concentration to a region of their higher concentration down a concentration gradient

D the net movement of molecules from a region of their lower concentration to a region of their higher concentration up a concentration gradient

（2025 Oct/Nov · 0654/23 · Question 3 · Extended）

2. Which row describes the diffusion of molecules from P to Q?

	P	Q	movement
A	higher concentration	lower concentration	down a concentration gradient
B	higher concentration	lower concentration	up a concentration gradient
C	lower concentration	higher concentration	down a concentration gradient
D	lower concentration	higher concentration	up a concentration gradient

（2025 May/Jun · 0654/23 · Question 2 · Extended）

3. By which process does oxygen pass from the alveoli to the blood capillaries in the lungs?

A diffusion

B osmosis

C secretion

D transpiration

（2024 May/Jun · 0654/12 · Question 2 · Core；同题：2024 May/Jun · 0654/13 · Question 2 · Core）

4. Oxygen produced in palisade mesophyll cells by photosynthesis diffuses into the air spaces in the leaf.

What causes this movement?

A osmosis between the leaf cells

B evaporation of water from mesophyll cells

C difference in oxygen concentration inside and outside the cells

D wind blowing over the leaves

（2024 May/Jun · 0654/23 · Question 2 · Extended）

二. 核对渗透对象、膜和水势方向

知识点 渗透是_____分子从水势较高区域，经_____膜向水势较低区域的净移动。
稀溶液的水势通常较高，浓溶液的水势通常较低，因此水的净移动方向是_____。
渗透可使水进入或离开细胞；渗透没有单位，水势常用 kPa 表示。

答案：水；部分透水；由稀溶液到浓溶液

怎么认 题目出现水进出细胞、部分透水膜或高低水势时，先核对移动对象、膜和水势方向。

例题 2

What is the name of the process where water passes into and out of cells through a partially permeable membrane?

A diffusion

B evaporation

C osmosis

D transpiration

（2025 May/Jun · 0654/11 · Question 3 · Core）

解：水通过部分透水膜进出细胞，符合渗透的条件。
因此该过程是渗透。
故选 C。

5. Which statement is a description of water movement by osmosis through a partially permeable membrane?

A the net movement of water from a concentrated solution to a dilute solution

B the net movement of water from a higher water potential to a lower water potential

C the net movement of water from a higher solute concentration to a lower solute concentration

D the net movement of water from a lower water potential to a higher water potential

（2026 Feb/Mar · 0654/22 · Question 9 · Extended）

6. What is osmosis?

A the diffusion of sugar molecules from a concentrated solution to a dilute solution through a partially permeable membrane

B the diffusion of sugar molecules from a dilute solution to a concentrated solution through a partially permeable membrane

C the diffusion of water molecules from a concentrated solution to a dilute solution through a partially permeable membrane

D the diffusion of water molecules from a dilute solution to a concentrated solution through a partially permeable membrane

（2023 Oct/Nov · 0654/22 · Question 2 · Extended）

7. What is meant by osmosis?

A the net movement of water molecules from a region of higher water potential to a region of lower water potential through a cell wall

B the net movement of water molecules from a region of higher water potential to a region of lower water potential through a partially permeable membrane

C the net movement of water molecules from a region of lower water potential to a region of higher water potential through a cell wall

D the net movement of water molecules from a region of lower water potential to a region of higher water potential through a partially permeable membrane

（2023 May/Jun · 0654/21 · Question 2 · Extended）

8. Which description for the process of osmosis is correct?

A Osmosis is the movement of water molecules from a region of high water potential across a fully permeable membrane to a region of lower water potential.

B Osmosis is the movement of water molecules from a region of low water potential across a partially permeable membrane to a region of high water potential.

C Osmosis is the movement of water molecules from a region of high water potential across a partially permeable membrane to a region of lower water potential.

D Osmosis is the movement of water molecules from a region of low water potential across a fully permeable membrane to a region of high water potential.

（2023 Feb/Mar · 0654/22 · Question 2 · Extended）

9. Water is lost by evaporation from the cells of a leaf.

Which process replaces this water?

A assimilation

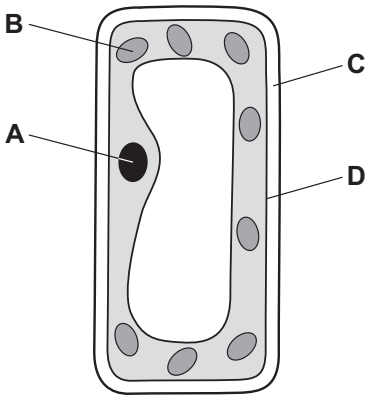
B egestion

C osmosis

D transpiration

（2025 Feb/Mar · 0654/12 · Question 4 · Core）

10. Which structure in a plant cell allows osmosis to occur?



（2022 Oct/Nov · 0654/13 · Question 2 · Core）

11. Which statements about osmosis are correct?

1 Osmosis requires a membrane.

2 Water can move out of cells by osmosis.

3 Water can move into cells by osmosis.

A 1 and 2 only **B** 1 and 3 only **C** 1, 2 and 3 **D** 2 and 3 only

（2022 Feb/Mar · 0654/12 · Question 2 · Core）

12. What is an example of osmosis?

A a leaf stalk swells up when placed in a bowl of water

B carbon dioxide enters a leaf during photosynthesis

C the movement of red blood cells to the lungs to collect oxygen

D the passage of digested food molecules through the wall of the small intestine

（2025 Oct/Nov · 0654/11 · Question 3 · Core）

题型 2：由渗透判断细胞状态与组织变化（考频★★★★☆）

知识点 渗透是水分子经部分透过性膜，由水势较_____的一侧向水势较_____的一侧净移动。

渗透发生的条件是膜两侧存在水势差；水势通常以 kPa 表示。

植物细胞吸水时液泡增大，细胞内容物紧贴细胞壁，膨压增大，细胞膨胀；失水时液泡缩小，膨压减小，细胞松弛。

继续失水，细胞膜与细胞壁分离，发生_____。

答案：高；低；质壁分离

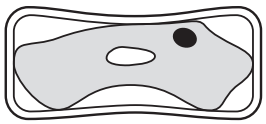
怎么认 题目出现细胞内容物贴壁或回缩、组织长度变化及水势关系时，先由吸水或失水判断细胞状态。

一. 由细胞或组织变化倒推渗透

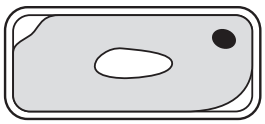
例题 1

Which cell is most flaccid?

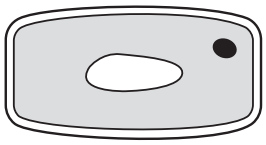
A



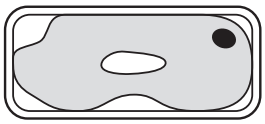
B



C



D



（2026 May/Jun · 0654/22 · Question 2 · Extended）

解：植物细胞失水时，液泡和细胞质体积减小，细胞内容物逐渐离开细胞壁。
图 A 中细胞内容物回缩且与细胞壁分离的范围最大，表明失水最多、膨压最低，细胞最松弛。
故选 A。

针对练习

1. When a plant cell is put into a solution that has a lower water potential than the cell, the cytoplasm can pull away from the cell wall.

What is the term for this?

A flaccid

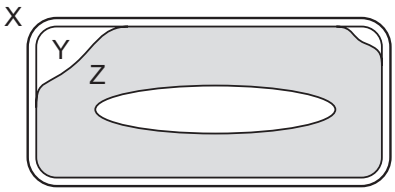
B plasmolysis

C turgid

D turgor pressure

（2023 Oct/Nov · 0654/21 · Question 2 · Extended）

2. The diagram shows a cell starting to plasmolyse.



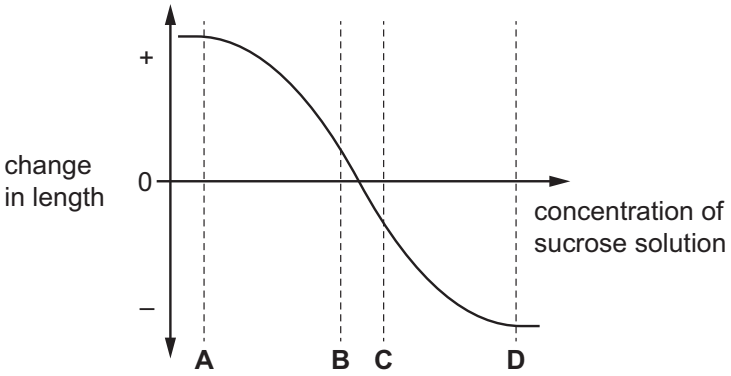
In which direction is osmosis occurring?

A X to Y **B** Y to X **C** Y to Z **D** Z to Y

（2022 Feb/Mar · 0654/22 · Question 2 · Extended）

3. Pieces of potato of the same length were placed in sucrose solutions of different concentrations. Their length was measured again after two hours.

At which sucrose concentration were the pieces of potato most flaccid?



（2024 Oct/Nov · 0654/23 · Question 2 · Extended）

二. 先比较外液再判断水的净移动

知识点 渗透是水分子通过_____膜，从水势_____处向水势_____处的净移动。

在温度等条件相同时，溶液浓度越大，水势越低；水势可用 kPa 表示。

外液水势低于细胞时，细胞失水，组织质量减小；外液水势高于细胞时，细胞吸水，组织质量增大，质量常以 g 记录。

植物细胞吸水后变得膨胀，失水后变得松弛，严重失水时发生质壁分离。

答案：部分透；较高；较低

怎么认 题目出现外液浓度或水势、质量变化或细胞图时，先比较细胞与外液水势。

例题 2

The mass of a peeled potato is recorded.

The potato is put in a salt solution with a lower water potential than the potato for two hours.

The outside of the potato is then dried and the mass recorded.

Which statement explains what happens to the potato after two hours in the salt solution?

A It gained mass by osmosis as salt moved into the potato from the surrounding solution.

B It gained mass by osmosis as water moved into the potato from the surrounding solution.

C It lost mass by osmosis as water moved from the potato into the surrounding solution.

D It lost mass by osmosis as salt moved from the potato into the surrounding solution.

（2025 May/Jun · 0654/22 · Question 3 · Extended）

解：盐溶液水势低于马铃薯，水沿水势梯度由马铃薯细胞进入盐溶液。

细胞失水，马铃薯质量减小。故选 C。

针对练习

4. The mass of a potato cylinder is recorded. The potato cylinder is then placed into concentrated sucrose solution.

After 2 hours, the potato cylinder is removed from the solution and the mass recorded.

The results are shown.

time / hours	mass / g
0	2.50
2	1.65

Which statement explains the change in mass of the potato?

A Sucrose moves out of the potato cells because the solution has a higher water potential than the cells.

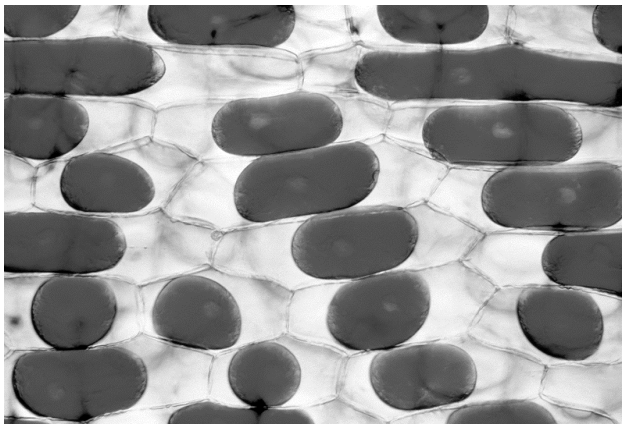
B Sucrose moves out of the potato cells because the solution has a lower water potential than the cells.

C Water moves out of the potato cells because the solution has a higher water potential than the cells.

D Water moves out of the potato cells because the solution has a lower water potential than the cells.

（2025 Oct/Nov · 0654/22 · Question 2 · Extended）

5. The photograph shows red onion cells placed in a concentrated salt solution.



Which statement explains their appearance?

A Water has moved into the cells against a water potential gradient.

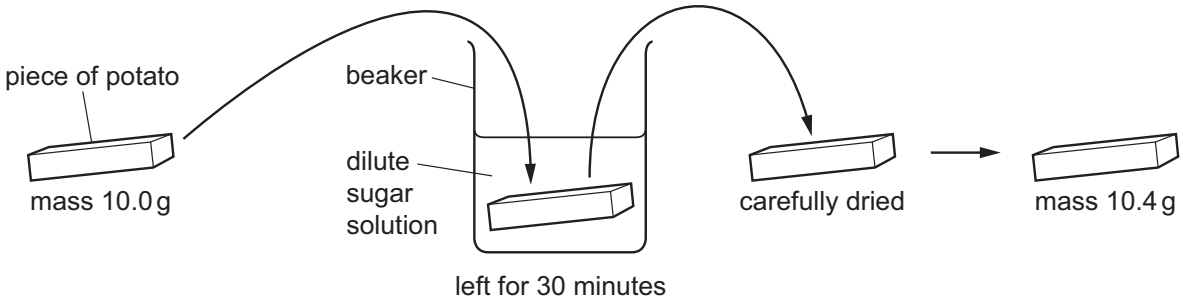
B Water has moved out of the cells down a water potential gradient.

C Water has moved out of the cells against a water potential gradient.

D Water has moved into the cells down a water potential gradient.

（2022 Oct/Nov · 0654/23 · Question 2 · Extended）

6. The diagram shows the stages of an experiment.



Which statement explains the increase in mass?

A Sugar has moved into the cells of the potato by osmosis.

B Sugar has moved out of the cells of the potato by osmosis.

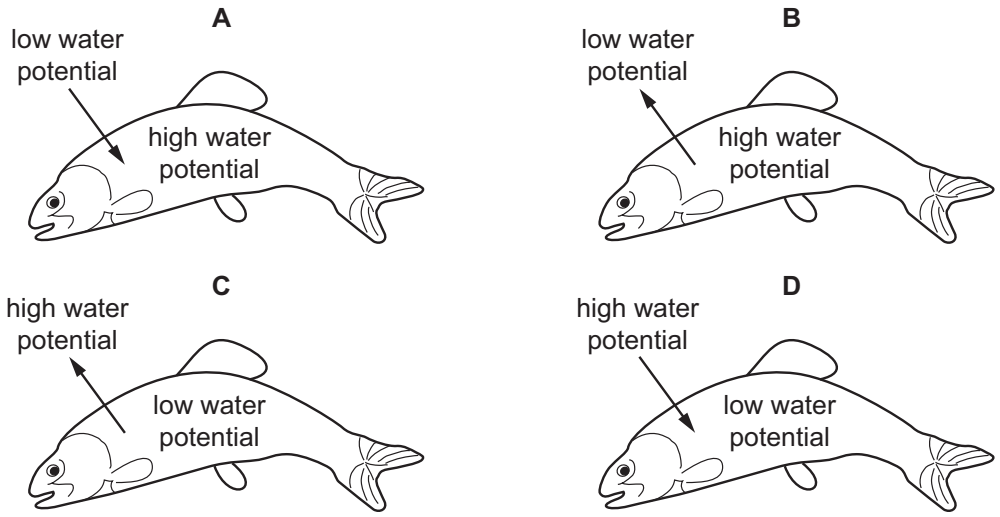
C Water has moved into the cells of the potato by osmosis.

D Water has moved out of the cells of the potato by osmosis.

（2025 May/Jun · 0654/12 · Question 3 · Core；同题：2025 May/Jun · 0654/13 · Question 3 · Core）

7. A salmon is a fish that can live in both fresh and salt water. Salmon are affected by water movement when the environment changes.

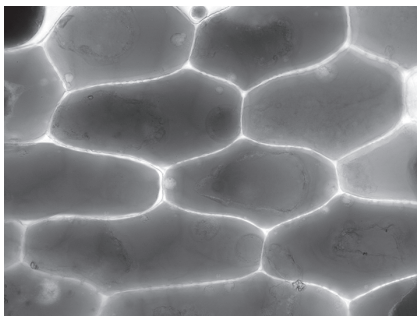
Which diagram shows the internal and external water potential and the movement of water when a salmon is in fresh water?



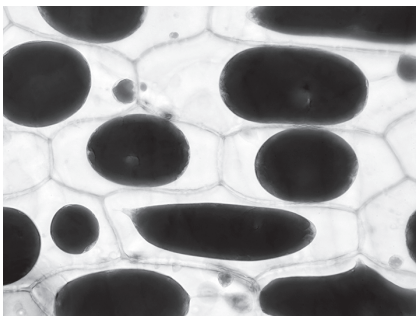
（2025 Feb/Mar · 0654/22 · Question 2 · Extended）

8. The photographs show some onion cells before and after being placed in a concentrated solution of glucose.

before



after



What explains the appearance of the onion cells after placing them into the concentrated solution of glucose?

A Glucose has entered the cells by osmosis.

B Glucose has left the cells by diffusion.

C Water has entered the cells by diffusion.

D Water has left the cells by osmosis.

（2024 Oct/Nov · 0654/11 · Question 2 · Core）

9. Red onion cells are placed in distilled water.

Which statement is correct?

A The cells plasmolyse; water moves into the cells from a high to a low water potential.

B The cells plasmolyse; water moves out of the cells from a low to a high water potential.

C The cells become turgid; water moves into the cells from a high to a low water potential.

D The cells become turgid; water moves out of the cells from a low to a high water potential.

（2022 Oct/Nov · 0654/21 · Question 2 · Extended）

题型 3：比较条件或曲线判断扩散快慢（考频★☆☆☆☆）

知识点 扩散是粒子由_____区域向低浓度区域的净移动，直至粒子均匀分布。

其余条件相同时，温度越高、浓度梯度越_____、扩散距离越_____，扩散速率越快。

扩散速率可按单位时间内净移动的物质的量表示，单位可写为 $\mathrm{mol\ s^{-1}}$。

答案：高浓度；大；短

怎么认 题目出现温度、浓度梯度、扩散距离或速率曲线时，先判断各因素对扩散速率的影响。

例题 1

Which conditions will result in the fastest rate of diffusion?

	temperature	concentration gradient	diffusion distance
A	high	large	short
B	high	small	long
C	low	small	short
D	low	large	long

（2024 May/Jun · 0654/21 · Question 2 · Extended）

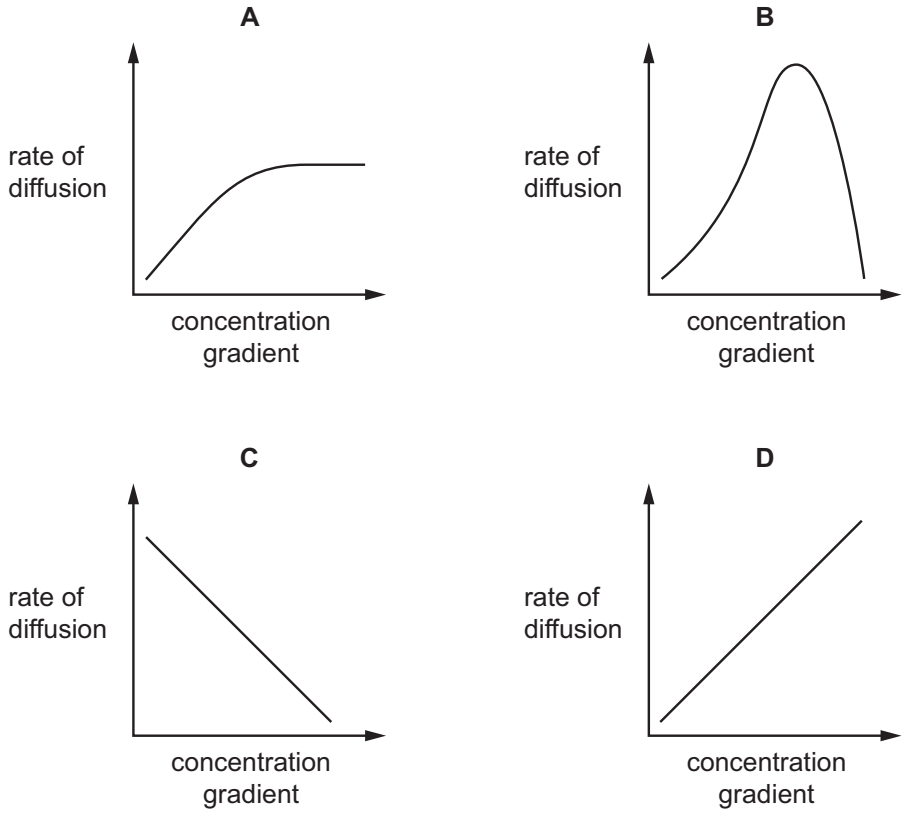
解：其余条件相同时，温度越高，粒子运动越快；浓度梯度越大，净移动的粒子越多；扩散距离越短，所需时间越短。

A 同时满足高温、大浓度梯度和短扩散距离，扩散速率最快。

故选 A。

针对练习

1. What is the effect of increasing the concentration gradient on the rate of diffusion?



（2024 Feb/Mar · 0654/22 · Question 2 · Extended）

题型 4：辨认逆浓度运输及其能量需求（考频★☆☆☆☆）

知识点 扩散是粒子从高浓度区域向低浓度区域的净移动；渗透是水分子通过部分透膜，从水势较高处向水势较低处的净移动，二者均不需要呼吸供能。

主动运输是粒子由_____浓度处向_____浓度处逆浓度梯度移动的过程，需要载体蛋白并消耗呼吸释放的_____。

题目只比较相对浓度时用高、低表示，不要求浓度单位；给出浓度数值时，单位由题干确定。

答案：低；高；能量

怎么认 题目出现两侧相对浓度、运输方式及呼吸供能时，先判断移动是否逆浓度梯度。

例题 1

Which processes require energy from respiration?

A diffusion and osmosis

B osmosis only

C active transport and diffusion

D active transport only

（2026 May/Jun · 0654/12 · Question 2 · Core）

解：扩散沿浓度梯度进行，渗透沿水势梯度通过部分透膜进行，二者均不需要呼吸供能。
主动运输逆浓度梯度进行，需要呼吸供能。
故选 D。

针对练习

1. Which row describes the uptake of mineral ions from the soil?

	relative concentration of mineral ions in soil	relative concentration of mineral ions in root hair cell	method of transport into root hair cell	requires energy from respiration
A	low	high	active transport	yes
B	low	high	diffusion	no
C	high	low	active transport	no
D	high	low	diffusion	yes

（2026 May/Jun · 0654/21 · Question 1 · Extended）

题型 5：确定肺泡中气体扩散的部位与方向（考频★☆☆☆☆）

知识点 扩散是粒子沿浓度梯度从_____浓度区域向_____浓度区域的净移动。
肺内气体交换发生在肺泡与毛细血管之间；肺泡壁和毛细血管壁薄，扩散距离短。
当肺泡内氧气浓度高于血液时，氧气由肺泡扩散进入_____；二氧化碳的扩散方向相反。

答案：高；低；血液毛细血管

怎么认 题目出现肺内气体扩散的部位和方向时，先确定交换部位，再比较气体浓度。

例题 1

Which statement about diffusion of gases in the lungs is correct?

A Carbon dioxide diffuses from alveoli into blood capillaries.

B Carbon dioxide diffuses from bronchi into blood capillaries.

C Oxygen diffuses from alveoli into blood capillaries.

D Oxygen diffuses from bronchi into blood capillaries.

（2026 May/Jun · 0654/21 · Question 9 · Extended）

解：肺内气体交换发生在肺泡和血液毛细血管之间。
肺泡内氧气浓度高于流入肺泡毛细血管的血液，氧气由肺泡扩散进入血液。

A 错，二氧化碳由血液扩散至肺泡；B、D 错，支气管不是气体交换部位；C 对。
故选 C。

第 4 章 生物大分子与食物检测

4.1 生物大分子与食物检测

题型 1：由组成单位辨认大分子（考频★★★☆☆）

知识点 淀粉和糖原都是由许多_____分子连接形成的大分子。
蛋白质由许多_____分子连接形成；淀粉酶属于蛋白质。
脂肪和油由_____和脂肪酸组成；亚油酸属于脂肪酸。

答案：葡萄糖；氨基酸；甘油

怎么认 题目出现大分子名称、组成单位或所求对应关系时，先写出大分子与小分子的配对。

例题 1

Which small molecules are joined together to make a starch molecule?

A amino acids

B fatty acids

C glucose

D glycerol

（2022 May/Jun · 0654/11 · Question 3 · Core；同题：2022 May/Jun · 0654/21 · Question 3 · Extended）

解：淀粉是由许多葡萄糖分子连接形成的大分子。
题目所求为组成淀粉的小分子，因此为葡萄糖。
故选 C。

针对练习

1. Which smaller molecules is glycogen made from?

A amino acids

B fatty acids

C glucose

D glycerol

（2024 Feb/Mar · 0654/12 · Question 3 · Core）

2. Which smaller molecules make up larger fat molecules?

A glucose and amino acids

B glucose and fatty acids

C glycerol and amino acids

D glycerol and fatty acids

（2024 May/Jun · 0654/11 · Question 3 · Core）

3. Which molecules make up fats and oils?

A amino acids and glycerol

B fatty acids and glycerol

C glucose and amino acids

D glucose and fatty acids

（2025 May/Jun · 0654/11 · Question 4 · Core）

4. Which row shows a large molecule and the small molecule it is made from?

	large molecule	small molecule
A	glycogen	glucose
B	glycogen	amino acid
C	oil	amino acid
D	oil	glucose

（2025 May/Jun · 0654/22 · Question 4 · Extended）

5. Which large molecule is made from many smaller glucose molecules?

A amino acid

B glycerol

C glycogen

D protein

（2024 Oct/Nov · 0654/22 · Question 3 · Extended）

6. Which molecule is made from glucose?

A amylase

B fat

C glycogen

D protein

PapaCambridge papacambridge.com

（2026 May/Jun · 0654/22 · Question 3 · Extended）

7. Glycerol is a component of which large molecules?

A fats

B glycogen

C proteins

D starch

（2022 Oct/Nov · 0654/11 · Question 3 · Core；同题：2022 Oct/Nov · 0654/12 · Question 3 · Core、2022 Oct/Nov · 0654/13 · Question 3 · Core、2022 Oct/Nov · 0654/21 · Question 3 · Extended、2022 Oct/Nov · 0654/22 · Question 3 · Extended、2022 Oct/Nov · 0654/23 · Question 3 · Extended）

8. Linoleic acid is a fatty acid.

Which larger molecule may contain linoleic acid?

A glycogen

B oil

C protein

D starch

（2023 May/Jun · 0654/11 · Question 3 · Core；同题：2023 May/Jun · 0654/21 · Question 3 · Extended）

9. Large biological molecules are made from smaller molecules joined together.

Which large molecule is correctly matched with its smaller molecule?

	large molecule	smaller molecule
A	fat	amino acid
B	glycogen	glucose
C	starch	fatty acid
D	protein	glycerol

（2022 May/Jun · 0654/23 · Question 3 · Extended）

题型 2：按试剂、操作和阳性颜色辨认食物检测（考频★★★☆☆）

知识点 还原糖用本尼迪特溶液（Benedict's solution）检测，并需_____；阳性时由蓝色变为绿色、黄色、橙色或砖红色沉淀。

蛋白质用_____检测，阳性时呈紫色；检测时不需加热。

淀粉用碘液检测，阳性时呈蓝黑色；脂肪用乙醇乳化法检测，阳性时形成_____。

检测试剂、操作条件和阳性现象应与营养物质一一对应。

答案：加热；双缩脲试剂；白色乳浊液

怎么认 题目出现营养物质、试剂、是否加热或颜色时，先按食物检测的对应关系配对。

例题 1

Which reagent is used to test for the presence of protein in a food sample?

A Benedict's solution

B biuret

C ethanol

D iodine

（2022 May/Jun · 0654/12 · Question 3 · Core；同题：2022 May/Jun · 0654/13 · Question 3 · Core、2022 May/Jun · 0654/22 · Question 3 · Extended）

解：由蛋白质的双缩脲反应得，所用试剂为双缩脲试剂（biuret）。

故选 B。

针对练习

1. What is the test for the presence of protein in a food sample?

A Benedict's solution

B biuret test

C ethanol emulsion

D iodine solution

（2025 Feb/Mar · 0654/12 · Question 5 · Core）

2. Which result with the biuret test shows that protein is present?

A blue

B green

C orange

D purple

（2025 May/Jun · 0654/21 · Question 1 · Extended）

3. Which food test requires heating?

A fat

B protein

C reducing sugar

D starch

（2023 Oct/Nov · 0654/13 · Question 3 · Core；同题：2023 Oct/Nov · 0654/23 · Question 3 · Extended）

4. Which colour does Benedict's solution change to when heated with a reducing sugar?

A blue

B blue-black

C orange

D purple

（2023 Oct/Nov · 0654/11 · Question 3 · Core；同题：2023 Oct/Nov · 0654/21 · Question 3 · Extended）

5. A sample of food is tested for reducing sugars by adding Benedict's solution and heating.

What indicates that reducing sugars are present?

A a blue-black colour

B a brick-red precipitate

C a purple colour

D a white emulsion

（2024 May/Jun · 0654/21 · Question 3 · Extended）

6. What is required to test for the presence of a reducing sugar?

	Benedict's solution	biuret solution	heat
A	✓	✗	✓
B	✗	✓	✓
C	✓	✗	✗
D	✗	✓	✗

（2024 Oct/Nov · 0654/12 · Question 3 · Core；同题：2024 Oct/Nov · 0654/13 · Question 3 · Core）

题型 3：由元素组成辨认营养物质（考频★★★☆☆）

知识点 碳水化合物和脂肪含碳、氢、氧；蛋白质除含碳、氢、氧外，还含_____。

在所列营养物质中，以_____为判别依据：含氮的是蛋白质，仅含碳、氢、氧的可为碳水化合物或脂肪。

元素组成表示物质所含元素的种类，不表示含量或比例，无单位。

答案：氮；氮元素的有无

怎么认 题目出现元素组成、营养物质名称或勾叉表格时，先核对是否含氮。

例题 1

Which chemical element is found in all proteins, but **not** in all carbohydrates or fats?

A carbon

B hydrogen

C oxygen

D nitrogen

（2022 Feb/Mar · 0654/12 · Question 3 · Core；同题：2022 Feb/Mar · 0654/22 · Question 3 · Extended）

解：碳水化合物和脂肪含碳、氢、氧，蛋白质还含氮。

蛋白质均含而碳水化合物或脂肪未必含有的元素是氮。故选 D。

针对练习

1. Which row identifies the elements that are found in a protein molecule?

	carbon	hydrogen	nitrogen	oxygen
A	✓	✗	✓	✓
B	✓	✓	✗	✓
C	✓	✓	✓	✓
D	✗	✓	✓	✓

（2024 Feb/Mar · 0654/22 · Question 3 · Extended）

2. Which row matches the nutrient to the chemical elements that it contains?

	nutrient	carbon	hydrogen	oxygen	nitrogen
A	fat	✓	✓	✗	✗
B	protein	✓	✓	✓	✓
C	starch	✓	✗	✓	✓
D	glucose	✗	✓	✓	✓

（2025 Oct/Nov · 0654/12 · Question 2 · Core；同题：2025 Oct/Nov · 0654/13 · Question 2 · Core）

3. Which biological molecule contains the elements carbon, hydrogen, nitrogen and oxygen?

A carbohydrate

B fat

C oil

D protein

（2024 Oct/Nov · 0654/21 · Question 3 · Extended）

4. Which type of biological molecule contains carbon, hydrogen, oxygen and nitrogen?

A fat

B protein

C reducing sugar

D starch

（2026 May/Jun · 0654/12 · Question 3 · Core）

5. Analysis of a large food molecule shows that it contains the elements carbon, hydrogen and oxygen only.

Which food groups could this molecule be from?

A carbohydrates and fats only

B carbohydrates and proteins only

C fats and proteins only

D carbohydrates, fats and proteins

（2024 May/Jun · 0654/22 · Question 3 · Extended）

题型 4：区分植物碳水化合物的储能与结构作用（考频★☆☆☆☆）

知识点 植物体内，淀粉是由许多葡萄糖单元构成的多糖，是植物储存能量的主要碳水化合物。纤维素构成植物细胞壁，蔗糖常作为运输形式，葡萄糖可作为呼吸作用的底物。

植物的储能碳水化合物是_____，细胞壁的结构成分是_____。

答案：淀粉；纤维素

怎么认 题目出现植物、碳水化合物和能量储存时，先确定植物的储能多糖是淀粉。

例题 1

Which carbohydrate is used as an energy store in plants?

A cellulose

B glucose

C starch

D sucrose

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（2026 Feb/Mar · 0654/22 · Question 11 · Extended）

解：植物将多余的葡萄糖转化为淀粉储存。
纤维素构成细胞壁，葡萄糖参与呼吸作用，蔗糖用于运输。
故选 C。

题型 5：由多项食物检测结果判断成分（考频★★★☆☆）

知识点 食物检测利用特定试剂的颜色变化判断生物分子是否存在，出现阳性结果才说明含有相应物质。

本尼迪特试剂与样品混合并加热后，由蓝色变为绿色、黄色、橙色或砖红色，表明含_____；保持蓝色为阴性。

双缩脲试剂呈紫色或淡紫色，表明含_____；保持蓝色为阴性。

碘液呈蓝黑色表明含淀粉；乙醇乳化试验出现_____表明含脂肪，仍为澄清溶液为阴性。

答案：还原糖；蛋白质；白色或乳白色乳浊液

怎么认 题目出现多项食物检测及终色时，先分别判定阳性或阴性，再取同时符合的营养物质组合。

例题 1

Tests are carried out on a colourless liquid. The results are shown.

test	resultant colour
biuret	purple
ethanol emulsion	white
iodine	brown

Which food groups does the liquid contain?

A protein and fat

B protein and starch

C reducing sugar and fat

D starch and fat

（2023 Feb/Mar · 0654/12 · Question 3 · Core；同题：2023 Feb/Mar · 0654/22 · Question 3 · Extended）

解：双缩脲试验呈紫色，说明含蛋白质；乙醇乳化试验呈白色，说明含脂肪；碘液呈棕色，说明不含淀粉。故液体含蛋白质和脂肪。故选 A。

针对练习

1. A colourless liquid gives the test results shown.

test	colour obtained
Benedict's	blue
biuret	purple
iodine	blue / black

Which nutrients are in the colourless liquid?

A protein, reducing sugar and starch

B protein and reducing sugar only

C protein and starch only

D protein only

（2023 Oct/Nov · 0654/12 · Question 3 · Core；同题：2023 Oct/Nov · 0654/22 · Question 3 · Extended）

2. A student tests a sample of food for the presence of different biological molecules. The results of the tests are shown.

test	results of test
add iodine solution	orange-brown colour
heat with Benedict's solution	red precipitate formed
add biuret reagent	lilac colour
ethanol emulsion test	clear solution

Which biological molecules are present in the food?

A fat and starch

B reducing sugars and protein

C reducing sugars and starch

D starch and protein

(2025 Oct/Nov · 0654/21 · Question 4 · Extended)

3. A student tests a sample of food to identify its composition.

The results are shown.

test	final colour of test
Benedict's test	brick-red precipitate
biuret test	blue
iodine solution	blue-black

Which substances are shown to be present in the food sample?

A protein, reducing sugar and starch

B protein and starch only

C reducing sugar and starch only

D reducing sugar and protein only

(2024 May/Jun · 0654/23 · Question 3 · Extended)

4. Three food tests are carried out on a sample of food. The results are shown.

food test	final colour
Benedict's	blue
biuret	blue
iodine	blue-black

From these results, which nutrient is in the food?

A reducing sugar

B protein

C starch

D fat

(2024 Oct/Nov · 0654/11 · Question 3 · Core)

5. Eggs contain fat, protein and water.

Which results are obtained from doing food tests on an egg?

	Benedict's test	biuret test	ethanol emulsion test	iodine test
A	blue	purple	white emulsion	yellow
B	orange	purple	white emulsion	blue-black
C	orange	blue	colourless	yellow
D	blue	blue	colourless	blue-black

（2023 May/Jun · 0654/23 · Question 3 · Extended）

6. Four different foods labelled **A**, **B**, **C** and **D** are tested to find out which nutrients they contain.

Which food contains both starch and protein but **no** reducing sugar?

	final colour with Benedict's solution	final colour with biuret solution	final colour with iodine solution
A	blue	blue	orange
B	blue	purple	blue-black
C	red	blue	orange
D	red	purple	blue-black

（2024 Oct/Nov · 0654/23 · Question 3 · Extended）

7. Which row represents a food that contains a reducing sugar and a fat?

	purple with biuret reagent	orange with Benedict's solution	milky-white with ethanol	blue-black with iodine solution
A	yes	no	no	yes
B	yes	no	yes	no
C	no	yes	no	yes
D	no	yes	yes	no

（2025 Oct/Nov · 0654/11 · Question 4 · Core）

题型 6：同时核对元素、组成单位与大分子（考频★☆☆☆☆）

知识点 蛋白质由氨基酸构成，所含元素为碳、氢、氧和_____。

脂肪由脂肪酸和甘油构成，所含元素主要为碳、氢和_____。

判断元素、组成单位和大分子的关系时，两项关系必须_____。

答案：氮；氧；同时成立

怎么认 题目出现元素、小分子和大分子对应表时，先核对每行两条组成关系。

例题 1

Which row shows the elements and the small molecules that are used to make the larger molecules?

	elements	small molecule	larger molecule
A	carbon, hydrogen and oxygen	glucose	fats
B	carbon, hydrogen, oxygen and nitrogen	amino acids	fats
C	carbon, hydrogen and oxygen	glucose	proteins
D	carbon, hydrogen, oxygen and nitrogen	amino acids	proteins

（2023 May/Jun · 0654/12 · Question 3 · Core；同题：2023 May/Jun · 0654/13 · Question 3 · Core、2023 May/Jun · 0654/22 · Question 3 · Extended）

解：由蛋白质的组成得，构成蛋白质的小分子是氨基酸，其元素包括碳、氢、氧和氮。
表中符合这两项关系的是 D 行。
故选 D。

题型 7：从分子式寻找蛋白质的组成单位（考频★☆☆☆☆）

知识点 蛋白质由许多_____连接而成，氨基酸是蛋白质的组成单位。
氨基酸都含氮元素，分子式中的元素符号 _____ 表示氮；当备选分子式中只有一个含氮时，可据此判断。
分子式中的下标表示一个分子中相应元素的原子个数，原子个数不带单位。

答案：氨基酸；N

怎么认 题目出现多个分子式并问蛋白质的组成部分时，先找含氮元素 N 的分子式。

例题 1

Which molecule is a component of proteins?

A $C_2H_5NO_2$　**B** $C_3H_8O_3$　**C** $C_6H_{12}O_6$　**D** $C_{10}H_{20}O_2$

（2025 Oct/Nov · 0654/22 · Question 3 · Extended）

解：蛋白质的组成单位是氨基酸，氨基酸含氮元素。
C_2H_5 N O_2 含有元素符号 N，其余分子式均不含氮。
因此，C_2H_5 N O_2 符合蛋白质组成单位的元素特征。故选 A。

4.2 生物大分子与食物检测：结构题

题型 1：识别蛋白质含有的化学元素（考频★★★☆☆）

知识点 蛋白质是由氨基酸组成的生物大分子，酶属于蛋白质。
所有蛋白质都含有_____四种化学元素。
硫只存在于部分蛋白质中，不是所有蛋白质共有的元素。

答案：碳、氢、氧、氮

怎么认 题目出现蛋白质或酶，并要求列出所含元素时，先写碳、氢、氧、氮。

例题 1

(c) Enzymes are proteins.

Circle the elements that all proteins are made from.

carbon **calcium** **hydrogen**

oxygen **nitrogen**

（2024 May/Jun 0654/31 第10题(c)）

解：酶属于蛋白质，所有蛋白质均含碳、氢、氧、氮。
答：圈出碳、氢、氧、氮。

针对练习

1. **(c)** Enzymes are proteins.

Circle the elements that **all** enzymes contain.

calcium **carbon** **chlorine** **hydrogen**

magnesium **nitrogen** **oxygen**

（2023 Oct/Nov 0654/33 第7题(c)）

2. **(c)** Enzymes are proteins.

(i) List the chemical elements present in all proteins.

（2023 Oct/Nov 0654/41 第7题(c)(i)）

3. **(d)** State the names of the **four** elements that all proteins contain.

（2022 Oct/Nov 0654/41 第7题(d)）

4. **(c)** Fish is a good source of protein in the diet.

List **all** the chemical elements that make up proteins.

（2026 May/Jun 0654/31 第2题(c)）

5. **(a)** Chemical digestion involves enzymes.

List **all** the chemical elements that make up an enzyme molecule.

（2026 Feb/Mar 0654/42 第3题(a)）

题型 2：列举碳水化合物的组成元素（考频★★☆☆☆）

知识点 碳水化合物由_____、_____和_____三种化学元素组成。

无论题目中的碳水化合物是纤维素、葡萄糖还是糖原，其组成元素均为碳、氢、氧。

答案：碳；氢；氧

怎么认 题目出现碳水化合物及列举或圈出组成元素时，先写碳、氢、氧。

例题 1

(c) Cell walls are made from a type of carbohydrate called cellulose.

Cellulose is made up of smaller molecules of glucose.

(i) List the chemical elements in all carbohydrates.

（2024 Oct/Nov 0654/31 第1题(c)(i)）

解：由碳水化合物的组成可知，所有碳水化合物均含碳、氢、氧三种元素。

答：碳、氢、氧。

针对练习

1. **(iii)** Glycogen is a type of carbohydrate.

Circle **all** the chemical elements that make up carbohydrates.

carbon	**hydrogen**	**magnesium**
nitrogen	**oxygen**	**sulfur**

（2026 Feb/Mar 0654/32 第1题(a)(iii)）

2. **(ii)** List the chemical elements that make up carbohydrates.

（2023 Oct/Nov 0654/32 第7题(c)(ii)）

题型 3：确定蛋白质检测的试剂（考频★★☆☆☆）

知识点 蛋白质可用_____检验；试剂中的铜离子在碱性条件下与肽键形成紫色络合物。

将待测食物制成溶液后加入试剂，出现_____说明含有蛋白质；保持蓝色说明未检出蛋白质。

该试验属于定性检验，结果用颜色表示，不涉及计量单位。

答案：双缩脲溶液；紫色

怎么认 题目出现检验蛋白质所用溶液或化学试验时，先确定双缩脲溶液或双缩脲试验。

例题 1

(d) State the name of the solution used to test for the presence of protein.

（2024 May/Jun 0654/31 第10题(d)）

解：由题意，所求为检验蛋白质所用的溶液，蛋白质用双缩脲溶液检验。

答：双缩脲溶液。

针对练习

1. **(ii)** State the name of the chemical test for the presence of proteins.

（2023 Oct/Nov 0654/41 第7题(c)(ii)）

2. **(ii)** State the chemical test for protein.

（2024 Oct/Nov 0654/43 第7题(c)(ii)）

第 5 章 酶与反应条件

5.1 酶与反应条件

题型 1：核对酶的组成和催化作用（考频★★★★☆）

知识点 酶是一类_____，在适宜温度等条件下作为生物催化剂，增大化学反应速率，反应前后自身不被消耗。
蛋白质由_____构成，通常含有碳、氢、氧、氮等元素；酶的活性受温度等反应条件影响。
消化酶催化食物的_____分解；摄取、吸收和排遗不属于食物的化学分解。

答案：蛋白质；氨基酸；化学

怎么认 题目出现酶的组成、催化作用或消化过程时，先判断蛋白质、生物催化剂和化学分解。

例题 1

Which statement about enzymes is correct?

A They are made from fat molecules.

B They are used up in a reaction.

C They speed up reactions.

D They are not affected by temperature.

（2022 Oct/Nov · 0654/12 · Question 4 · Core）

解：酶由蛋白质构成，不由脂肪构成；酶在反应前后不被消耗，且活性受温度影响；酶能增大反应速率。故选 C。

针对练习

1. What is a characteristic of enzymes?

A act as catalysts

B made from fatty acids

C turn Benedict’s solution red when heated

D physically digest food

（2025 May/Jun · 0654/23 · Question 3 · Extended）

2. Which type of molecules are enzymes?

A carbohydrates

B fats

C hormones

D proteins

（2025 May/Jun · 0654/11 · Question 5 · Core）

3. Which type of molecules are enzymes?

A carbohydrates

B fats

C oils

D proteins

（2024 May/Jun · 0654/11 · Question 4 · Core）

4. Which type of molecule are enzymes?

A carbohydrate

B DNA

C fat

D protein

（2025 May/Jun · 0654/21 · Question 3 · Extended）

5. Which type of molecules make up enzymes?

A fats

B carbohydrates

C minerals

D proteins

（2026 May/Jun · 0654/13 · Question 1 · Core）

6. Which type of molecule are enzymes?

A amino acids

B carbohydrates

C fats

D proteins

（2023 May/Jun · 0654/11 · Question 4 · Core）

7. Which process involves enzymes?

A absorption

B digestion

C egestion

D ingestion

（2022 Oct/Nov · 0654/13 · Question 4 · Core）

8. Which type of molecule are enzymes?

A carbohydrate

B fat

C protein

D starch

（2023 Oct/Nov · 0654/12 · Question 4 · Core；同题：2023 Oct/Nov · 0654/22 · Question 4 · Extended）

9. Which type of molecule is an enzyme?

A carbohydrate

B fat

C protein

D vitamin

（2026 May/Jun · 0654/23 · Question 3 · Extended）

10. Which statements about enzymes are correct?

1 Enzymes are biological catalysts.

2 Enzymes are made of fat.

3 Enzymes are made of protein.

A 1 and 2 **B** 1 and 3 **C** 1 only **D** 3 only

（2025 May/Jun · 0654/12 · Question 4 · Core；同题：2025 May/Jun · 0654/13 · Question 4 · Core）

11. Which elements can be found in an enzyme molecule?

1 carbon

2 nitrogen

3 oxygen

A 1, 2 and 3 **B** 1 and 3 only **C** 1 only **D** 2 only

（2022 Oct/Nov · 0654/11 · Question 4 · Core）

12. Which small molecules make up enzymes?

A amino acids

B fatty acids

C glucose

D glycerol

（2026 Feb/Mar · 0654/12 · Question 3 · Core）

13. Which statements are correct for **all** enzymes?

1 They are proteins.

2 They are **not** affected by temperature.

3 They increase the rate of chemical reactions.

4 They work best at a high pH.

A 1, 2 and 4 **B** 1, 3 and 4 **C** 1 and 3 only **D** 2 and 4 only

（2025 Oct/Nov · 0654/11 · Question 5 · Core）

题型 2：区分温度改变与变性对活性部位的作用（考频★★★★☆）

知识点 酶促反应速率表示单位时间内生成的_____量；温度通常以 °C 为单位。
在最适温度以下升高温度，酶和底物分子的动能增大，有效碰撞更频繁，酶促反应速率_____。
在不引起变性的低温下，降温会降低反应速率，但酶活性部位的形状通常_____。
冷藏可减慢食物腐败，但不表示酶已变性或微生物细胞已死亡。

答案：产物；增大；不变

怎么认 题目出现低温冷藏、最适温度以下升降温或曲线上升段时，先判断分子动能和有效碰撞频率的变化。

一. 最适温度以下改变碰撞频率

例题 1

One method of preventing food spoilage is to store it at 4 °C in a refrigerator.

Why does storing food at low temperatures help to prevent food spoilage?

A It decreases enzyme activity.

B It denatures enzymes.

C It increases enzyme production.

D It kills cells.

（2024 Oct/Nov · 0654/11 · Question 4 · Core）

解：4 °C 为低温，分子动能减小，酶与底物的有效碰撞减少，酶活性降低。
低温并未使酶变性，也不能说明所有细胞均已死亡。
故选 A。

针对练习

1. During an enzyme-controlled reaction, the temperature is gradually lowered from the enzyme's optimum temperature of 20 °C to 5 °C.

Which changes occur as the temperature is lowered?

	formation of product	shape of active site of enzyme
A	decreases	no change
B	decreases	changes
C	increases	no change
D	increases	changes

（2023 May/Jun · 0654/23 · Question 4 · Extended）

2. Which statement correctly describes enzyme activity as the temperature increases up to an optimum temperature?

A The enzyme has less frequent effective collisions with the product.

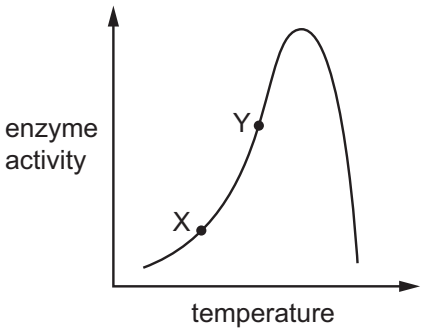
B The enzyme has less frequent effective collisions with the substrate.

C The enzyme has more frequent effective collisions with the product.

D The enzyme has more frequent effective collisions with the substrate.

（2026 May/Jun · 0654/21 · Question 2 · Extended）

3. The diagram shows the effect of temperature on enzyme activity.



What has increased the enzyme activity between points X and Y?

A decreased denaturation

B decreased kinetic energy

C increased denaturation

D increased kinetic energy

（2023 Oct/Nov · 0654/23 · Question 4 · Extended）

二. 高温或偏离 pH 改变活性部位

知识点 酶的活性部位具有与底物互补的形状，底物与其结合后发生反应。

变性是酶的活性部位形状发生改变；高于最适温度或 pH 明显偏离最适 pH 时，酶可能发生_____。

低温使分子动能和有效碰撞频率降低，但通常不使酶变性；变性后，_____不能与活性部位契合。

被酶作用的是底物，不是_____；温度常用 °C 表示，pH 没有单位。

答案：变性；底物；产物

怎么认 题目出现高温、偏离最适 pH 或活性部位形状图时，先判断底物能否与活性部位契合。

例题 2

Enzymes work best at an optimum pH. Protease in the stomach works best at pH 1.6.

What is a reason why the activity of protease decreases at pH values greater than 1.6?

A The enzyme's active site changes shape.

B The kinetic energy of the molecules increases.

C There are more effective collisions.

D There is a higher substrate concentration.

（2025 Oct/Nov · 0654/23 · Question 4 · Extended）

解：蛋白酶在 pH 1.6 时活性最高。pH 大于 1.6 后偏离最适 pH，酶的活性部位形状改变，底物与活性部位的契合程度降低，酶活性下降。

故选 A。

4. The diagram shows a functional human enzyme at 37 °C.



Which row shows the likely shape of this enzyme at 5 °C and 80 °C?

	at 5 °C	at 80 °C
A		
B		
C		
D		

（2024 May/Jun · 0654/23 · Question 4 · Extended）

5. Enzyme action stops due to denaturation.

What causes denaturation?

A a change in shape of the active site of the enzyme that occurs at a temperature that is lower than the optimum temperature

B a change in shape of the active site of the substrate that occurs at a temperature that is lower than the optimum temperature

C a change in shape of the active site of the enzyme that occurs at a temperature that is higher than the optimum temperature

D a change in shape of the active site of the substrate that occurs at a temperature that is higher than the optimum temperature

（2025 Oct/Nov · 0654/21 · Question 5 · Extended）

6. Which statement about denaturation is correct?

A Denaturation is the change in shape of the active site of the enzyme at a pH above the optimum pH.

B Denaturation is the change in shape of the active site of the enzyme at a temperature below the optimum temperature.

C Denaturation is the change in shape of the active site of the substrate at a pH below the optimum pH.

D Denaturation is the change in shape of the active site of the substrate at a temperature above the optimum temperature.

（2024 May/Jun · 0654/21 · Question 4 · Extended）

7. Which statements explain why an enzyme stops working when heated to high temperatures?

1 There is a low frequency of collisions between substrate and enzyme.

2 The active site no longer has a complementary shape to the substrate.

3 The enzyme is denatured.

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

(2024 Feb/Mar · 0654/22 · Question 4 · Extended)

8. Which effect will temperature change have on enzyme activity?

A High temperatures will denature them, making it difficult for substrate molecules to fit in the active site.

B High temperatures will denature them, making it easy for substrate molecules to fit in the active site.

C Low temperatures will denature them, making it difficult for substrate molecules to fit in the active site.

D Low temperatures will denature them, making it easy for substrate molecules to fit in the active site.

(2022 May/Jun · 0654/22 · Question 4 · Extended)

9. Which statement explains why enzyme activity stops at high temperatures?

A The enzyme's active site changes shape so the product **cannot** fit.

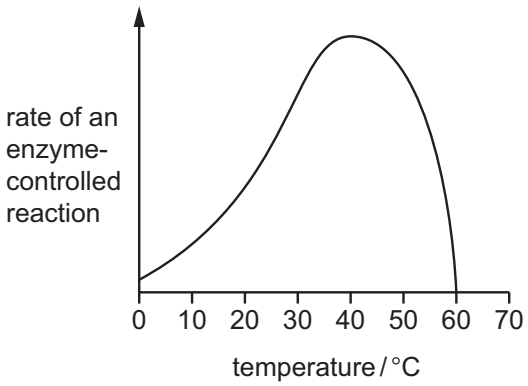
B The enzyme's active site changes shape so the substrate **cannot** fit.

C The molecules are moving more quickly and so enzyme and substrate are less likely to collide.

D The molecules are moving more slowly and so enzyme and substrate are more likely to collide.

(2026 May/Jun · 0654/22 · Question 4 · Extended)

10. The graph shows the effect of temperature on the rate of an enzyme-controlled reaction.



Which statements are correct?

1 Enzyme molecules denature above 50 °C and below 20 °C.

2 Increasing the temperature between 10 °C and 40 °C increases the kinetic energy of enzyme molecules.

3 The shape of the active site changes between 40 °C and 60 °C.

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

(2024 Oct/Nov · 0654/21 · Question 4 · Extended)

题型 3：辨认活性部位并核对酶与底物结合（考频★★☆☆☆）

知识点 酶是作为生物催化剂的蛋白质，能加快化学反应，反应后仍保持不变。

酶分子上与底物结合的特定部位称为_____；底物必须与该部位的形状_____。

二者结合后形成_____，反应完成后产物离开，酶可再次催化反应。

一种酶只能催化其活性部位能够结合的底物所参与的反应。

答案：活性部位；互补；酶与底物的复合物

怎么认 题目出现反应箭头上方的物质或酶与底物结合的叙述时，先确认酶具有活性部位。

例题 1

Which molecule in this reaction has an active site?

$$\text{fat} \xrightarrow{\text{lipase}} \text{fatty acid + glycerol}$$

A fat

B fatty acid

C glycerol

D lipase

（2025 Oct/Nov · 0654/22 · Question 4 · Extended）

解：反应箭头上方的 lipase 表示催化脂肪分解的酶。
活性部位位于酶分子上，因此具有活性部位的是 lipase。
故选 D。

针对练习

1. Which statements describe enzyme action?

1 The active site of the enzyme combines with the substrate to form an enzyme–substrate complex.

2 The active site of the substrate combines with the enzyme to form an enzyme–substrate complex.

3 The enzyme–substrate complex breaks apart to leave an enzyme and a product.

A 1 and 3 **B** 1 only **C** 2 and 3 **D** 2 only

（2026 Feb/Mar · 0654/22 · Question 10 · Extended）

2. Which row about enzymes is correct?

	each enzyme catalyses many different reactions	the active site is the part of the enzyme where the substrate binds	enzymes are complex carbohydrates	enzymes are denatured at their optimum temperature	enzymes can work outside of cells
A	✓	✓	✗	✗	✗
B	✓	✗	✓	✗	✓
C	✗	✓	✗	✗	✓
D	✗	✓	✓	✓	✗

key
✓ = true
✗ = false

（2023 May/Jun · 0654/21 · Question 4 · Extended）

题型 4：读酶活性曲线或表格判断最适条件（考频★★★☆☆）

知识点 酶活性可用酶催化反应的_____表示；活性最大时的条件称为最适条件。

在其他条件相同时，升温使酶活性逐渐增大；达到_____后继续升温，酶因变性而活性迅速下降。

每种酶有最适 pH，偏离最适 pH 时酶活性降低。

横轴为温度时，单位为 °C；横轴为 pH 时无单位，纵轴为酶活性或反应速率。

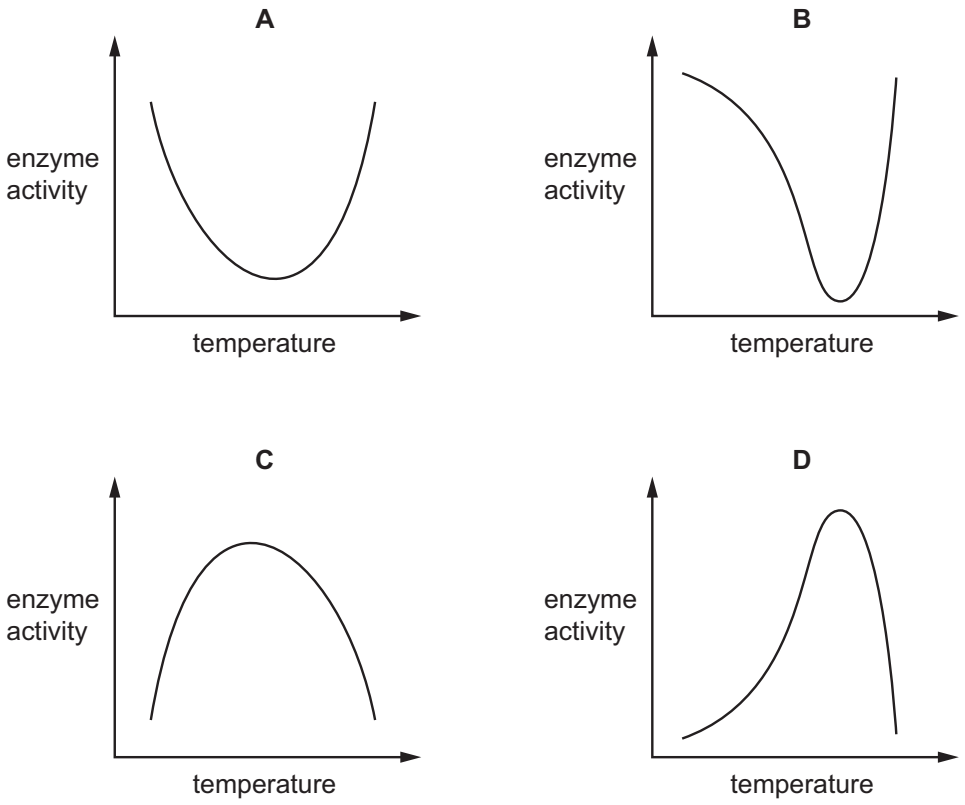
答案：反应速率；最适温度

怎么认 题目出现温度或 pH 与酶活性曲线、坐标轴名称或最适条件时，先认横轴变量，再判曲线形状。

一. 选择或命名温度与 pH 曲线

例题 1

Which graph shows the effect of temperature on enzyme activity?



（2023 Oct/Nov · 0654/11 · Question 4 · Core）

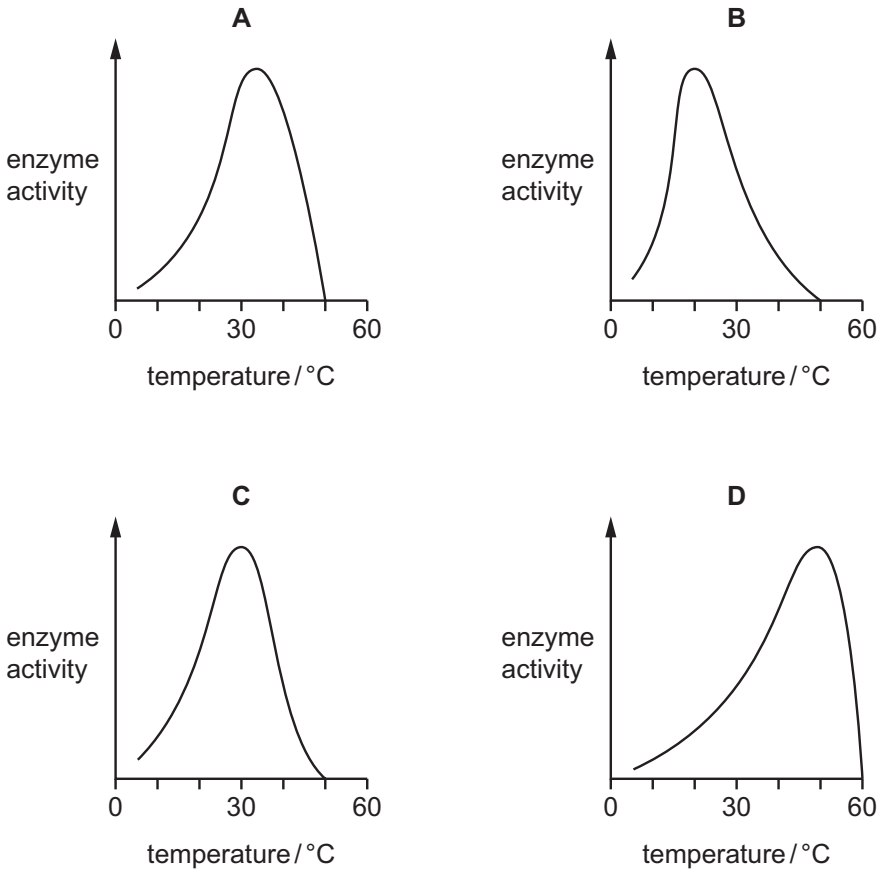
解：横轴为温度，纵轴为酶活性。低温升温时，酶活性逐渐增大；超过最适温度后，酶因变性而活性迅速下降。

图 D 先逐渐上升，达到峰值后陡降，符合温度对酶活性的影响。故选 D。

针对练习

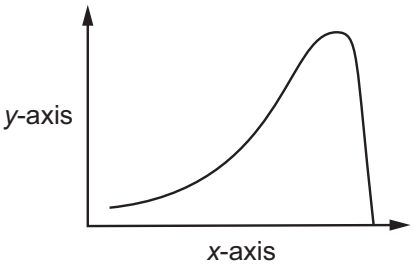
1. The graphs show the possible effects of temperature on enzyme activity.

Which graph is correct for a human enzyme?



（2025 Feb/Mar · 0654/12 · Question 6 · Core）

2. The graph shows the effect of increasing temperature on an enzyme-controlled reaction.



What are the correct labels for the *y*-axis and the *x*-axis?

	y-axis	*x*-axis
A	rate of reaction	temperature
B	rate of reaction	time
C	time	rate of reaction
D	time	temperature

（2022 May/Jun · 0654/21 · Question 4 · Extended）

二. 读速率大小与区间趋势

知识点 酶活性可用单位时间内反应物的减少量或生成物的增加量表示，其单位由物质的量与时间单位共同决定。

在其他条件相同、测量时间相同且题目说明代理量与速率成正比的条件下，泡沫高度等代理量越大，酶活性越_____。

温度或 pH 逐渐增大时，酶活性通常先升至_____，再降低；峰值右侧的温度或 pH 高于最适值。

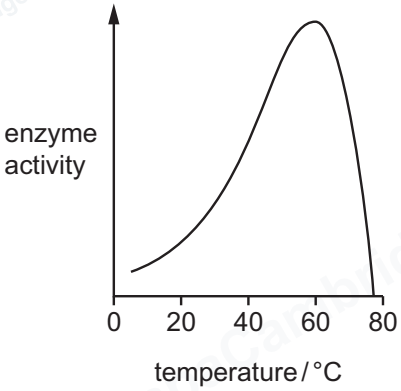
读图表时先按纵轴比较活性或代理量，再沿横轴读取温度；温度常用 °C，pH _____单位。

答案：高；最大值；没有

怎么认 题目出现酶活性随温度或 pH 变化的曲线、表格或代理量时，先读纵轴，再找峰值、上升区间或峰值右侧。

例题 2

The graph shows the activity of an enzyme at different temperatures.



Which temperature has the maximum activity for this enzyme?

A 20 °C **B** 40 °C **C** 60 °C **D** 80 °C

（2026 May/Jun · 0654/12 · Question 4 · Core）

解：纵轴表示酶活性，曲线最高点对应最大酶活性。

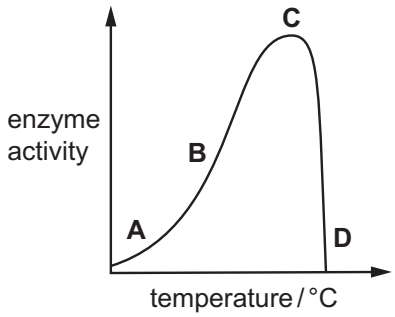
由最高点向横轴读数，得温度为 60 °C。

故选 C。

针对练习

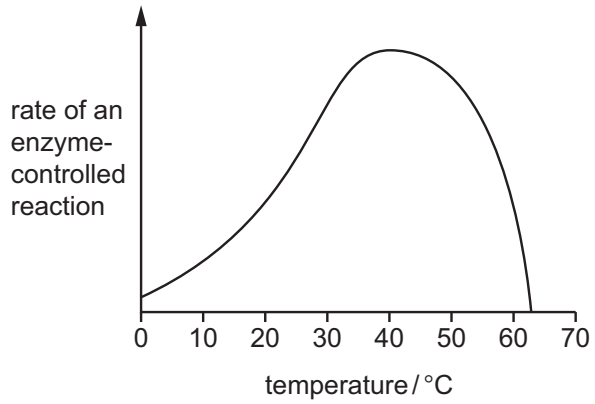
3. The graph shows the effect of temperature on an enzyme-controlled reaction.

Which point has the highest frequency of effective collisions?



（2025 Feb/Mar · 0654/22 · Question 3 · Extended）

4. The graph shows the effect of increasing temperature on the rate of an enzyme-controlled reaction.



Which statement describes what is happening between 10 °C and 30 °C on the graph?

A An increase in the rate of reaction increases the temperature of the reaction.

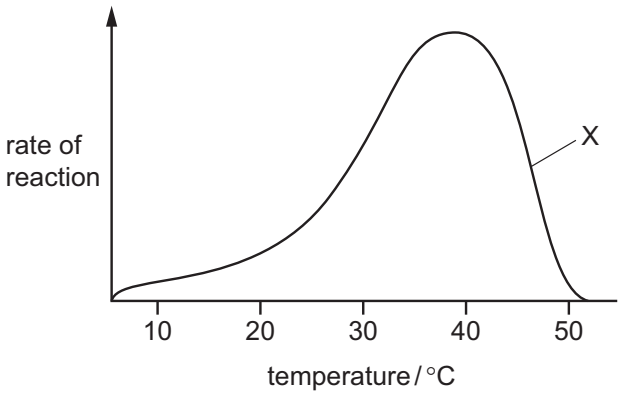
B An increase in temperature has no effect on the rate of a reaction.

C As the rate of reaction increases, the temperature has no effect.

D As the temperature increases, the rate of reaction also increases.

（2024 Oct/Nov · 0654/12 · Question 4 · Core；同题：2024 Oct/Nov · 0654/13 · Question 4 · Core）

5. The graph shows the rate of reaction of salivary amylase at different temperatures.



What does the graph show at point X?

A The enzyme has stopped working.

B The reaction is nearly completed.

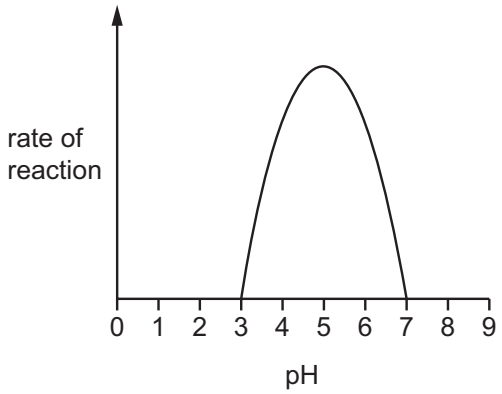
C The reaction rate is controlled by pH.

D The temperature is higher than the optimum.

（2022 Oct/Nov · 0654/21 · Question 4 · Extended；同题：2022 Oct/Nov · 0654/22 · Question 4 · Extended；同题：2022 Oct/Nov · 0654/23 · Question 4 · Extended）

6. Fungus can live at the base of human hair where the activity of one of its enzymes can cause dry skin.

The graph shows the action of the fungal enzyme at different pH values.



Different shampoos have different pH values.

Which shampoo causes the greatest amount of dry skin?

A pH 3 **B** pH 5 **C** pH 7 **D** pH 9

（2022 May/Jun · 0654/11 · Question 4 · Core）

7. Catalase is an enzyme that breaks down hydrogen peroxide to form a foam of water and oxygen. The maximum height of the foam produced at different temperatures in a given length of time is measured.

The rate of the reaction is proportional to the height of foam.

The table shows the results.

temperature / °C	height of foam / mm
10	1.2
20	3.1
30	4.2
40	5.4
50	3.6
60	0.0

Which conclusion can be drawn from these results?

A Increasing the temperature decreases the rate of the reaction up to 50 °C.

B Increasing the temperature decreases the rate of the reaction up to 60 °C.

C Increasing the temperature increases the rate of the reaction up to 40 °C.

D Increasing the temperature increases the rate of the reaction up to 50 °C.

（2022 May/Jun · 0654/12 · Question 4 · Core；同题：2022 May/Jun · 0654/13 · Question 4 · Core）

题型 5：把反应时间或物质量转换成酶活性（考频★★☆☆☆）

知识点 酶活性表示酶催化反应的快慢；在底物初始量、酶量及其他条件相同时，相同时间内底物减少越多，酶活性越_____。

同量底物完成反应所需时间越短，酶活性越_____；剩余底物的纵轴值越低，表示已分解量越多。

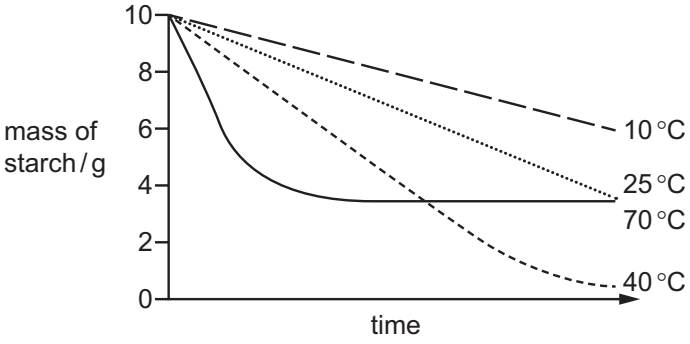
反应时间 t 可用 s 或 min；以 $\frac{1}{t}$ 表示相对活性时，单位为 s^{-1} 或 min^{-1}。

答案：大；大

怎么认 题目出现完全反应时间或剩余底物量时，先按用时越短或底物减少越多判断酶活性越大。

例题 1

The graph shows the rate at which 10 g of starch is broken down by amylase at four different temperatures.



At which temperature does amylase work best to break down starch?

A 10 °C　　**B** 25 °C　　**C** 40 °C　　**D** 70 °C

（2023 Feb/Mar · 0654/12 · Question 4 · Core；同题：2023 Feb/Mar · 0654/22 · Question 4 · Extended）

解：各温度下淀粉初始质量均为 10 g，比较相同时间后已分解的淀粉质量。

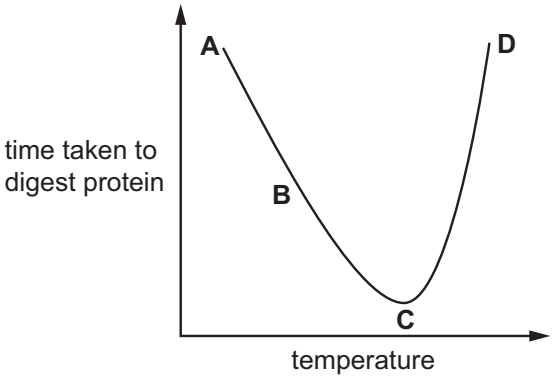
$m_{已分解} = 10\ g - m_{剩余}$

图中 40 °C 曲线的剩余淀粉质量最小，故已分解质量最大，淀粉酶活性最大。故选 C。

针对练习

1. The graph shows the effect of temperature on the time taken for a protease to digest protein.

At which point on the graph is the greatest frequency of effective collisions between enzyme and substrate?



（2022 May/Jun · 0654/23 · Question 4 · Extended）

2. Six test-tubes contain amylase and starch solution. The temperatures of the test-tube contents are different. All other conditions are the same.

The table shows the time taken for the amylase to break down the starch.

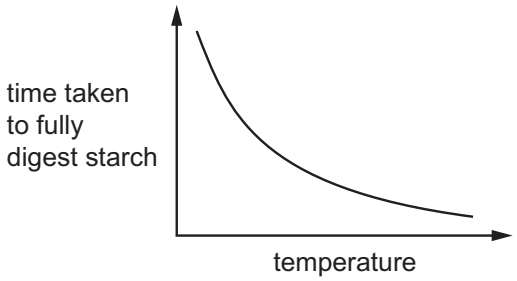
temperature / °C	25	30	35	40	45	50
time / seconds	121	87	46	43	72	99

At which temperature is the activity of the amylase greatest?

A 25 °C **B** 35 °C **C** 40 °C **D** 50 °C

(2025 May/Jun · 0654/22 · Question 5 · Extended)

3. The graph shows the effect of increasing temperature on the time taken for amylase to fully digest a sample of starch.



Which statements are correct?

1 As the temperature increases, the kinetic energy of the amylase and starch molecules increases.

2 The time taken to fully digest the starch decreases as temperature increases because there are more frequent collisions between starch and amylase molecules.

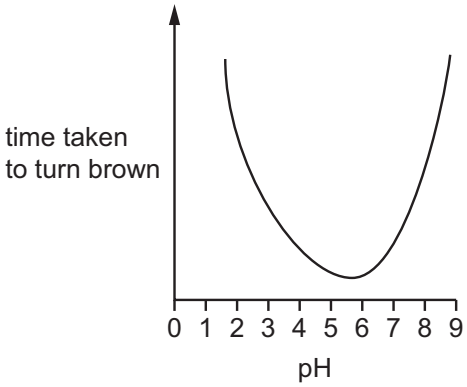
3 The time taken to fully digest the starch decreases as temperature increases because the shape of the amylase changes as it denatures.

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

(2023 Oct/Nov · 0654/21 · Question 4 · Extended)

4. When the phenol molecules in apples are exposed to air, they react with oxygen and the fruit turns brown. This is an enzyme-controlled reaction.

The graph shows the effect of pH on the time taken for pieces of apple to turn brown.



Which statements are correct?

1 The optimum pH for this enzyme is between 5 and 6.

2 As the pH increases from 3 to 5, the phenol molecules and the enzyme move faster.

3 As the pH becomes higher than 6, the shape of the active site changes.

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

（2024 Oct/Nov · 0654/23 · Question 4 · Extended）

题型 6：由生物生活环境寻找最适温度和 pH（考频★★☆☆☆）

知识点 酶活性最高时的温度称为_____，温度通常用 °C 表示。

酶活性最高时的 pH 称为_____；pH 没有单位，小于 7 为酸性，大于 7 为碱性。

长期生活在特殊环境中的生物，其酶通常适应该环境，最适条件常与生活环境的温度和_____相近。

温度超过最适温度后，酶可能变性，酶活性随之降低。

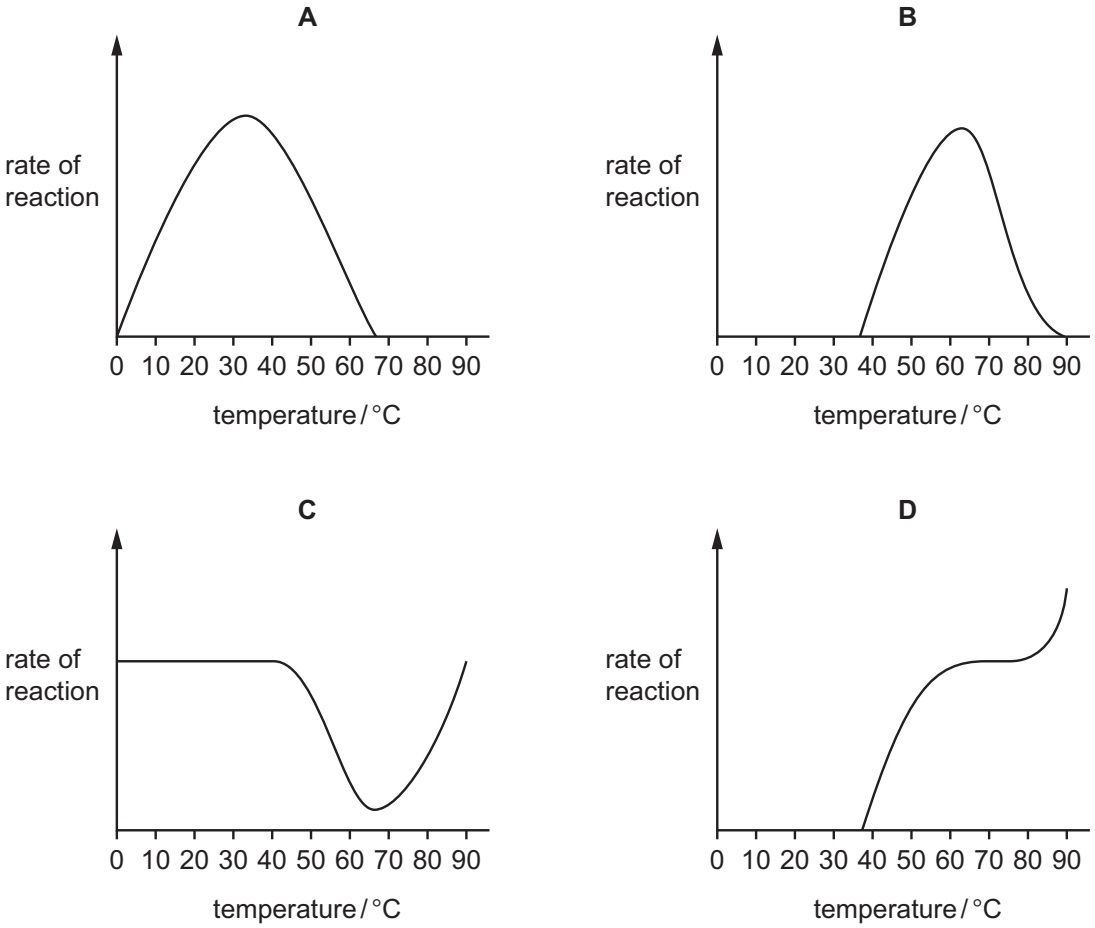
答案：最适温度；最适 pH；pH

怎么认 题目出现生活温度及酸性或碱性环境时，先据环境判断酶活性峰值对应的温度和 pH。

例题 1

The Pompeii worm lives in deep-sea hydrothermal vents where **average** temperatures are often as high as 68 °C.

Which graph represents the activity of enzymes found in the Pompeii worm?



（2022 Feb/Mar · 0654/12 · Question 4 · Core；同题：2022 Feb/Mar · 0654/22 · Question 4 · Extended）

解：庞贝虫生活环境的平均温度可达 68 °C，其酶适应高温环境。
图 B 的酶活性峰值约在 65 °C，与生活环境温度相近，且超过最适温度后活性下降。
故选 B。

针对练习

1. Some species of bacteria live in alkaline hot springs at temperatures of 80 °C.

Which conditions will best suit the enzymes of these bacteria?

	temperature / °C	pH
A	30	3
B	30	9
C	70	3
D	70	9

（2025 Oct/Nov · 0654/12 · Question 3 · Core；同题：2025 Oct/Nov · 0654/13 · Question 3 · Core）

2. Some bacteria live in acidic, hot springs.

What are the optimum conditions for the enzymes of these bacteria?

A 20 °C and pH 4

B 20 °C and pH 9

C 80 °C and pH 4

D 80 °C and pH 9

（2024 Oct/Nov · 0654/22 · Question 4 · Extended）

题型 7：同时比较两种酶的 pH 活动范围（考频★☆☆☆☆）

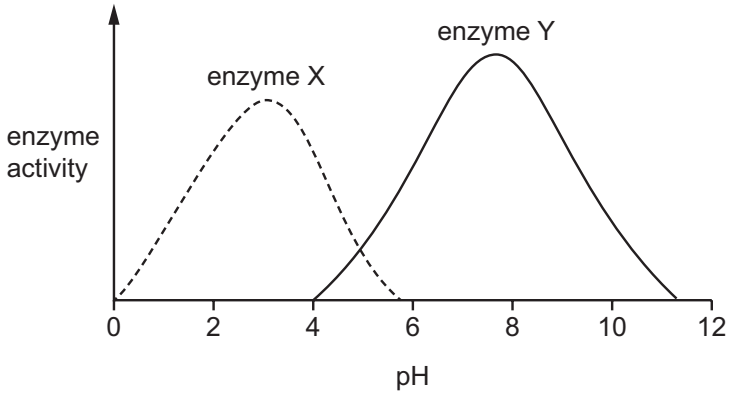
知识点 酶活性表示酶催化反应的快慢，常用单位时间内反应物的减少量或生成物的_____表示。pH 会影响酶活性；在某一 pH 下，曲线高于横轴表示酶活性_____零，曲线落在横轴上表示无活性。比较两种酶时，应在同一 pH 处分别读取两条曲线；pH 没有单位，本图纵轴表示相对活性。

答案：增加量；大于

怎么认 题目出现两种酶的 pH 活性曲线并判断活动情况时，先在同一 pH 处读两条曲线是否高于零。

例题 1

The graph shows the effect of pH on two different enzymes.



Which statement is correct?

A Both enzymes show no activity in conditions of pH 4.

B Both enzymes are active in conditions of pH 5.

C Only enzyme X is active in conditions of pH 10.

D Only enzyme Y is active in conditions of pH 3.

（2024 Feb/Mar · 0654/12 · Question 4 · Core）

解：在 pH = 5 处，酶 X 的虚线和酶 Y 的实线均高于横轴，故两种酶的活性均大于零，均有活性。故选 B。

题型 8：比较产物随时间曲线的斜率与平台（考频★☆☆☆☆）

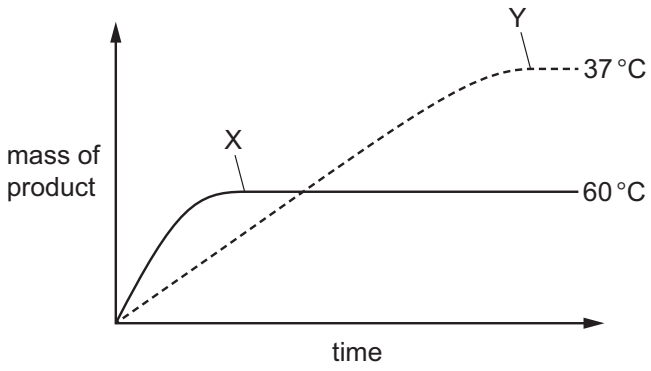
知识点 产物质量-时间图像的斜率表示反应速率；曲线起始处的_____越大，初始反应速率越大。温度升高时粒子的动能增大，有效碰撞可增多；温度过高会使酶_____，反应因失去催化作用而停止。曲线变为水平线表示产物质量不再增加，原因须结合平台高度和相同的起始条件判断；反应速率单位为质量/时间，如 g/min。

答案：斜率；变性

怎么认 题目出现产物质量随时间变化的多条曲线时，先比较起始斜率，再结合平台高度判断停止原因。

例题 1

The graph shows the mass of product produced by an enzyme-controlled reaction over time when the reaction mixture is placed separately at 37 °C and at 60 °C. The starting concentration of the substrate and the concentration of the enzyme used are kept constant.



What can be concluded from the graph?

A At point X on the graph, the enzyme has run out of substrate.

B The enzyme denatures at point Y on the graph.

C The reaction mixture has a higher kinetic energy at 37 °C.

D The reaction mixture has a higher initial rate of reaction when placed at 60 °C.

（2024 May/Jun · 0654/22 · Question 4 · Extended）

解：由产物质量-时间图像可知，反应初始速率由曲线起始处的斜率表示。
图中 60 °C 曲线起始处的斜率大于 37 °C 曲线，故 60 °C 时初始反应速率较大。
故选 D。

5.2 酶与反应条件：结构题

题型 1：列举影响酶活性的条件（考频★★☆☆☆）

知识点 酶活性表示酶催化反应的快慢，可用单位时间内反应物的减少量或产物的增加量表示。影响酶活性的主要条件有_____和_____；比较其中一个条件的影响时，其余条件应保持相同。酶活性的单位由所测物理量决定，例如 cm^3/s 或 mol/s。

答案：温度；pH

怎么认 题目出现影响酶活性的因素并排除某一因素时，先列举其余因素中的一个。

例题 1

(b) State **one** factor, other than temperature, that affects enzyme activity.

（2024 May/Jun 0654/31 第10题(b)）

解：影响酶活性的主要条件有温度和 pH。题目排除温度，故可列举 pH。
答：pH。

针对练习

1. **(b)** State **one** factor, other than pH, that affects enzyme activity.

（2023 Oct/Nov 0654/33 第7题(b)）

2. **(b)** Name **one** factor, other than pH, that affects enzyme activity.

（2022 May/Jun 0654/32 第4题(b)；同题：2022 May/Jun 0654/33 第4题(b)）

3. **(ii)** State **one other** factor, apart from pH, that affects the activity of enzymes.

（2024 Oct/Nov 0654/32 第7题(a)(ii)；同题：2024 Oct/Nov 0654/33 第7题(a)(ii)）

题型 2：用粒子碰撞解释最适温度前的酶活性上升（考频★★☆☆☆）

知识点 酶活性表示酶催化反应的速率，可用单位时间内底物减少量或产物生成量表示，单位随测量方法而定。
在酶未变性且温度由低温升至最适温度的过程中，酶分子和底物分子的_____增大，运动加快。二者碰撞更_____，能形成酶与底物复合物的有效碰撞增多，因而酶活性升高；酶活性最高时的温度称为_____。

答案：动能；频繁；最适温度

怎么认 题目出现最适温度前的升温区间并要求解释酶活性上升时，先由粒子动能增大推出有效碰撞增多。

例题 1

(c) Figure 3.1 is a graph showing the effect of temperature on amylase activity.

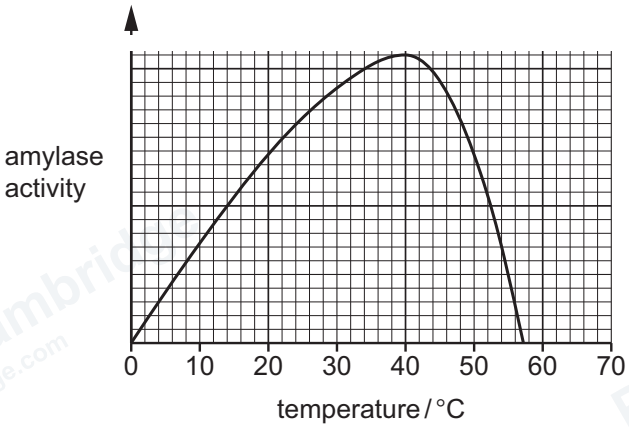


Figure 3.1

Explain the effect of increasing temperature from 0 °C to 40 °C on amylase activity shown in Figure 3.1.

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（2026 Feb/Mar 0654/42 第3题(c)）

解：由图可知，温度从 0 °C 升至 40 °C 时，淀粉酶活性逐渐升高，并在约 40 °C 时达到最大值。
升温使淀粉酶分子和底物分子的动能增大，运动加快，二者碰撞更频繁。
单位时间内有效碰撞次数增多，形成的酶与底物复合物增多，故淀粉酶催化反应的速率提高。
答：温度从 0 °C 升至 40 °C 时，有效碰撞增多，淀粉酶活性升高至最大值。

针对练习

1. **(a)** Photosynthesis is an enzyme-controlled reaction.

Fig. 4.1 is a graph showing the effect of temperature on the rate of photosynthesis.

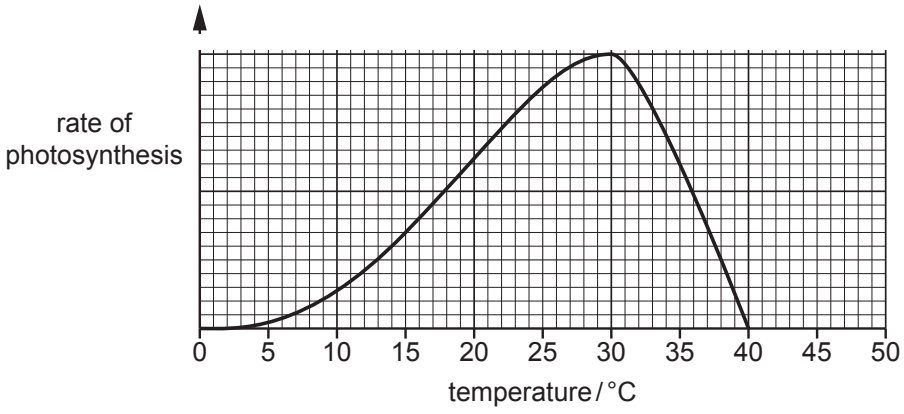


Fig. 4.1

(i) Explain the results between 0–30 °C in Fig. 4.1.

（2023 May/Jun 0654/42 第4题(a)(i)）

2. A student investigates the effect of temperature on the rate of photosynthesis.

Fig. 4.1 shows the apparatus they use.

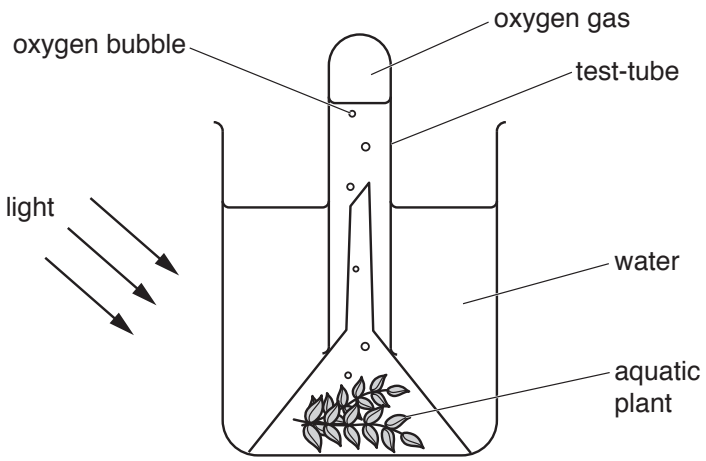


Fig. 4.1

The student counts the number of oxygen bubbles produced in one minute.

He repeats this investigation, changing the temperature of the water each time.

The number of oxygen bubbles produced per minute is equivalent to the rate of photosynthesis.

Table 4.1 shows the results.

Table 4.1

temperature / °C	number of bubbles produced per minute
0	0
5	4
10	8
15	13
20	16
25	18
30	19
35	8
40	0

(b) Photosynthesis is an enzyme-controlled reaction.

(i) Explain the results in Table 4.1 between 5 °C and 15 °C.

（2022 May/Jun 0654/43 第4题(b)(i)）

第 6 章 光合作用、叶片与限制因素

6.1 光合作用、叶片与限制因素

题型 1：核对光合作用的原料与产物（考频★★★☆☆）

知识点 光合作用是绿色植物利用_____，把二氧化碳和水制造成碳水化合物并释放氧气的过程。反应物是二氧化碳和_____，产物通常写成_____；二氧化碳被消耗，因此该过程能从大气中移除二氧化碳。
叶绿素是吸收光能的必要条件，不列入原料或产物；这一物质关系不涉及单位。

答案：光能；水；葡萄糖和氧气

怎么认 题目出现光合作用的定义、物质表、方程或气体箭头时，先按原料、产物及条件对应。

例题 1

Which row is correct for photosynthesis?

	raw materials	products
A	carbon dioxide and glucose	oxygen and water
B	carbon dioxide and water	oxygen and glucose
C	oxygen and glucose	carbon dioxide and water
D	oxygen and water	carbon dioxide and glucose

（2022 Oct/Nov · 0654/11 · Question 5 · Core）

解：由光合作用的物质关系得，
原料为二氧化碳和水，产物为氧气和葡萄糖。
故选 B。

针对练习

1. What are the products of photosynthesis in a green plant?

A carbon dioxide and water

B glucose and carbon dioxide

C oxygen and glucose

D oxygen and water

（2024 Oct/Nov · 0654/12 · Question 5 · Core；同题：2024 Oct/Nov · 0654/13 · Question 5 · Core）

2. Which row shows the correct raw materials and products of photosynthesis?

	raw materials		products	
A	CO_2	H_2O	$C_6H_{12}O_6$	O_2
B	$C_6H_{12}O_6$	H_2O	CO_2	O_2
C	O_2	CO_2	$C_6H_{12}O_6$	H_2O
D	O_2	$C_6H_{12}O_6$	CO_2	H_2O

（2023 Oct/Nov · 0654/22 · Question 5 · Extended）

3. Which word is missing from the word equation for photosynthesis?

carbon dioxide + ... → glucose + oxygen

A carbohydrate

B chlorophyll

C light

D water

（2024 Feb/Mar · 0654/12 · Question 5 · Core）

4. Which process removes carbon dioxide from the atmosphere?

A combustion

B decomposition

C photosynthesis

D respiration

（2024 May/Jun · 0654/11 · Question 13 · Core）

5. Which process requires chlorophyll?

A excretion

B photosynthesis

C respiration

D transpiration

（2026 May/Jun · 0654/12 · Question 5 · Core）

6. What is the manufacture of carbohydrates from raw materials using light energy called?

A growth

B photosynthesis

C respiration

D reproduction

（2024 May/Jun · 0654/23 · Question 5 · Extended）

7. Which statement about photosynthesis is correct?

A A plant uses carbon dioxide and glucose to produce oxygen and water.

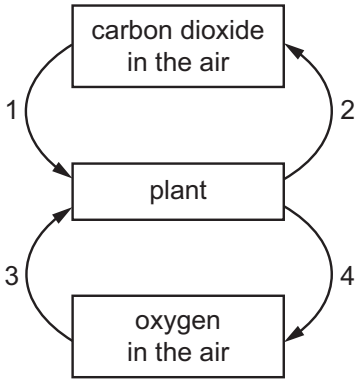
B A plant uses carbon dioxide and water to produce glucose and oxygen.

C A plant uses glucose and oxygen to produce carbon dioxide and water.

D A plant uses oxygen and water to produce glucose and carbon dioxide.

（2025 May/Jun · 0654/12 · Question 5 · Core；同题：2025 May/Jun · 0654/13 · Question 5 · Core）

8. Which two arrows represent photosynthesis?



A 1 and 3 **B** 1 and 4 **C** 2 and 3 **D** 2 and 4

（2023 May/Jun · 0654/11 · Question 5 · Core）

题型 2：把矿物离子与植物合成用途对应（考频★★★☆☆）

知识点 镁离子是叶绿素分子的组成成分，植物用镁离子制造_____。
硝酸根离子为植物制造_____提供氮，氨基酸再合成蛋白质，供植物生长。

答案：叶绿素；氨基酸

怎么认 题目出现镁离子、硝酸根离子及合成物质时，先配对镁与叶绿素、硝酸根与氨基酸。

例题 1

Which **ion** is important for chlorophyll production in plants?

A calcium
B iron
C magnesium
D nitrate

（2022 Feb/Mar · 0654/12 · Question 5 · Core）

解：镁离子是叶绿素分子的组成成分，植物制造叶绿素需要镁离子。
故选 C。

针对练习

1. Which substance is essential to make chlorophyll?

A calcium ions
B cellulose
C iron ions
D magnesium ions

（2025 May/Jun · 0654/21 · Question 4 · Extended）

2. Plants need magnesium ions and nitrate ions.

Which statements correctly show what the plants make using these ions?

1 Magnesium ions are needed for making amino acids.

2 Nitrate ions are needed for making amino acids.

3 Magnesium ions are needed for making chlorophyll.

4 Nitrate ions are needed for making chlorophyll.

A 1 and 4 **B** 2 and 3 **C** 2 only **D** 4 only

（2023 Oct/Nov · 0654/23 · Question 5 · Extended）

3. Plants require various ions to manufacture other molecules.

Which row shows the molecules that plants make from magnesium ions and nitrate ions?

	magnesium ions	nitrate ions
A	chlorophyll	chlorophyll
B	chlorophyll	protein
C	protein	chlorophyll
D	protein	protein

（2023 Oct/Nov · 0654/13 · Question 5 · Core）

4. Why are nitrate ions necessary for plant growth?

A They are essential for producing starch.

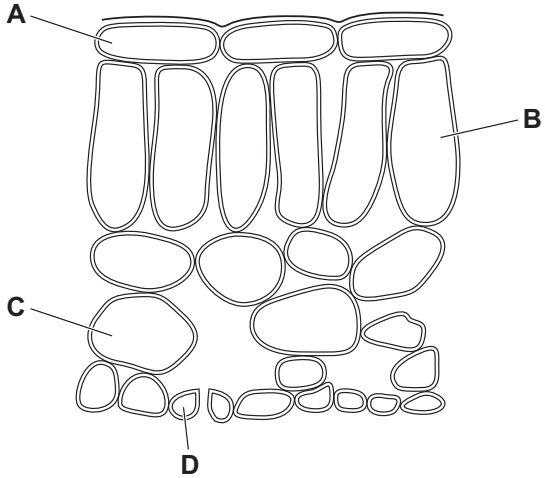
B They are found in the chloroplasts.

C They are part of the cell sap.

D They are used in making amino acids.

（2023 Feb/Mar · 0654/12 · Question 5 · Core；同题：2023 Feb/Mar · 0654/22 · Question 5 · Extended）

5. Which cell does **not** require magnesium ions for the synthesis of chlorophyll?



（2022 Oct/Nov · 0654/21 · Question 5 · Extended）

题型 3：按图辨认叶片层次与光合场所（考频★★★☆☆）

知识点 双子叶植物叶片横切面自上而下通常为上表皮、栅栏叶肉、海绵叶肉和下表皮；栅栏叶肉细胞细长且排列紧密，海绵叶肉细胞形状不规则、排列疏松并有较大气隙。

在有光且叶绿素参与时，光合作用在_____中进行；_____细胞靠近叶片上表面且叶绿体较多，通常制造的葡萄糖最多。

气孔是表皮上的开口，开口两侧的一对细胞叫_____。

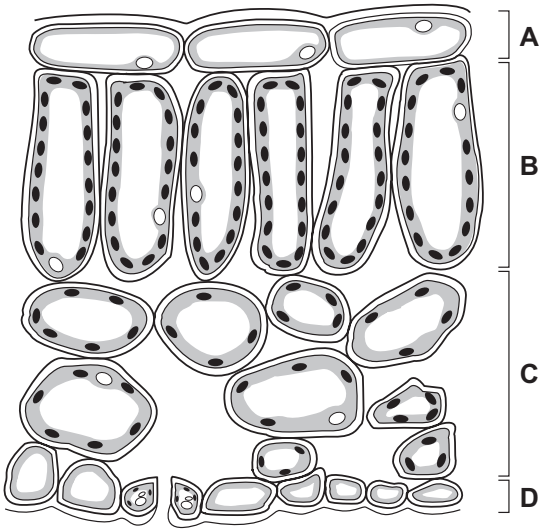
答案：叶绿体；栅栏叶肉；保卫细胞

怎么认 题目出现叶片横切面、细胞排列或细胞器标注时，先按位置、排列和叶绿体形态辨认。

例题 1

The diagram shows a section of a dicotyledonous leaf.

Which layer is the spongy mesophyll?



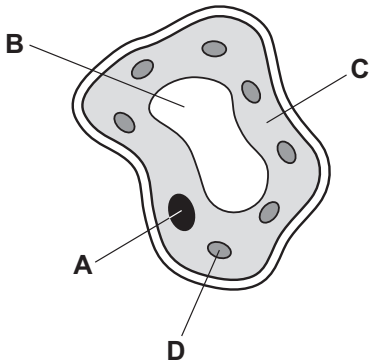
（2022 Oct/Nov · 0654/13 · Question 5 · Core；同题：2022 Oct/Nov · 0654/23 · Question 5 · Extended）

解：由图可见，A 位于叶片最上方，为上表皮；B 细胞细长且排列紧密，为栅栏叶肉。C 细胞形状不规则、排列疏松且有较大气隙，为海绵叶肉。故选 C。

针对练习

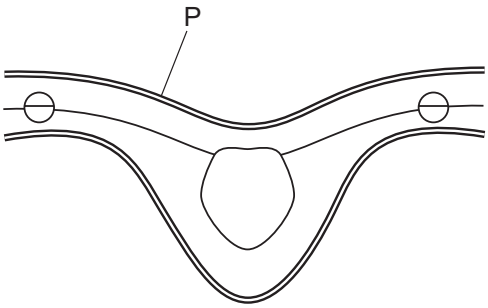
1. The diagram shows a section through a cell from a leaf.

Which part makes glucose using light?



（2025 Oct/Nov · 0654/11 · Question 6 · Core）

2. The diagram shows a plan of the cross-section of a dicotyledonous leaf.



What is the name of the part labelled P?

A palisade mesophyll

B spongy mesophyll

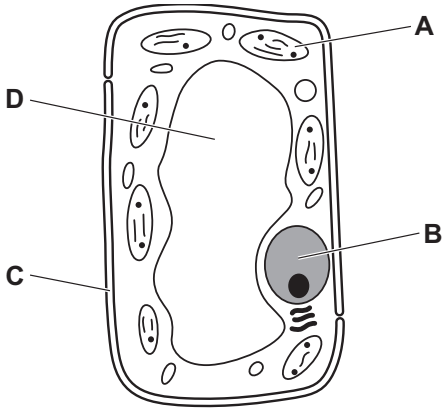
C upper epidermis

D vascular bundle

(2024 Oct/Nov · 0654/11 · Question 5 · Core)

3. The diagram shows a mesophyll cell.

In which structure does photosynthesis take place?



(2024 Oct/Nov · 0654/21 · Question 5 · Extended)

4. Which leaf cell produces the most glucose?

A palisade mesophyll

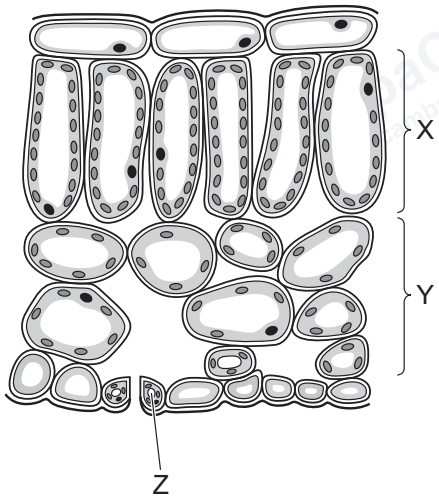
B phloem

C spongy mesophyll

D xylem

(2025 Feb/Mar · 0654/12 · Question 3 · Core)

5. The diagram shows a cross-section of a leaf.



Which row identifies the structures in the leaf?

	X	Y	Z
A	palisade mesophyll	spongy mesophyll	stomata
B	spongy mesophyll	palisade mesophyll	stomata
C	palisade mesophyll	spongy mesophyll	guard cell
D	spongy mesophyll	palisade mesophyll	guard cell

（2026 May/Jun · 0654/13 · Question 2 · Core）

题型 4：由黄叶或生长变化判断矿物缺乏（考频★★☆☆☆）

知识点 镁离子是合成_____所需的矿物离子；叶绿素使叶片呈绿色，并吸收光能进行光合作用。
镁离子不足时，叶绿素含量下降，叶片由绿变黄，光合作用随之_____。
有机物制造量减少，植株生长不良；老叶叶脉间黄化是缺镁的表现。

答案：叶绿素；减弱

怎么认 题目出现叶片变黄、老叶叶脉间黄化或题干已知缺镁时，先联系叶绿素合成减少。

例题 1

A farmer notices that the older leaves of his maize plant are becoming yellow between the veins.

What is the plant lacking?

A carbon dioxide

B magnesium ions

C sunlight

D water

（2024 Feb/Mar · 0654/22 · Question 5 · Extended）

解：老叶叶脉间变黄，表明叶绿素含量下降。
合成叶绿素需要镁离子，因此植株缺少镁离子。
故选 B。

针对练习

1. What causes plant leaves to turn yellow?

A a lack of magnesium in the soil

B a lack of starch in the leaves

C a reduction in the rate of photosynthesis

D a reduction in the rate of respiration

（2024 Oct/Nov · 0654/23 · Question 5 · Extended）

2. A farmer observes that a field of grass is **not** as green as usual.

Which substance has decreased in availability?

A oxygen in the air

B nitrogen in the soil

C magnesium in the soil

D carbon dioxide in the air

（2026 May/Jun · 0654/23 · Question 4 · Extended）

3. Which row shows the effect of magnesium ion deficiency on plants?

	leaf colour	growth
A	green	good
B	green	poor
C	yellow	good
D	yellow	poor

（2025 Oct/Nov · 0654/22 · Question 5 · Extended）

4. Plants do **not** grow well when they are deficient in magnesium ions.

What is the reason for this?

A increased water uptake from the soil

B not able to synthesise proteins from carbohydrates

C reduced diffusion of carbon dioxide into the leaf

D reduced production of chlorophyll

（2025 Feb/Mar · 0654/22 · Question 4 · Extended）

题型 5：辨认光合作用的能量转换（考频★☆☆☆☆）

知识点 绿色植物进行光合作用时，叶绿素_____光能，光能转化为糖等物质中储存的_____能。
叶绿素不产生能量；上述转化需有光和叶绿素，并以二氧化碳和水合成糖。
能量的国际单位是_____，符号为 J。

答案：吸收；化学；焦耳

怎么认 题目出现叶绿素、光能及糖中的能量时，先判断光能是否转化为化学能。

例题 1

Which statement about the process of photosynthesis is correct?

A Chlorophyll produces chemical energy for the synthesis of carbohydrates.

B Chlorophyll produces light energy for the synthesis of carbohydrates.

C Chlorophyll transfers chemical energy to light energy for the synthesis of carbohydrates.

D Chlorophyll transfers light energy to chemical energy for the synthesis of carbohydrates.

（2024 Oct/Nov · 0654/22 · Question 5 · Extended）

解：由光合作用的能量转换可知，叶绿素吸收光能，光能转化为糖等物质中的化学能。
故选 D。

针对练习

1. Endothermic reactions use up more energy than they release while exothermic reactions release energy overall.

Which row describes the type of reaction that occurs in the process of photosynthesis and in the process of respiration?

	respiration	photosynthesis
A	endothermic	endothermic
B	endothermic	exothermic
C	exothermic	endothermic
D	exothermic	exothermic

（2023 May/Jun · 0654/23 · Question 8 · Extended）

题型 6：比较光照条件并识别限制因素（考频★★★☆☆）

知识点 光合速率表示植物在单位时间内进行光合作用的快慢，可用单位时间内产生的氧气体积或气泡数表示，常用单位为 cm^3/min 或 个/min。
其他条件保持不变时，低光强范围内，光照强度越大，光合速率越_____；曲线达到平台后，光照不再是限制因素。
限制因素是供给相对不足、使光合速率不能继续升高的因素；同时提高光照强度和二氧化碳浓度，光合速率通常_____。
灯离水生植物越远，植物接受的光照强度越_____，产生的氧气泡越少。

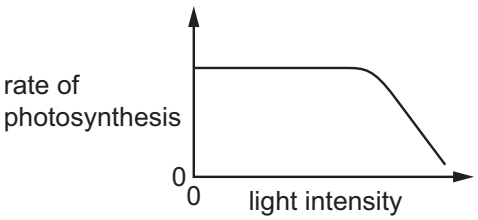
答案：大；提高；小

怎么认 题目出现光照强度与光合速率曲线、光照和二氧化碳高低组合或灯距变化时，先判断光强变化及曲线是否已到平台。

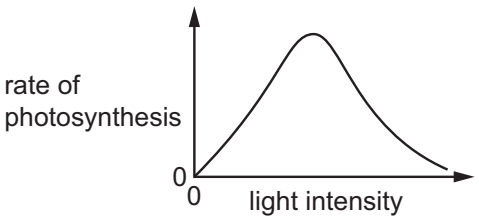
例题 1

Which graph shows the effect of light intensity on the rate of photosynthesis, if all other factors are kept constant?

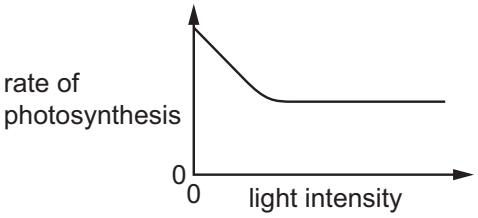
A



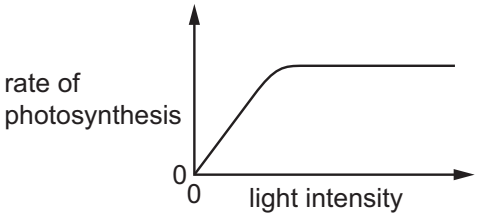
B



C



D



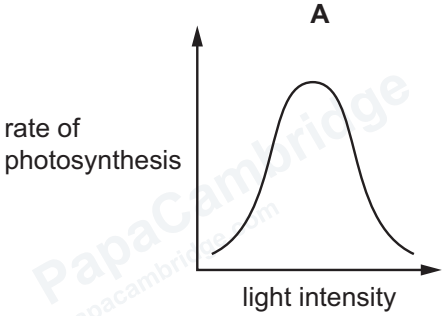
（2022 May/Jun · 0654/21 · Question 5 · Extended；同题：2022 May/Jun · 0654/22 · Question 5 · Extended、2022 May/Jun · 0654/23 · Question 5 · Extended）

解：其他因素保持不变，低光强时光照是限制因素，随光照强度增大，光合速率增大。
光照强度继续增大后，其他因素成为限制因素，光合速率保持不变。
故曲线先上升后达到平台，故选 D。

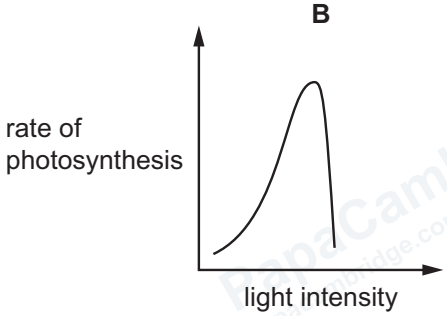
针对练习

1. Which graph shows the effect of increasing light intensity on the rate of photosynthesis?

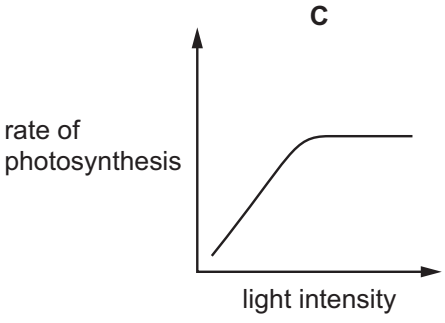
A



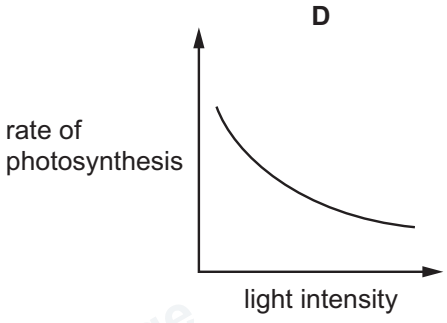
B



C



D



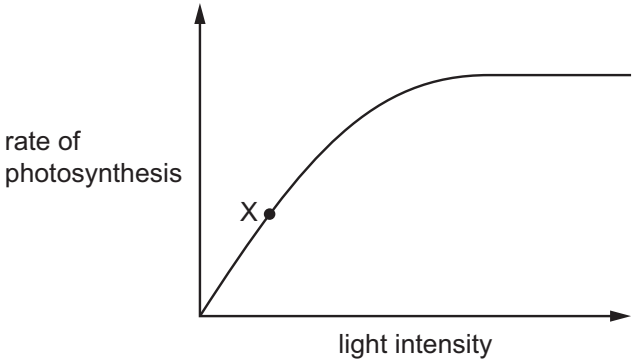
（2026 May/Jun · 0654/22 · Question 5 · Extended）

2. Which conditions will result in the highest rate of photosynthesis?

	light intensity	carbon dioxide concentration
A	high	high
B	high	low
C	low	high
D	low	low

(2023 Oct/Nov · 0654/11 · Question 5 · Core)

3. The graph shows the effect of increasing light intensity on the rate of photosynthesis of a submerged aquatic plant.



Which factor is limiting the rate of photosynthesis at X?

A carbon dioxide concentration

B humidity

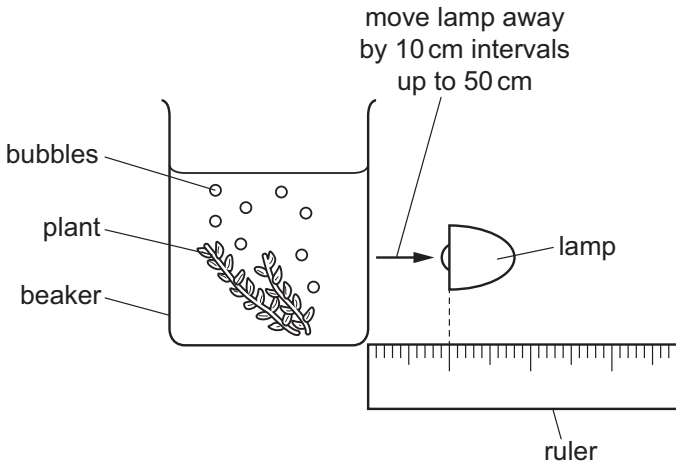
C light intensity

D temperature

(2023 May/Jun · 0654/22 · Question 5 · Extended)

4. An experiment is set up to investigate the effect of changing the light intensity on the rate of photosynthesis.

The lamp is moved in 10 cm intervals away from the plant and the number of bubbles of gas recorded in 60 seconds.



What will be the result of moving the lamp further away from the beaker containing the plant?

A The number of bubbles of carbon dioxide will decrease.

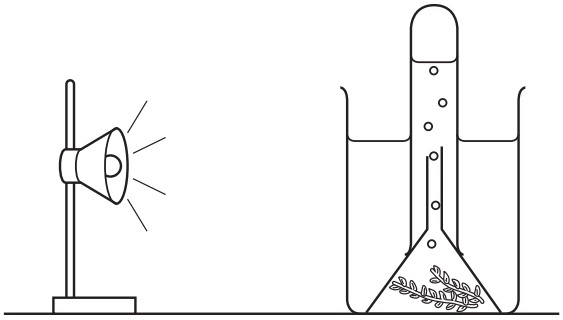
B The number of bubbles of carbon dioxide will increase.

C The number of bubbles of oxygen will decrease.

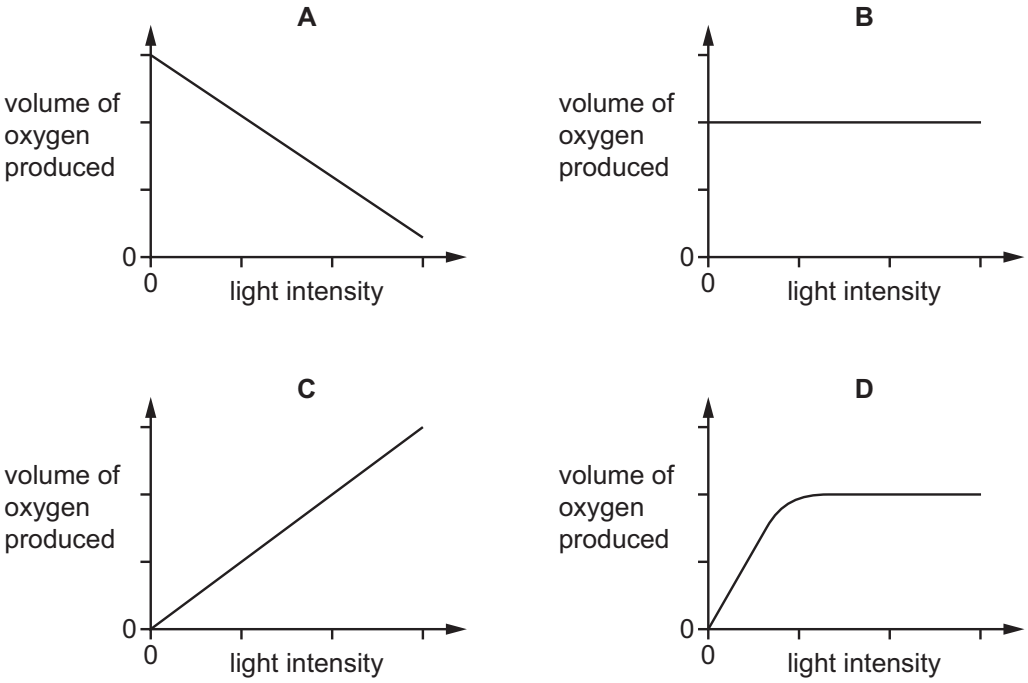
D The number of bubbles of oxygen will increase.

（2023 May/Jun · 0654/21 · Question 5 · Extended）

5. The volume of oxygen produced by a submerged aquatic plant is investigated at different light intensities as shown.



Which graph shows how the volume of oxygen produced varies with light intensity?



（2022 Oct/Nov · 0654/22 · Question 5 · Extended）

题型 7：把叶片结构与气体交换功能对应（考频★★☆☆☆）

知识点 气孔是由一对_____围成的孔隙，这对细胞改变形状，使气孔开闭，控制二氧化碳、氧气和水蒸气的进出。

海绵叶肉细胞排列疏松，细胞间有_____，使气体能在叶片内部扩散。

白天，水由湿润的叶肉细胞表面蒸发；栅栏叶肉细胞含较多叶绿体，光合作用较强，吸收较多二氧化碳。

浮水叶只有上表皮接触空气时，气孔位于_____，使叶片能与空气进行气体交换。

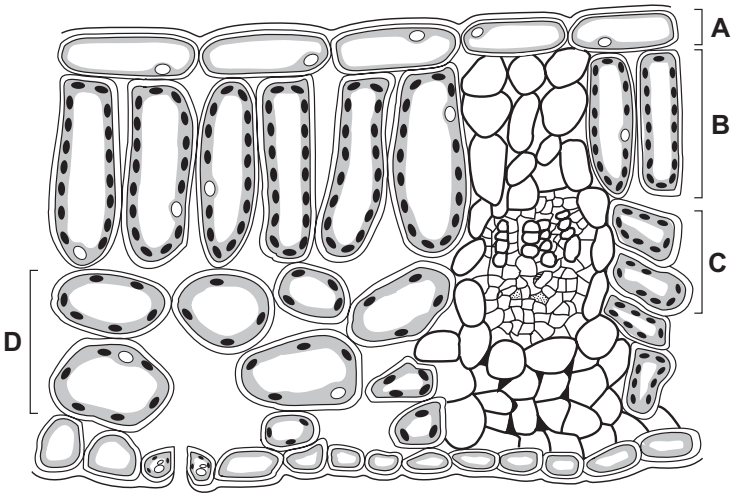
答案：保卫细胞；较大气隙；上表皮

怎么认 题目出现叶片横切图并问气体交换的组织、通道或控制细胞时，先找气隙、气孔和保卫细胞。

例题 1

The diagram shows a cross-section through a leaf.

Which tissue is adapted for gas exchange?



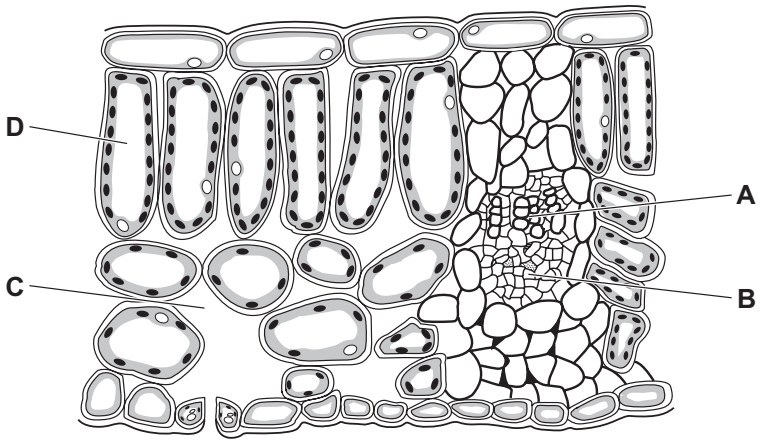
（2023 Oct/Nov · 0654/21 · Question 5 · Extended）

解：D 处为海绵叶肉组织，其细胞排列疏松，细胞间有较大气隙，为气体在叶片内部扩散提供通道。故选 D。

针对练习

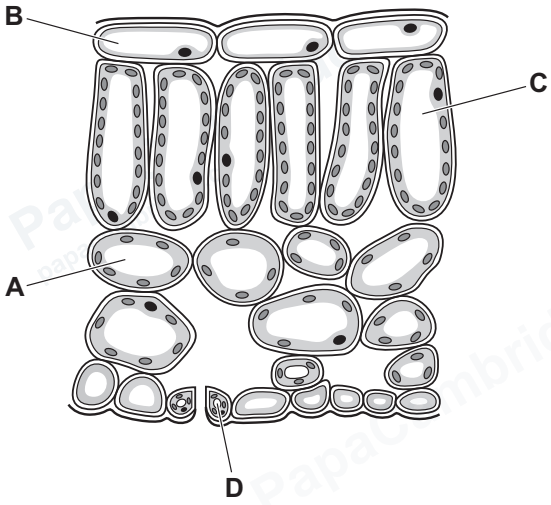
1. The diagram shows a section through a leaf.

Which labelled part enables oxygen to escape from the leaf?



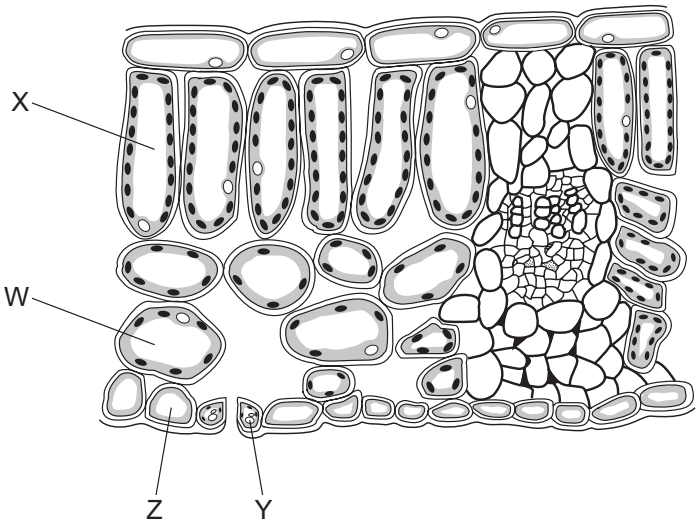
（2025 Oct/Nov · 0654/21 · Question 6 · Extended）

2. Which cell in a plant leaf controls gas exchange?



（2026 May/Jun · 0654/21 · Question 3 · Extended）

3. The diagram shows the cross-section of part of a leaf with cells labelled W, X, Y and Z.



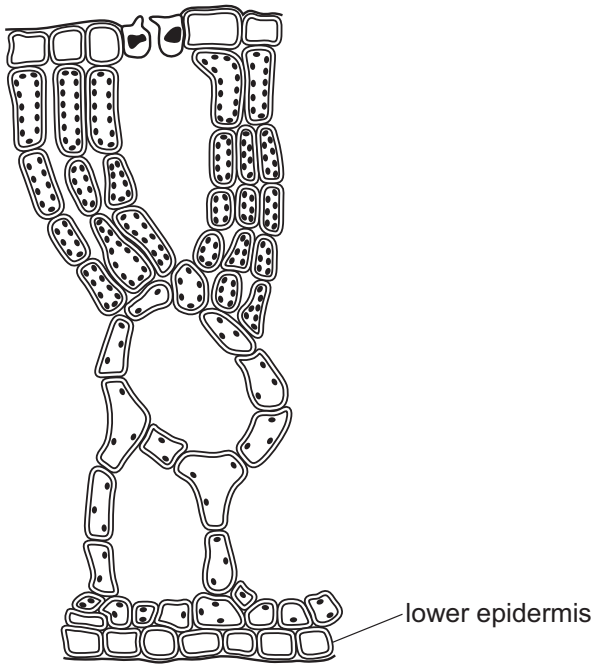
Which cells lose most water and which cells absorb most carbon dioxide during the daytime?

A W and X **B** X and Y **C** Y and Z **D** W and Z

（2024 May/Jun · 0654/12 · Question 5 · Core；同题：2024 May/Jun · 0654/13 · Question 5 · Core）

4. The diagram shows a cross-section of a leaf of a plant.

The leaf is adapted to float on water with the upper epidermis exposed to the air.



Which statement explains one adaptation visible in the diagram?

A Guard cells in the lower epidermis are always closed to stop water escaping the leaf.

B The palisade mesophyll cells are next to the lower epidermis to maximise photosynthesis.

C The stomata are in the upper epidermis so that gas exchange with the air can take place.

D There is no cuticle in the upper epidermis to prevent water entering the leaf.

（2024 May/Jun · 0654/21 · Question 5 · Extended）

题型 8：根据遮光或斑叶判断淀粉检测结果（考频★★☆☆☆）

知识点 光合作用制造的葡萄糖可转化为淀粉并储存在叶片中；淀粉遇碘液呈_____，无淀粉时碘液保持黄色或黄褐色。

去淀粉后的叶片重新形成淀粉，需要光照、叶绿素、二氧化碳和水；遮光部分缺少_____，斑叶白色部分缺少_____。

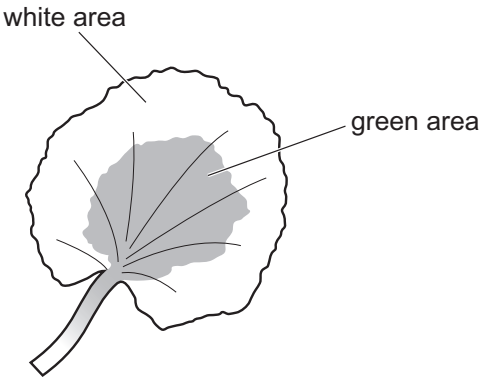
实验期间，未遮光的绿色区域能形成淀粉；遮光区域或白色区域不能形成淀粉。

答案：蓝黑色；光照；叶绿素

怎么认 题目出现黑纸遮光、斑叶或碘液测淀粉时，先逐区判断是否同时有光和叶绿素。

例题 1

The diagram shows a variegated leaf.



Which requirement for photosynthesis can be tested using this leaf but **not** using a completely green leaf?

A carbon dioxide

B chlorophyll

C light

D water

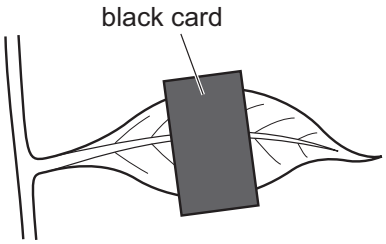
（2025 Feb/Mar · 0654/12 · Question 7 · Core）

解：斑叶绿色区域含叶绿素，白色区域不含叶绿素；两区域位于同一片叶，光照、二氧化碳和水等条件相同。比较两区域的淀粉检测结果，可以检验叶绿素是否为光合作用所必需。故选 B。

针对练习

1. The starch in a plant is removed.

One part of a leaf of the plant is covered with black card.



The plant is then put in the light for six hours.

The card is removed and the leaf is tested for starch using iodine solution.

Which row shows the colours of the iodine solution after it is added to different parts of the leaf?

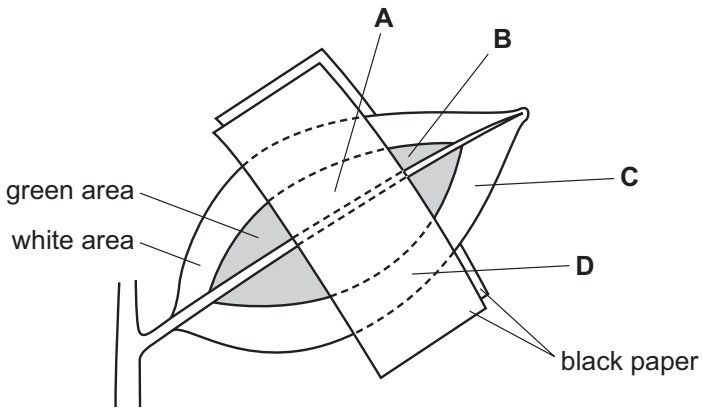
	part of leaf	
	not covered by card	covered by card
A	blue-black	blue-black
B	blue-black	yellow
C	yellow	blue-black
D	yellow	yellow

（2025 May/Jun · 0654/11 · Question 6 · Core）

2. The diagram shows a leaf, still attached to a plant, with both green and white areas that have been partly covered with black paper.

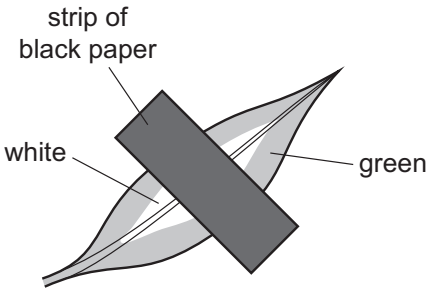
The leaf is left in bright light for six hours and then tested for starch.

Which area of the leaf turns blue-black after the starch test?

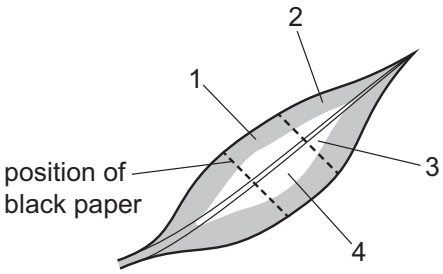


（2023 May/Jun · 0654/12 · Question 5 · Core；同题：2023 May/Jun · 0654/13 · Question 5 · Core）

3. A plant with variegated leaves is destarched. A strip of black paper is attached to both sides of a leaf and the plant is placed in the light for 24 hours.



The leaf is then tested for starch.



key

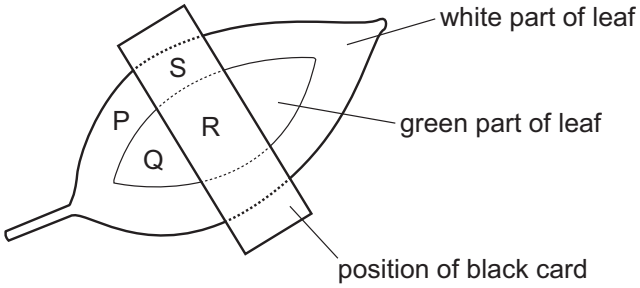
1 green under paper
2 green in the light
3 white in the light
4 white under paper

Which areas of the leaf stain blue-black with iodine?

A 1 and 4 **B** 1 only **C** 2 and 3 **D** 2 only

（2022 Oct/Nov · 0654/12 · Question 5 · Core）

4. A plant has leaves which have white parts and green parts. One of the leaves is partly covered by a piece of black card on both sides. The plant is left in the light for two days.



The leaf is then removed and tested for the presence of starch.

Which row is correct?

	P	Q	R	S
A	✓	✗	✗	✓
B	✗	✓	✓	✗
C	✗	✓	✗	✗
D	✓	✗	✓	✓

key
✓ = starch present
✗ = starch absent

（2022 Feb/Mar · 0654/22 · Question 5 · Extended）

题型 9：判断植物营养所需材料（考频★☆☆☆☆）

知识点 绿色植物的营养需要光和水，还需要从环境中摄取_____和_____。

在有光和叶绿素的条件下，植物利用二氧化碳和水制造有机物；无机离子由根从土壤中吸收。

有机物是光合作用的产物，不是绿色植物必须摄取的营养原料。

答案：二氧化碳；无机离子

怎么认 题目出现植物营养所需材料或带勾叉的表格时，先核对光、水、二氧化碳和无机离子。

例题 1

Plant nutrition needs light and water.

Which row shows what else needs to be taken in?

	carbon dioxide	ions	organic compounds
A	✓	✓	✓
B	✗	✗	✓
C	✓	✓	✗
D	✓	✗	✗

（2022 Feb/Mar · 0654/22 · Question 1 · Extended）

解：植物除需要光和水外，还需摄取二氧化碳和无机离子。

有机物可由光合作用制造，不需作为营养原料从环境中摄取。

表中对应的组合为 C。故选 C。

针对练习

1. What do plants need for their nutrition?

A carbon dioxide, ions, organic compounds and light

B carbon dioxide, ions, organic compounds and water

C carbon dioxide, ions, light and water

D carbon dioxide, organic compounds, light and water

（2022 Oct/Nov · 0654/21 · Question 1 · Extended；同题：2022 Oct/Nov · 0654/22 · Question 1 · Extended、2022 Oct/Nov · 0654/23 · Question 1 · Extended）

题型 10：用光合作用方程比例求分子数（考频★☆☆☆☆）

知识点 在光和叶绿素存在的条件下，光合作用把二氧化碳和水转化为葡萄糖和氧气。

配平后，每生成 1 个葡萄糖分子，需要 6 个二氧化碳分子，二者的分子数之比为 _____。

若生成 n 个葡萄糖分子，需要 _____ 个二氧化碳分子；分子数是计数值，没有单位。

答案：$6:1$；$6n$

怎么认 题目出现葡萄糖分子数并求所需二氧化碳分子数时，先按 $6:1$ 写出分子数关系。

例题 1 How many molecules of carbon dioxide are needed to produce six molecules of glucose?

A 1　　**B** 2　　**C** 3　　**D** 36

（2024 May/Jun · 0654/22 · Question 5 · Extended）

解：由每生成 1 个葡萄糖分子需要 6 个二氧化碳分子，得

$6 \times 6 = 36$

故选 D。

题型 11：追踪光合糖转为贮藏和生长材料（考频★☆☆☆☆）

知识点 光合作用形成的葡萄糖可转化为贮藏物质和生长材料；多个葡萄糖分子结合形成_____，其不溶于水，适合储存在细胞中。

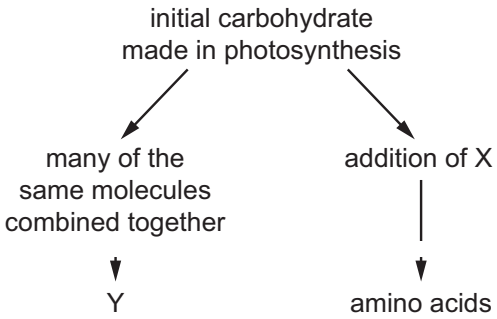
氨基酸含氮；在根吸收的_____供应下，植物可利用葡萄糖形成的含碳物质合成氨基酸。镁离子用于形成叶绿素，不能提供氨基酸中的氮。

答案：淀粉；硝酸根离子

怎么认 题目出现光合糖的用途流程图时，先按产物判断所需原料或形成的物质。

例题 1

The diagram shows some of the uses in a plant of the initial carbohydrate made by photosynthesis.



Which statement is correct?

A X is a magnesium ion.

B X is iron.

C Y is starch.

D Y is an oil molecule.

（2023 May/Jun · 0654/23 · Question 5 · Extended）

解：光合作用形成的初始糖是葡萄糖，许多葡萄糖分子结合形成淀粉，因此 Y 是淀粉。
氨基酸含氮，X 应为硝酸根离子，不是镁离子或铁。
故选 C。

题型 12：确定光照实验需固定的变量（考频★☆☆☆☆）

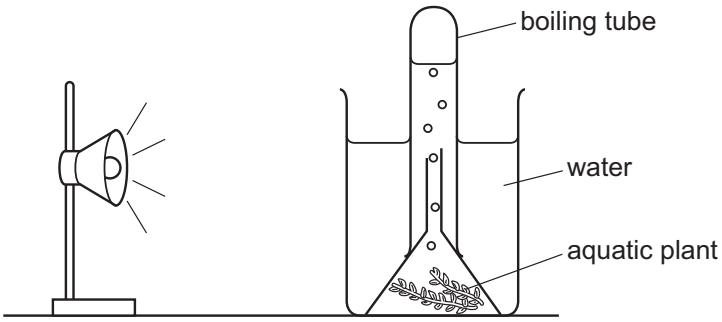
知识点 探究光照强度对光合作用速率的影响时，光照强度是_____，实验中只改变这一条件。
每分钟产生的氧气气泡数可表示光合作用速率，单位为个/分钟，是实验测量的_____。
比较不同光照强度时，植物大小和水温应作为_____保持不变，水温常用 °C 表示。

答案：自变量；因变量；控制变量

怎么认 题目出现不同光照强度和每分钟气泡数时，先把光照判为自变量，再固定植物大小与水温。

例题 1

The rate of photosynthesis of an aquatic plant is measured by counting the number of bubbles of oxygen produced every minute, as shown. The rate is measured at different light intensities.



Which two variables need to be kept constant?

A size of plant and temperature of the water

B light intensity and size of the boiling tube

C size of plant and size of the boiling tube

D temperature of the water and light intensity

（2024 May/Jun · 0654/11 · Question 5 · Core）

解：实验研究光照强度对光合作用速率的影响，故光照强度是改变的变量。
植物大小和水温都会影响光合作用速率，比较时应保持不变。
故选 A。

题型 13：移除气体并比较多组光合实验（考频★☆☆☆☆）

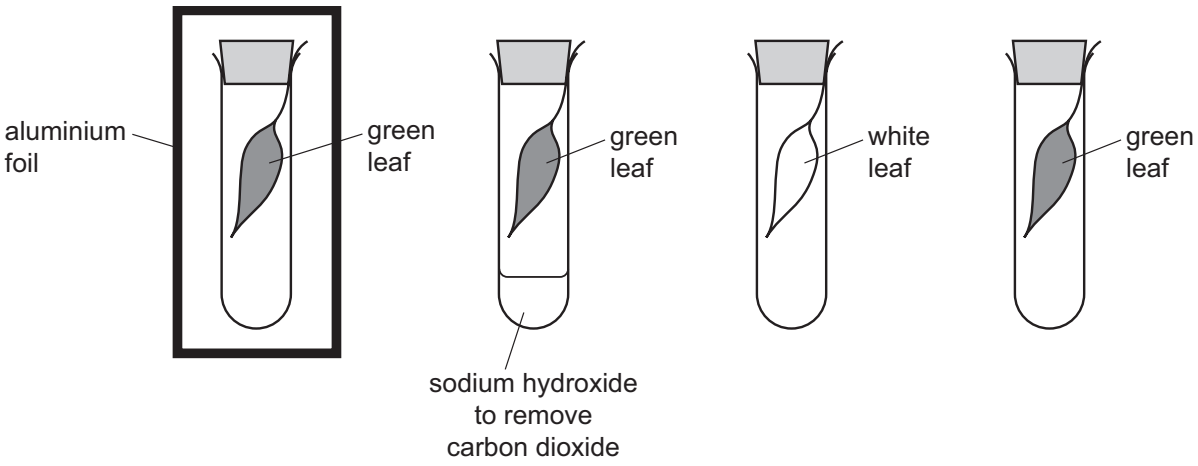
知识点 经暗处理的叶片中原有淀粉已被消耗；在其他条件相同时，含叶绿素的叶片有_____和_____，才能通过光合作用形成淀粉。
二氧化碳是光合作用的原料，氧气是产物；除去氧气不妨碍淀粉形成。
碘液用于检验淀粉，出现_____说明叶片中有淀粉。

答案：光；二氧化碳；蓝黑色

怎么认 题目出现叶片遮光、除气体或白色叶片并问碘液颜色时，先逐组核对光、二氧化碳和叶绿素。

例题 1

The diagram shows an investigation into factors affecting photosynthesis.



The tubes are left for 24 hours after which the leaves are tested with iodine solution.

How many of these leaves turn blue-black when tested with iodine solution?

A 1 **B** 2 **C** 3 **D** 4

（2022 May/Jun · 0654/12 · Question 5 · Core；同题：2022 May/Jun · 0654/13 · Question 5 · Core）

解：铝箔遮光的绿色叶片缺少光，含氢氧化钠的试管缺少二氧化碳，白色叶片缺少叶绿素，均不能形成淀粉。
未作处理的绿色叶片有光、二氧化碳和叶绿素，能形成淀粉，故共有 1 片叶变蓝黑色。
故选 A。

针对练习

1. A student places a plant in the dark for 24 hours.

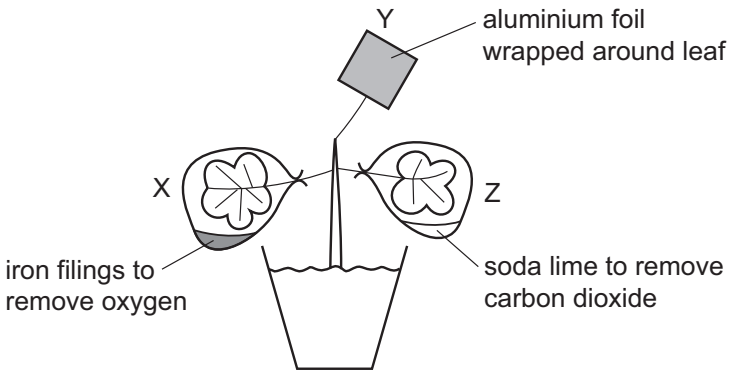
Aluminium foil is then placed around one leaf.

A second leaf is sealed in a bag with soda lime to remove carbon dioxide.

A third leaf is then sealed in a bag with iron filings to remove oxygen.

The plant is then left in the light for a further 24 hours.

The diagram shows the experiment.



Which leaves would turn blue-black when tested with iodine solution?

A X only **B** X and Y **C** Y and Z **D** Z only

（2022 May/Jun · 0654/11 · Question 5 · Core）

6.2 光合作用、叶片与限制因素：结构题

题型 1：沿引线辨认叶片横切结构（考频★★★☆☆）

知识点 叶片横切面是垂直于叶片表面切开后看到的组织排列，典型叶片由上至下依次为角质层、上表皮、栅栏叶肉、海绵叶肉和下表皮。

上表皮外侧的透明薄层是_____；细胞细长、排列紧密且位于上表皮下方的组织是_____。

下表皮上的气孔由一对_____围成；形状不规则、排列疏松且细胞间隙较大的细胞属于海绵叶肉。

答案：角质层；栅栏叶肉；保卫细胞

怎么认 题目出现叶片横切图及字母引线时，先看引线终点所在的细胞层或开口，再按位置和细胞形态辨认。

例题 1

(a) Fig. 7.1 is a drawing of a cross-section of a leaf.

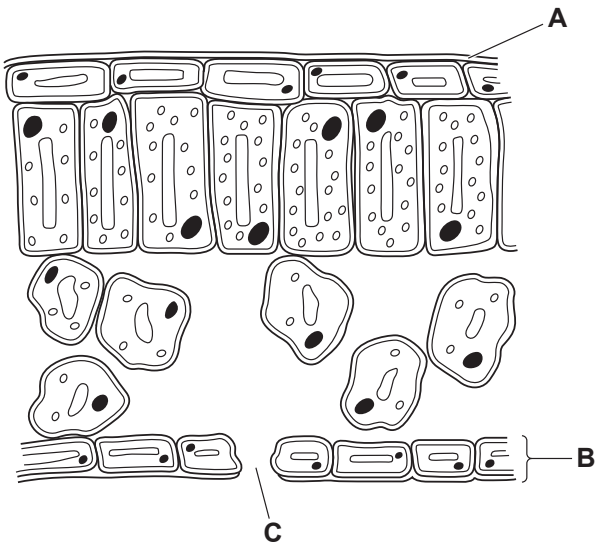


Fig. 7.1

State the names of the parts labelled **A**, **B** and **C** in Fig. 7.1.

A

B

C

（2023 May/Jun 0654/31 第7题(a)）

解：A 的引线终点在上表皮外侧的薄层，故 A 为角质层。
B 的括号标出叶片下方的一层细胞，故 B 为下表皮。
C 的引线终点在下表皮细胞之间的开口，故 C 为气孔。
答：A 为角质层，B 为下表皮，C 为气孔。

针对练习

1. **(a)** Fig. 7.1 is a diagram of a cross-section of a leaf.

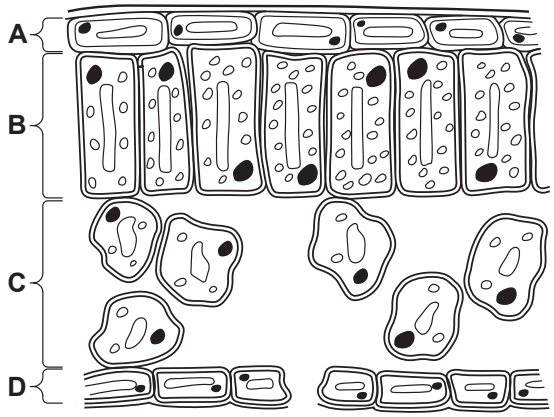


Fig. 7.1

(i) State the names of the parts labelled **A** and **B** in Fig. 7.1.

A

B

（2023 Oct/Nov 0654/43 第7题(a)(i)）

2. **(a)** Fig. 4.1 shows a cross-section of a leaf.

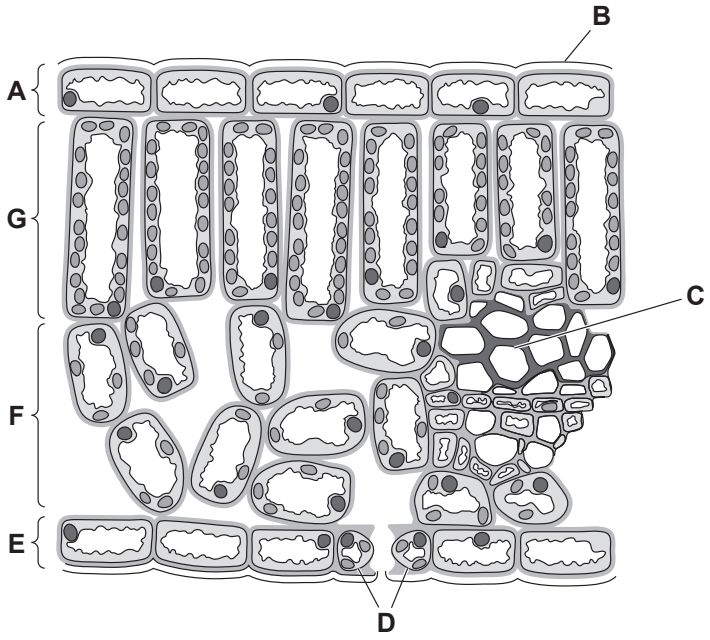


Fig. 4.1

(ii) State the names of the parts labelled **A** and **B** in Fig. 4.1.

A

B

（2024 May/Jun 0654/43 第4题(a)(ii)）

3. **(a)** Fig. 10.1 is a diagram of a cross-section through a leaf.

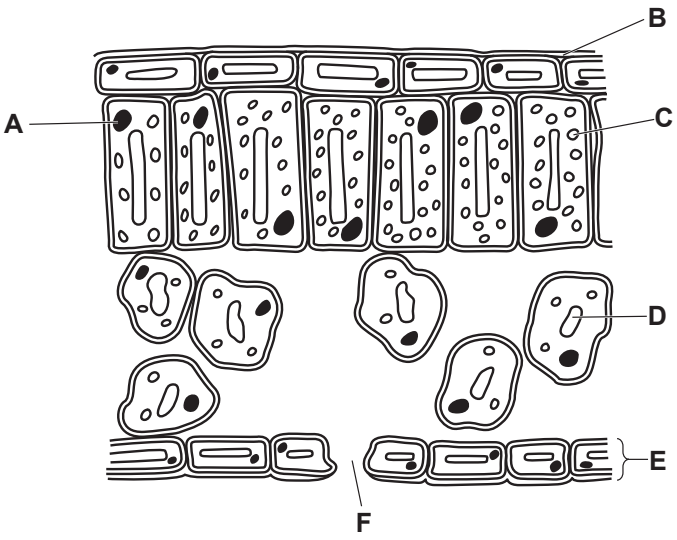


Fig. 10.1

(ii) State the name of the part labelled **E** in Fig. 10.1.

（2022 May/Jun 0654/32 第10题(a)(ii)；同题：2022 May/Jun 0654/33 第10题(a)(ii)）

4. **(b)** Fig. 7.1 is a photomicrograph of a cross-section through a leaf.

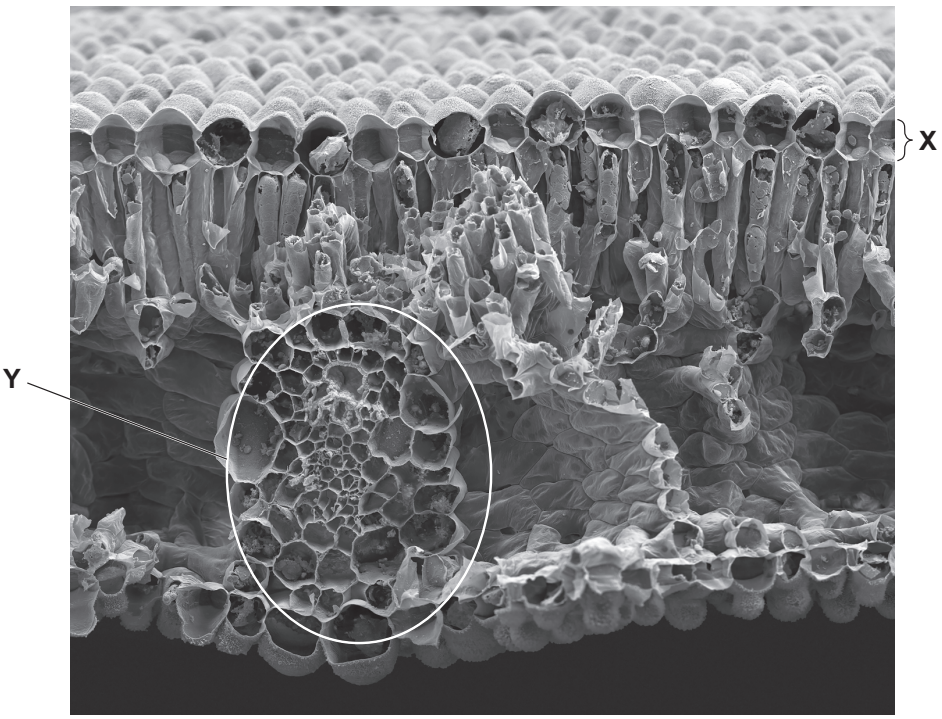


Fig. 7.1

(i) State the name of the part labelled **X** in Fig. 7.1.

（2024 May/Jun 0654/32 第7题(b)(i)；同题：2024 May/Jun 0654/33 第7题(b)(i)）

5. **(a)** Fig. 10.1 is a diagram of a cross-section through a leaf.

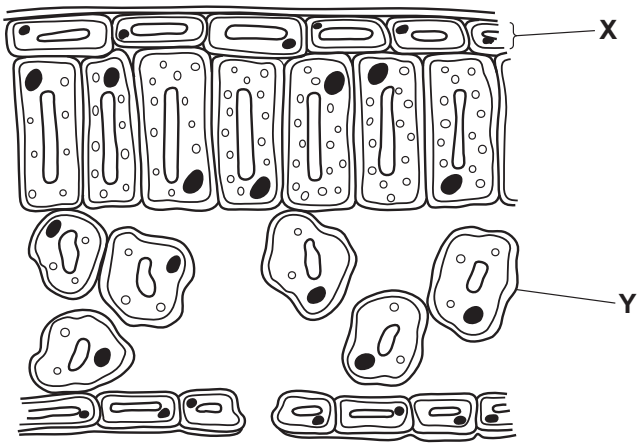


Fig. 10.1

(i) State the name of the **part** labelled **X** and the **cell** labelled **Y** in Fig. 10.1.

part X

cell Y

（2023 Oct/Nov 0654/33 第10题(a)(i)）

6. Figure 1.1 shows some of the cells in part of a leaf.

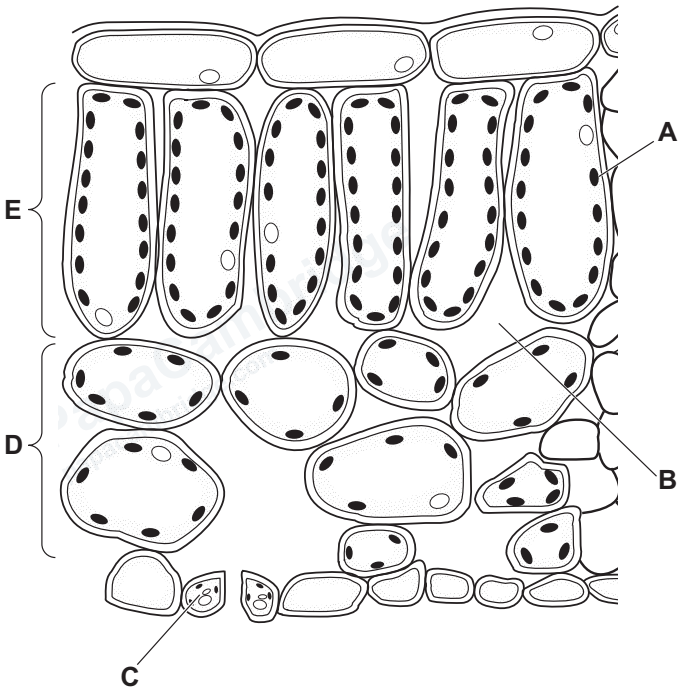


Figure 1.1

(a) Name the cell labelled **C** in Figure 1.1.

（2026 May/Jun 0654/42 第1题(a)）

题型 2：确定光合作用的能量转移（考频★★☆☆☆）

知识点 光合作用中，叶绿素吸收_____能，并将其转化为储存在葡萄糖等有机物中的_____能。这一能量转移发生在含叶绿素的细胞受到光照时，能量的单位是焦耳，符号为 J。

答案：光；化学

怎么认 题目出现叶绿素和光合作用中的能量转移时，先写光能转化为化学能。

例题 1

(c) Complete the sentence to describe the transfer of energy during photosynthesis.

During photosynthesis chlorophyll transfers energy into energy.

（2024 Oct/Nov 0654/42 第4题(c)）

解：叶绿素吸收光能，光合作用合成的有机物储存化学能，故光能转化为化学能。
答：光能；化学能。

针对练习

1. **(b)** Complete the energy transfer that takes place using chlorophyll.

energy → energy

（2023 May/Jun 0654/41 第4题(b)）

2. **(d)** Chlorophyll is also necessary for photosynthesis.

State the energy transfer that chlorophyll is responsible for.

energy → energy

（2022 May/Jun 0654/43 第4题(d)）

题型 3：说明栅栏叶肉细胞对光合作用的适应（考频★★☆☆☆）

知识点 栅栏叶肉位于叶片上表皮下方，是叶片进行光合作用的主要组织。
栅栏叶肉细胞通常呈_____，排列紧密，单位叶面积内可容纳较多细胞。
细胞内有许多_____，其中的叶绿素吸收光能；靠近上表皮还能获得较强光照。

答案：长柱状；叶绿体

怎么认 题目出现栅栏叶肉或上表皮下方的长柱状细胞，并问光合作用适应时，先写叶绿体多，再写细胞长且排列紧密。

例题 1

(d) Describe two ways the cells in the palisade mesophyll layer are adapted for photosynthesis.

（2023 May/Jun 0654/42 第4题(d)）

解：栅栏叶肉细胞内有许多叶绿体，其中的叶绿素可吸收较多光能；细胞呈长柱状并排列紧密，单位叶面积内有较多含叶绿体的细胞，可吸收更多光能。
答：叶绿体多；细胞呈长柱状并排列紧密。

针对练习

1. **(a)** Fig. 4.1 shows a cross-section of a leaf.

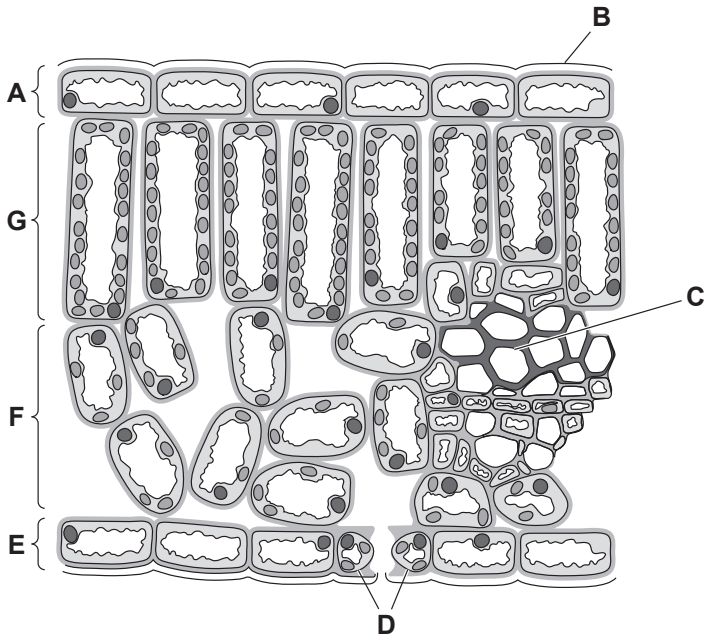


Fig. 4.1

(iii) Describe **two** ways in which the part labelled **G** in Fig. 4.1 is adapted for photosynthesis.

（2024 May/Jun 0654/43 第4题(a)(iii)）

2. Fig. 4.1 summarises one pathway of water through a plant.

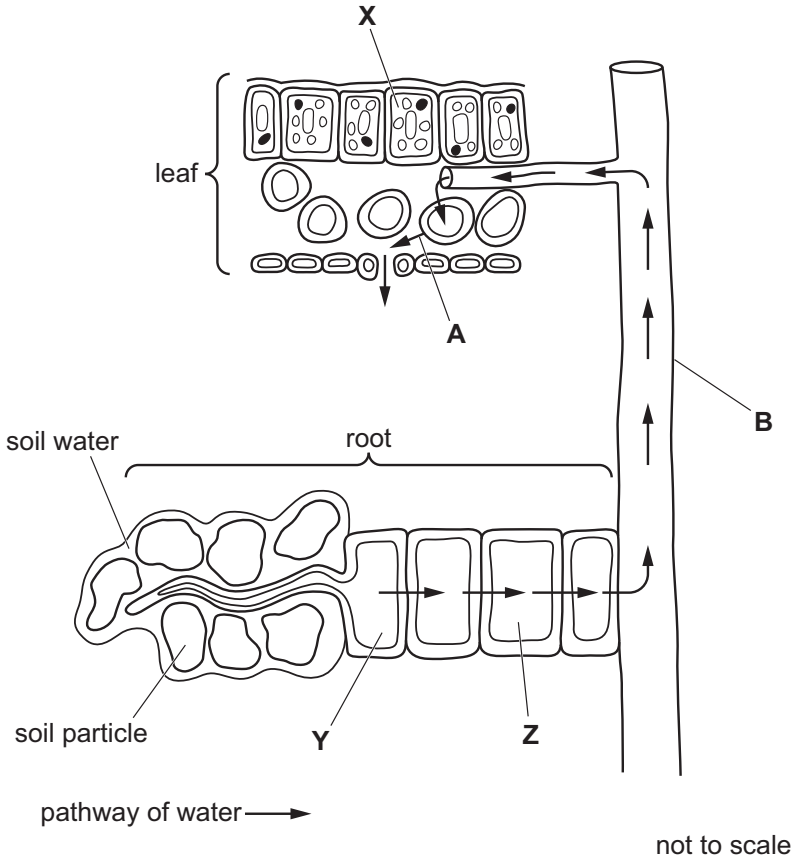


Fig. 4.1

(b) Describe **two** ways that cell **X** in Fig. 4.1 is adapted for photosynthesis.

（2024 Oct/Nov 0654/43 第4题(b)）

第 7 章 营养、消化与吸收

7.1 营养、消化与吸收

题型 1：从缺乏症反推营养成分及食物来源（考频★★★★☆）

知识点 维生素 C 参与结缔组织的正常形成，长期缺乏可导致_____；橙、柠檬等柑橘类水果富含维生素 C。
维生素 D 促进钙的吸收和骨骼矿化，儿童长期缺乏可导致_____，骨骼变软。
蛋白质用于生长和组织修复，严重缺乏可导致_____，表现为生长迟缓、水肿、腹部膨大和肌肉量减少。

答案：坏血病；佝偻病；夸希奥科病

怎么认 题目出现坏血病、佝偻病、水肿腹胀或柑橘类食物时，先对应维生素 C、维生素 D 或蛋白质。

例题 1

The condition kwashiorkor is characterised by a poor growth rate, swelling of the hands and feet, and a bulging stomach.

Which component of a balanced diet is lacking in someone with kwashiorkor?

A fibre

B protein

C iron

D vitamin D

（2022 Oct/Nov · 0654/23 · Question 6 · Extended）

解：生长迟缓、手足肿胀和腹部膨大符合夸希奥科病的表现。
夸希奥科病由膳食中蛋白质缺乏引起，故选 B。

针对练习

1. Citrus fruits such as oranges and lemons are a principal dietary source of which nutrient?

A carbohydrate

B protein

C vitamin C

D vitamin D

（2026 May/Jun · 0654/12 · Question 6 · Core）

2. A 5-year-old child has rickets.

Which nutrient is deficient in the child's diet?

A carbohydrate

B protein

C vitamin C

D vitamin D

（2025 Feb/Mar · 0654/12 · Question 8 · Core）

3. A deficiency of which nutrient causes a person to suffer from scurvy?

A calcium

B iron

C vitamin C

D vitamin D

（2026 May/Jun · 0654/11 · Question 3 · Core）

4. Which dietary deficiency causes rickets?

A iron

B protein

C vitamin C

D vitamin D

（2026 Feb/Mar · 0654/12 · Question 4 · Core）

5. Which food helps prevent scurvy?

A bread

B cheese

C eggs

D lemons

（2025 May/Jun · 0654/12 · Question 6 · Core；同题：2025 May/Jun · 0654/13 · Question 6 · Core）

6. What is a good source of vitamin C?

A citrus fruits

B liver

C meat

D milk

（2023 Oct/Nov · 0654/13 · Question 6 · Core）

7. A person is unwell with the following symptoms.

- swollen abdomen (belly)
- red patches on their skin
- loss of muscle mass

What is the likely condition that this person has?

A iron deficiency

B kwashiorkor

C marasmus

D scurvy

（2023 May/Jun · 0654/23 · Question 6 · Extended）

8. Which statements are correct?

1 A lack of vitamin C causes scurvy.

2 A lack of vitamin D causes softening of bones.

3 A lack of calcium causes kwashiorkor.

4 A lack of iron causes marasmus.

A 1 and 2 **B** 1 and 4 **C** 2 and 3 **D** 3 and 4

（2024 Feb/Mar · 0654/22 · Question 6 · Extended）

9. There was an increase of 27% in the number of hospital admissions related to scurvy between 2009 and 2014.

Which row explains this change?

	diet contains	number of people
A	too little vitamin C	decrease
B	too little vitamin D	decrease
C	too little vitamin C	increase
D	too little vitamin D	increase

（2025 Oct/Nov · 0654/12 · Question 5 · Core；同题：2025 Oct/Nov · 0654/13 · Question 5 · Core）

10. A person has a low red blood cell count and is constipated.

Which row shows the components that may be in short supply in this person's diet?

	low red blood cell count	constipated
A	calcium	water
B	calcium	fats
C	iron	fibre
D	iron	protein

（2023 May/Jun · 0654/11 · Question 6 · Core）

题型 2：定位消化器官并核对食物路线（考频★★★☆☆）

知识点 消化道（alimentary canal）是食物通过的连续通道，食物依次经过口、_____、胃、小肠、大肠、直肠和肛门。

小肠之后连接_____；未消化食物不进入血液、肝或胰腺。

排遗（egestion）是未消化食物从_____排出体外的过程；肝和胰腺不是食物经过的通道。

判断食物路线时，应选消化道内连续相接的结构；器官定位不涉及物理量及单位。

答案：食道；大肠；肛门

怎么认 题目出现消化系统标号图、器官名称或食物路线时，先沿连续消化道核对各标号及先后次序。

一. 由位置辨认器官和通道

例题 1

Which location does undigested food move to after passing through the small intestine?

A blood

B large intestine

C pancreas

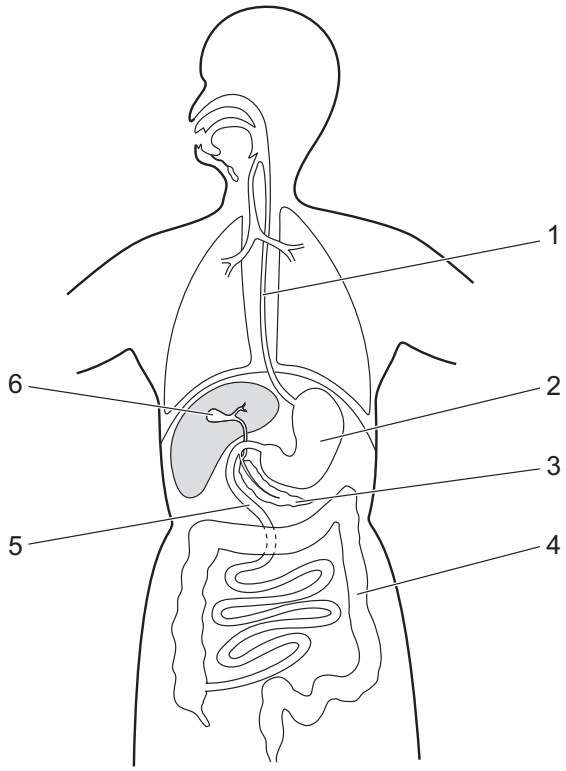
D stomach

（2025 Oct/Nov · 0654/11 · Question 7 · Core）

解：未消化食物仍沿消化道移动，小肠之后连接大肠。
所以未消化食物通过小肠后进入大肠。故选 B。

针对练习

1. The diagram shows the human alimentary canal and other organs.

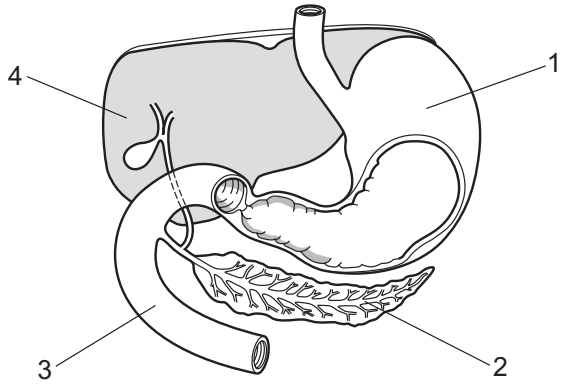


Which row shows the route of food through the alimentary canal?

	first →			last
A	1	2	3	4
B	1	2	5	4
C	2	4	3	5
D	2	4	5	6

（2025 May/Jun · 0654/11 · Question 7 · Core）

2. The diagram shows part of the human alimentary canal and associated organs.



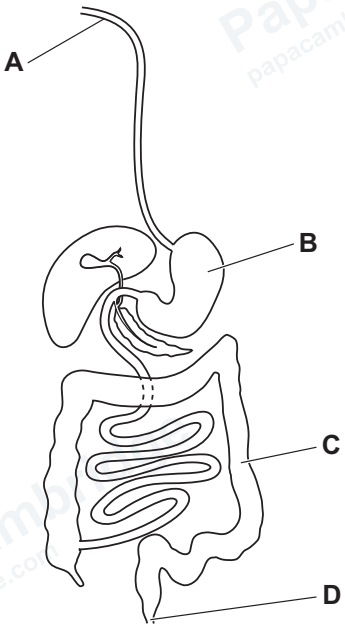
Which labels identify the liver, pancreas and stomach?

	liver	pancreas	stomach
A	2	1	3
B	2	3	1
C	4	2	3
D	4	2	1

（2024 May/Jun · 0654/12 · Question 4 · Core；同题：2024 May/Jun · 0654/13 · Question 4 · Core）

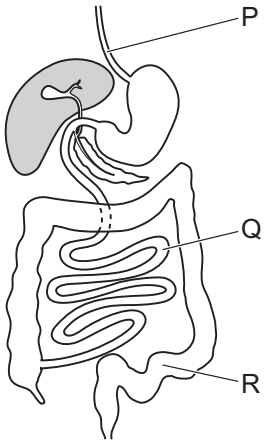
3. The diagram shows the human digestive system.

Which letter shows where egestion occurs?



（2026 May/Jun · 0654/13 · Question 3 · Core）

4. The diagram shows part of the human alimentary canal.



Which row identifies P, Q and R?

	P	Q	R
A	oesophagus	large intestine	stomach
B	stomach	small intestine	large intestine
C	stomach	large intestine	small intestine
D	oesophagus	small intestine	large intestine

（2022 Oct/Nov · 0654/12 · Question 6 · Core）

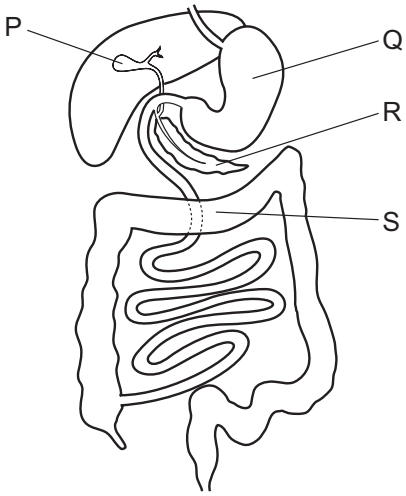
二. 由器官核对各段的消化与吸收功能

知识点 消化是把_____的食物分子分解成_____分子的过程，化学消化由消化酶催化。
在图示范围内，胃和胰腺产生消化酶；胃内与小肠内发生化学消化，胰腺产生的酶进入小肠后发挥作用。
肝脏产生胆汁，胆囊_____胆汁，大肠吸收水。
酶在适宜的温度和酸碱度条件下发挥作用，这些器官功能没有计量单位。

答案：大而不溶；小而可溶；储存

怎么认 题目出现消化系统标注图并询问酶的产生或作用部位时，先辨认胃、胰腺和小肠。

例题 2 The diagram shows part of the human digestive system.



Which organs produce digestive enzymes?

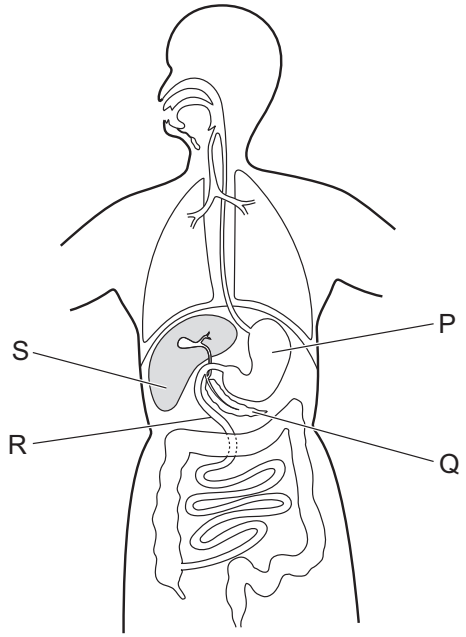
A P and Q **B** Q and R **C** R and S **D** S and P

（2025 Oct/Nov · 0654/22 · Question 6 · Extended）

解：图中 P 为胆囊，Q 为胃，R 为胰腺，S 为大肠。
胃和胰腺产生消化酶，故对应 Q 和 R。
故选 B。

针对练习

5. The diagram shows the human alimentary canal.

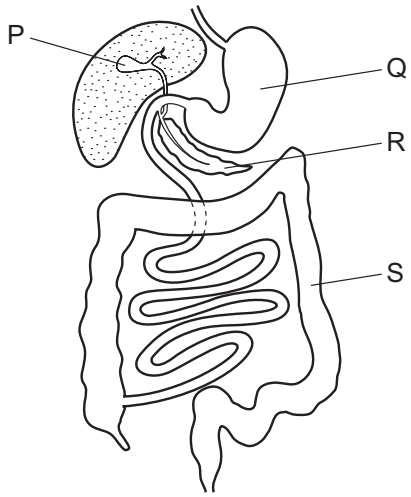


In which labelled organs are large insoluble molecules broken down into small soluble molecules?

A P and R **B** R and S **C** S and Q **D** Q and P

（2023 Feb/Mar · 0654/22 · Question 6 · Extended）

6. The diagram shows part of the digestive system.



Which labelled parts produce digestive enzymes, absorb water and store bile?

	produce digestive enzymes	absorb water	store bile
A	P	Q	R
B	Q	R	P
C	R	S	P
D	S	P	R

（2022 May/Jun · 0654/11 · Question 6 · Core；同题：2022 May/Jun · 0654/12 · Question 6 · Core；同题：2022 May/Jun · 0654/21 · Question 6 · Extended；同题：2022 May/Jun · 0654/13 · Question 6 · Core；同题：2022 May/Jun · 0654/22 · Question 6 · Extended；同题：2022 May/Jun · 0654/23 · Question 6 · Extended）

7. Some processes that occur in the alimentary canal and associated organs are listed.

1 absorption

2 assimilation

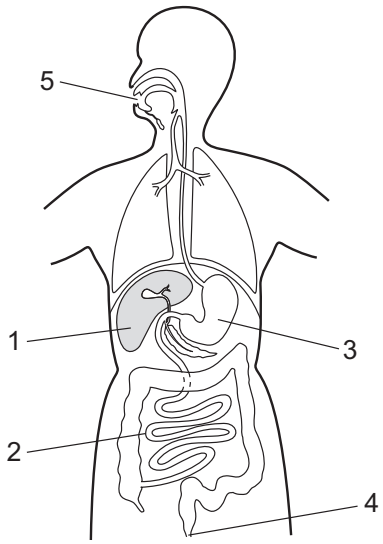
3 digestion

4 egestion

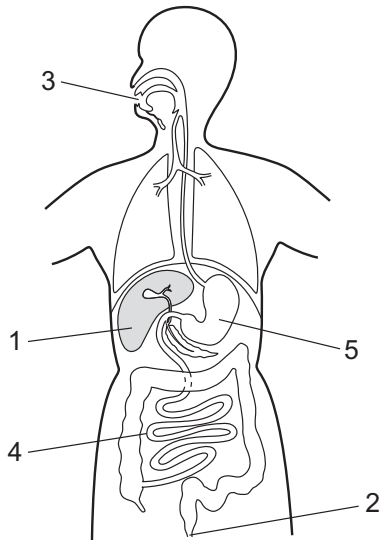
5 ingestion

Which diagram correctly links each process to the part of the alimentary canal or associated organs?

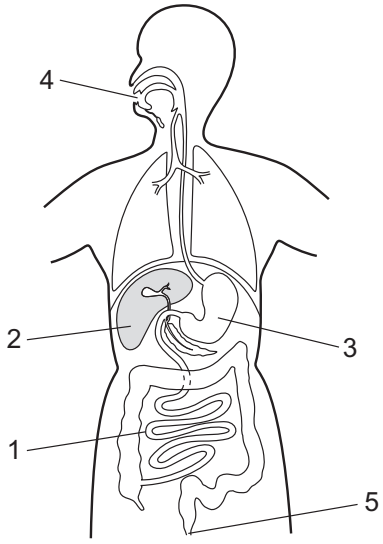
A



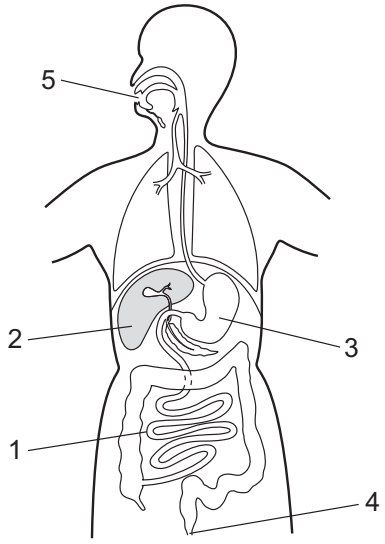
B



C



D



（2023 May/Jun · 0654/21 · Question 6 · Extended）

题型 3：按营养功能选择食物或饮食成分（考频★★★☆☆）

知识点 平衡膳食含有种类齐全、含量适当的营养成分，以满足人体的需要。

碳水化合物是主要的_____，面包、意大利面和米饭是常见来源；蛋白质用于生长和组织修复。

钙用于形成坚固的_____；铁是血红蛋白的组成成分，肝脏等含铁丰富的食物可为其形成提供铁。

膳食纤维促进食物通过消化道，有助于_____；比较营养含量时须取相同质量，常用单位为 g/100 g 或 mg/100 g。

答案：能量来源；骨骼和牙齿；预防便秘

怎么认 题目出现食物、营养成分或营养含量表，并问功能、所需部位或合适食物时，先把功能对应到营养成分。

例题 1

Which food ensures the blood has enough haemoglobin to carry oxygen?

A cheese which contains a large amount of calcium

B orange juice which contains a large amount of vitamin C

C liver which contains a large amount of iron

D salmon which contains a large amount of vitamin D

（2022 Oct/Nov · 0654/13 · Question 6 · Core）

解：血红蛋白含铁，血红蛋白充足才能运输氧。
肝脏含有大量铁，可为血红蛋白的形成提供铁。
故选 C。

针对练习

1. Calcium and iron are components of the diet.

Which parts of the body need these components?

	dietary component	
	calcium	iron
A	blood	bone
B	bone	skin
C	bone	blood
D	skin	bone

（2024 Feb/Mar · 0654/12 · Question 6 · Core）

2. Which component of a balanced diet is needed to prevent constipation?

A carbohydrate

B fat

C protein

D fibre

（2024 Oct/Nov · 0654/23 · Question 6 · Extended）

3. Which component of a balanced diet is a source of energy?

A carbohydrates

B minerals

C vitamins

D water

（2026 May/Jun · 0654/21 · Question 4 · Extended）

4. Which nutrient is needed to make strong bones and teeth?

A calcium

B fat

C starch

D fibre

（2023 May/Jun · 0654/12 · Question 6 · Core；同题：2023 May/Jun · 0654/13 · Question 6 · Core）

5. What is the dietary importance of fibre?

A It builds and repairs tissue.

B It builds strong bones and teeth.

C It helps to prevent constipation.

D It provides a source of iron.

（2024 Oct/Nov · 0654/11 · Question 6 · Core）

6. Which row about food groups is correct?

	food group	main function	food source examples
A	carbohydrate	provide energy	bread, pasta, rice
B	fat	tissue growth and repair	bread, pasta, rice
C	fibre	tissue growth and repair	fish, meat, seeds
D	protein	provide energy	fish, meat, seeds

（2023 Oct/Nov · 0654/11 · Question 6 · Core）

7. Which row provides the greatest amount of the nutrient needed to move food through the alimentary canal?

	nutrient content / 100 g			
	calcium / mg	fibre / g	protein / g	sugar / g
A	36.0	5.1	9.0	24.8
B	35.0	2.8	3.3	20.0
C	46.0	10.9	9.0	0.8
D	8.5	0.0	28.0	0.0

（2023 Oct/Nov · 0654/12 · Question 6 · Core；同题：2023 Oct/Nov · 0654/22 · Question 6 · Extended）

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题型 4：区分机械消化与化学消化改变的对象（考频★★★☆☆）

知识点 机械消化把食物分成较小的食物块，食物分子不发生化学变化。

化学消化在_____的催化下，把大而不溶的分子分解成_____，产物才能被吸收。

油脂经化学消化生成_____。

答案：酶；小而可溶的分子；脂肪酸和甘油

怎么认 题目出现消化前后食物块或分子的大小、溶解性及产物时，先判断改变的是食物块还是分子。

例题 1

Which type of molecules speed up chemical digestion?

A carbohydrates

B enzymes

C hormones

D fatty acids

（2023 May/Jun · 0654/12 · Question 4 · Core；同题：2023 May/Jun · 0654/13 · Question 4 · Core；同题：2023 May/Jun · 0654/22 · Question 4 · Extended）

解：化学消化依靠酶催化，酶能加快大分子分解成小分子的过程。

故选 B。

针对练习

1. What are the products when oils are digested?

A amino acids and glycerol

B fats and amino acids

C fatty acids and glycerol

D fatty acids and sugars

（2024 May/Jun · 0654/12 · Question 3 · Core；同题：2024 May/Jun · 0654/13 · Question 3 · Core）

2. Starch is chemically digested into maltose by the enzyme amylase.

What are the properties of the maltose molecules?

A large and insoluble

B large and soluble

C small and insoluble

D small and soluble

（2025 May/Jun · 0654/22 · Question 7 · Extended）

3. Which row about digestion is correct?

	type of digestion	before digestion	after digestion
A	chemical	large pieces of food	small pieces of food
B	chemical	large insoluble molecules	small soluble molecules
C	physical	large soluble molecules	small insoluble molecules
D	physical	large pieces of food	small soluble molecules

（2025 Oct/Nov · 0654/21 · Question 7 · Extended）

4. Which statements about chemical digestion are correct?

1 It breaks food into smaller pieces.

2 It converts small molecules into larger ones.

3 It produces molecules that can be absorbed.

4 It produces small molecules.

A 1 and 2 **B** 1 and 3 **C** 2 and 4 **D** 3 and 4

（2023 Feb/Mar · 0654/12 · Question 6 · Core）

5. Protein shakes are used by athletes to supplement their diet. They are a drink made by dissolving protein powders in water or milk.

Which types of digestion will be required before they can be absorbed?

	chemical digestion	mechanical digestion
A	✓	✓
B	✓	✗
C	✗	✓
D	✗	✗

（2024 Oct/Nov · 0654/22 · Question 6 · Extended）

6. Which statements about mechanical digestion are correct?

1 Food is broken down into smaller pieces.

2 Food molecules do not undergo chemical changes.

3 Soluble molecules are formed from insoluble ones.

4 Large molecules are broken down to smaller ones.

A 1 and 2 **B** 1 and 4 **C** 2 and 3 **D** 3 and 4

（2023 Oct/Nov · 0654/23 · Question 6 · Extended）

题型 5：辨认牙齿形态及咬切功能（考频★★☆☆☆）

知识点 切齿、犬齿、前臼齿和臼齿可根据齿冠形态、牙列位置和功能辨认。

切齿的齿冠边缘_____，用于咬断食物；犬齿的齿冠_____，用于刺穿和撕裂食物。

前臼齿和臼齿位于犬齿后方，咀嚼面较_____，用于压碎和磨碎食物。

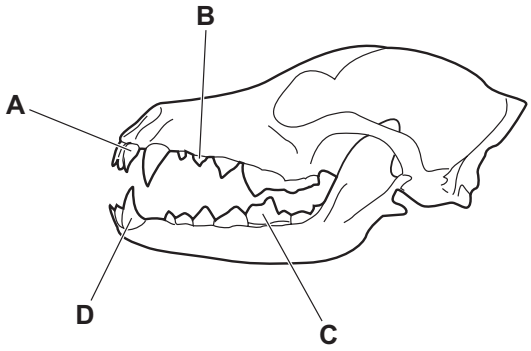
答案：平直如刃；尖长；宽大

怎么认 题目出现牙列图、牙齿外形或咬断食物的功能时，先按齿冠形态和牙列位置辨认牙齿种类。

例题 1

Dogs are mammals and have the same types of teeth as humans.

Which tooth is a canine?



（2022 Oct/Nov · 0654/11 · Question 6 · Core；同题：2022 Oct/Nov · 0654/21 · Question 6 · Extended）

解：犬齿位于切齿后方，齿冠尖长。

图中 D 所示牙齿位于下颌切齿后方，形状尖长，故选 D。

针对练习

1. Humans have different types of teeth.

Which type of tooth is used for biting off food?

A canines

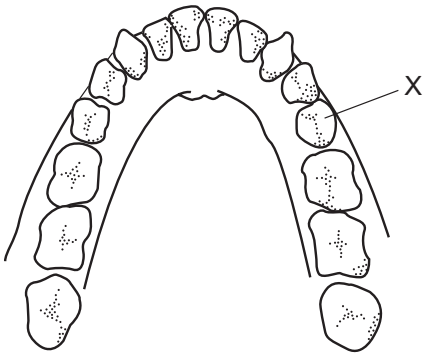
B incisors

C premolars

D molars

（2024 May/Jun · 0654/21 · Question 6 · Extended）

2. The diagram shows human teeth in the lower jaw.



Which type of tooth is X?

A canine

B incisor

C molar

D premolar

（2024 Oct/Nov · 0654/12 · Question 6 · Core；同题：2024 Oct/Nov · 0654/13 · Question 6 · Core）

题型 6：区分胆汁的乳化与中和作用（考频★★☆☆☆）

知识点 胆汁是由_____产生的碱性消化液，进入小肠后能中和来自胃的酸性食糜。
胆汁把大脂肪滴分散成许多小脂肪滴，这一过程称为_____，可增大脂肪酶作用的表面积。
乳化属于物理过程，胆汁不含消化酶，不能对脂肪进行_____消化。

答案：肝脏；乳化；化学

怎么认 题目出现胆汁的功能或能中和胃液的碱性混合物时，先判断所问是乳化作用还是产生器官。

例题 1

What is one of the functions of bile?

A denaturing lipase
B digesting fats
C emulsifying fats
D increasing acidity

（2023 May/Jun · 0654/22 · Question 6 · Extended）

解：胆汁能将大脂肪滴分散成许多小脂肪滴，此过程为乳化。
胆汁不含脂肪酶，不能消化脂肪；胆汁呈碱性，不会增加酸性。
故选 C。

针对练习

1. What is a function of bile?

A assimilation of proteins
B chemical digestion of carbohydrates
C emulsification of fats
D lubrication of ingested food

（2026 May/Jun · 0654/21 · Question 5 · Extended）

2. Which organ produces an alkaline mixture that neutralises gastric juices?

A salivary glands
B large intestine
C liver
D stomach

（2025 May/Jun · 0654/21 · Question 6 · Extended）

题型 7：区分吸收与同化的去向（考频★☆☆☆☆）

知识点 吸收（absorption）是消化后的食物小分子穿过小肠壁进入_____的过程；同化（assimilation）是这些物质进入身体细胞，被利用并成为细胞组成的过程。摄入是食物和饮料经口进入身体，排遗是未消化食物以粪便形式经肛门排出。判断同化，物质应进入_____并在其中被利用；上述过程不涉及计量单位。

答案：血液；身体细胞

怎么认 题目出现已消化食物的去向并询问同化时，先判断是否进入细胞并成为细胞组成。

例题 1

What is assimilation?

A the movement of digested food molecules into the cells of the body where they are used, becoming part of the cells

B the movement of digested food molecules through the wall of the intestine into the blood

C the passing out of food that has not been digested, as faeces, through the anus

D the taking of food and drink into the body through the mouth

（2022 Feb/Mar · 0654/12 · Question 6 · Core；同题：2022 Feb/Mar · 0654/22 · Question 6 · Extended）

解：由同化的定义，已消化的食物分子进入身体细胞，在细胞中被利用并成为细胞的一部分。
A 所述的去向和结果均符合此定义。
故选 A。

题型 8：把消化酶的来源、底物和作用部位对应（考频★★☆☆☆）

知识点 消化酶是催化大分子、不溶性食物分解为小分子、可溶性物质的蛋白质，具有专一性。

淀粉酶由唾液腺和胰腺产生，分泌到口腔和小肠，将淀粉分解为_____。

脂肪酶由胰腺产生，在小肠内将脂肪分解为_____；蛋白酶由胃和胰腺产生，在胃和小肠内将蛋白质分解为氨基酸。

胰岛素、胰高血糖素属于激素；胆汁由肝脏产生，且不属于_____。

淀粉酶在接近中性的条件下活性较高，最适 pH 接近 7；pH 没有单位。

答案：麦芽糖；脂肪酸和甘油；消化酶

怎么认 题目出现酶名、分泌器官、作用部位或最适 pH 时，先分别核对来源、底物和作用位置。

例题 1

Pancreatic insufficiency is a condition that occurs when the pancreas is unable to produce enough enzymes.

Which secretions are reduced due to this condition?

A amylase, lipase and protease

B amylase, lipase and bile

C amylase, insulin and protease

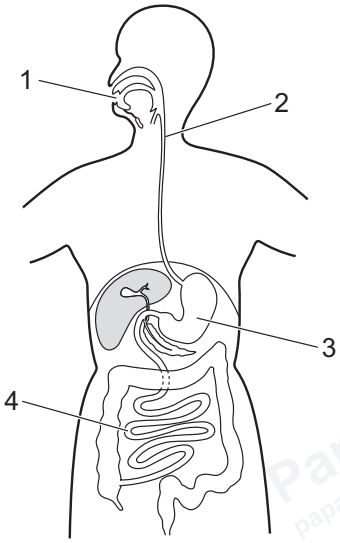
D glucagon, insulin and protease

（2023 Oct/Nov · 0654/21 · Question 6 · Extended）

解：由胰腺能分泌淀粉酶、脂肪酶和蛋白酶，得减少的分泌物为这三种酶。
胰岛素和胰高血糖素是激素，胆汁由肝脏产生。
故选 A。

针对练习

1. The diagram shows the human digestive system.



Which labels identify two locations where amylase acts?

A 1 and 2 **B** 1 and 4 **C** 2 and 3 **D** 2 and 4

（2026 May/Jun · 0654/23 · Question 5 · Extended）

2. Which row about secretions in the alimentary canal is correct?

	substance secreted	action	area of alimentary canal
A	amylase	breaks down fats into fatty acids and glycerol	small intestine
B	bile	breaks down fats into fatty acids and glycerol	small intestine
C	hydrochloric acid	breaks down proteins into amino acids	stomach
D	protease	breaks down proteins into amino acids	stomach

（2024 May/Jun · 0654/23 · Question 6 · Extended）

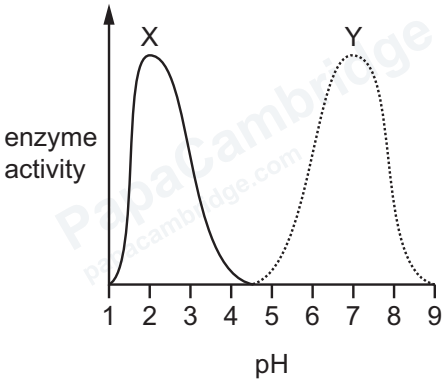
3. Which row shows the parts of the alimentary canal where the enzymes amylase, lipase and protease are secreted?

	mouth	small intestine	stomach
A	amylase	protease	amylase
B	amylase	lipase	protease
C	protease	protease	lipase
D	protease	lipase	lipase

（2025 May/Jun · 0654/23 · Question 4 · Extended）

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4. The diagram shows the optimum pH for two different digestive enzymes, X and Y.



Which row identifies amylase and an organ where amylase is secreted?

	amylase	organ where secreted
A	Y	pancreas
B	Y	stomach
C	X	pancreas
D	X	stomach

（2026 Feb/Mar · 0654/22 · Question 12 · Extended）

题型 9：把绒毛结构与吸收通道对应（考频★☆☆☆☆）

知识点 小肠绒毛是小肠内壁表面的指状突起，能增大吸收的_____。
绒毛内有丰富的_____，可及时运走葡萄糖、氨基酸等水溶性物质，维持浓度差。
绒毛中央的_____吸收脂肪酸和甘油等脂肪消化产物。
消化酶催化食物分解，酶的存在不属于绒毛提高吸收效率的结构特征。

答案：表面积；毛细血管；乳糜管

怎么认 题目出现绒毛的结构、标号或吸收物质时，先核对表面积、血流和两类吸收通道。

例题 1

Which features of villi help to maximise the absorption of digested food?

1 a good blood supply
2 a large surface area
3 the presence of enzymes
4 the presence of lacteals

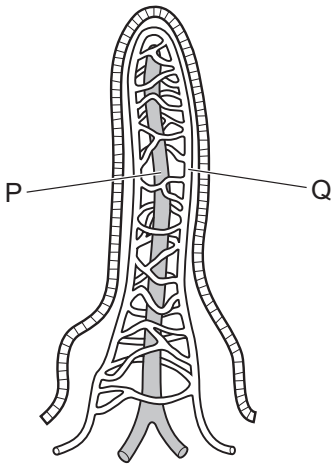
A 1, 2 and 4 **B** 1, 3 and 4 **C** 1 and 3 only **D** 2 and 4 only

（2022 Oct/Nov · 0654/22 · Question 6 · Extended）

解：较大的表面积增加了吸收面积；良好的血液供应及时运走已吸收的水溶性营养物质，维持浓度差；乳糜管可吸收脂肪消化产物，故 1、2、4 均能帮助吸收。
消化酶催化食物分解，酶的存在不属于绒毛帮助吸收的结构特征，故 3 不选。
故选 A。

针对练习

1. The diagram shows a villus.



What are structures P and Q and which substances do they absorb?

	structure		substance absorbed	
	capillary	lacteal	amino acids	fatty acids
A	P	Q	P	Q
B	P	Q	Q	P
C	Q	P	P	Q
D	Q	P	Q	P

（2024 Oct/Nov · 0654/21 · Question 6 · Extended）

题型 10：解释半透膜或碘液实验中的淀粉消化（考频★☆☆☆☆）

知识点 消化是将不溶性的大分子食物分解成可溶性的_____的过程。

在适宜温度和 pH 下，唾液中的淀粉酶能把淀粉分解成糖。

糖分子较小，可通过_____；碘液未遇淀粉时保持_____。

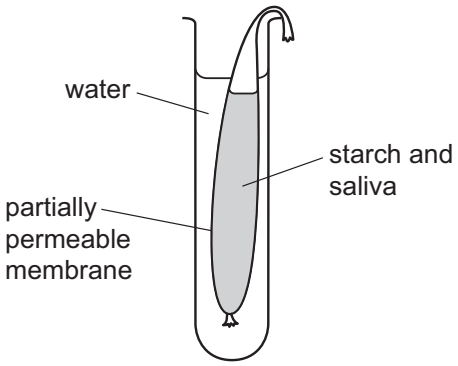
答案：小分子物质；半透膜；棕色

怎么认 题目出现淀粉与唾液混合、膜外检出糖或碘液仍呈棕色时，先判断淀粉是否被分解。

例题 1

Starch is mixed with saliva and placed into a bag made of a partially permeable membrane.

The bag is placed into a tube filled with water, as shown.



After one hour, sugar molecules are found in the water outside the bag.

Which process has taken place inside the bag?

A assimilation

B digestion

C egestion

D ingestion

（2024 May/Jun · 0654/11 · Question 6 · Core）

解：唾液中的淀粉酶在袋内把淀粉分解成较小的糖分子。
糖分子可通过半透膜进入袋外的水，袋外检出糖说明袋内已形成淀粉的消化产物。
把淀粉分解成较小糖分子的过程属于消化。故选 B。

针对练习

1. A scientist places equal volumes of starch and saliva into a test-tube.

After 30 minutes, the mixture in the test-tube is tested with iodine solution.

The iodine solution remains brown.

Which process does this experiment demonstrate?

A absorption

B assimilation

C digestion

D ingestion

（2024 May/Jun · 0654/12 · Question 6 · Core；同题：2024 May/Jun · 0654/13 · Question 6 · Core）

题型 11：由表面积变化解释机械消化加速（考频★☆☆☆☆）

知识点 机械消化是把大块食物分成小块的物理过程，物质的化学性质不变。

总容积相同时，分割后物块的总表面积_____，与酶接触的机会增多。

在酶的种类、浓度、温度及食物总量相同时，消化时间越_____，化学消化速率越快。

表面积用 cm^2 表示，消化时间用 min 表示；同量物质完全消化时，速率与时间成反比。

机械消化能加快化学消化，但不是化学消化发生的必要条件。

答案：增大；短

怎么认 题目出现同体积物块切成若干小块及消化时间表时，先比较总表面积和耗时。

例题 1

A student investigates the effect of size of gelatine cubes on the rate of digestion by protease.

The student places a cube of gelatine with a volume of 8 cm^3 into a beaker of protease. The time taken for the cube to be digested is recorded.

A second 8 cm^3 cube of gelatine is cut up into eight 1 cm^3 cubes to represent mechanical digestion and the experiment is repeated.

The results are shown.

gelatine	time taken to digest the gelatine / minutes
one 8 cm^3 cube	320
eight 1 cm^3 cubes	80

Which statements are correct?

1 Cutting up the 8 cm^3 cube increases the surface area exposed to the enzyme.

2 Chemical digestion cannot occur unless mechanical digestion also occurs.

3 Mechanical digestion increases the rate of chemical digestion.

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

（2024 May/Jun · 0654/22 · Question 6 · Extended）

解： 一个 $8cm^3$ 的明胶正方体边长为 2 cm，故

$S_1 = 6 \times 2^2 = 24cm^2$

八个 $1cm^3$ 的明胶正方体边长均为 1 cm，故

$S_2 = 8 \times 6 \times 1^2 = 48cm^2$

总容积不变而总表面积增大，故 1 正确。

相同总量明胶的消化时间由 320 min 缩短为 80 min，且

$\frac{320}{80} = 4$

故分割后的平均消化速率增大，3 正确。

未切割的明胶仍被蛋白酶消化，故机械消化不是化学消化发生的必要条件，2 错误。

正确的是 1 和 3，故选 C。

题型 12：由年龄与性别表比较能量需求（考频★☆☆☆☆）

知识点 能量需求表示每人每天所需要的能量，表中单位为千焦/人/天（kJ per person per day）。
比较男女的能量需求时，应在_____内比较两列数值。
判断某结论是否对所有年龄成立，须逐组核对，单个年龄组不能代表_____年龄组。
判断最低值时，分别找出男女两列的最小数；判断年龄变化趋势时，按年龄顺序比较_____年龄组的数值。

答案：同一年龄组；全部；相邻

怎么认 题目出现年龄、性别与能量需求表并要求判断结论时，先逐年龄比较两列，再查最小值和后续趋势。

例题 1

The table shows the energy demand of males and females of different ages.

age range	energy demand / kJ per person per day	
	males	females
0–4	5520	5230
5–14	9100	7890
15–19	11 300	8870
20–59	10 290	8330
60+	8410	7450

Which conclusions can be made from this data?

1 The energy demand of males is greater than that of females at all ages.

2 The energy demand of both males and females for age range 0–4 is the lowest.

3 The energy demand of males and females decreases after age range 15–19.

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 only

（2025 May/Jun · 0654/21 · Question 5 · Extended）

解：逐年龄组比较，5520 > 5230，9100 > 7890，11300 > 8870，10290 > 8330，8410 > 7450，故结论 1 成立。
男性一列的最小值为 5520，女性一列的最小值为 5230，均在 0–4 岁，故结论 2 成立。
15–19 岁后，男性为 11300 > 10290 > 8410，女性为 8870 > 8330 > 7450，均随年龄组递增而下降，故结论 3 成立。
故选 A。

7.2 营养、消化与吸收：结构题

题型 1：沿引线辨认消化器官（考频★★☆☆☆）

知识点 消化系统由消化道和附属器官组成；食物沿消化道依次经过口腔、食道、胃、小肠、大肠、直肠和_____。
肝脏、胆囊和胰腺属于附属器官；胆囊位于肝脏下方，胰腺呈长条状并位于胃的_____。
辨认结构时，以引线末端接触的器官为准，并结合器官的相对位置和外形判断。

答案：肛门；下方

怎么认　题目出现消化系统图及字母引线并要求辨认器官时，先找引线末端，再据位置和外形确定名称。

例题 1　**(a)** Fig. 1.1 is a diagram of the alimentary canal and associated organs.

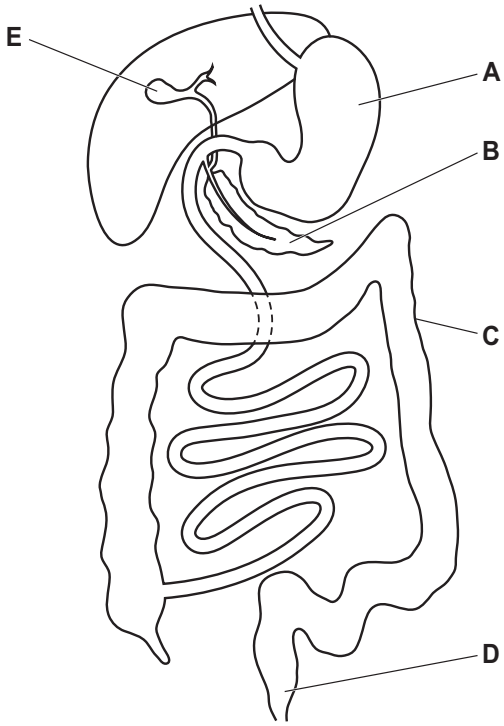


Fig. 1.1

(i) Identify the parts labelled **A**, **C** and **E** in Fig. 1.1.

A

C

E

（2025 Oct/Nov 0654/32 第1题(a)(i)）

解：A 的引线末端指向连接食道的囊状器官，故 A 为胃。
C 的引线末端指向包围小肠的粗管，故 C 为大肠。
E 的引线末端指向肝脏下方的小囊，故 E 为胆囊。
答：A 胃；C 大肠；E 胆囊。

针对练习

1. **(a)** Fig. 1.1 is a diagram of the alimentary canal and associated organs.

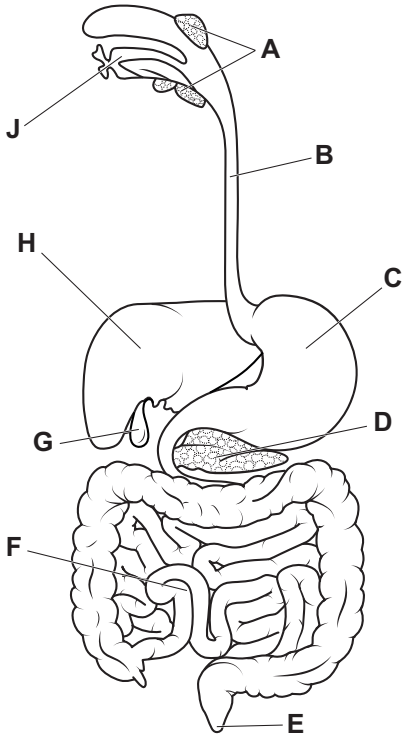


Fig. 1.1

(ii) State the names of the parts labelled **D** and **H** in Fig. 1.1.

D

H

（2023 May/Jun 0654/31 第1题(a)(ii)）

2. **(a)** Fig. 7.1 is a diagram of the alimentary canal and associated organs.

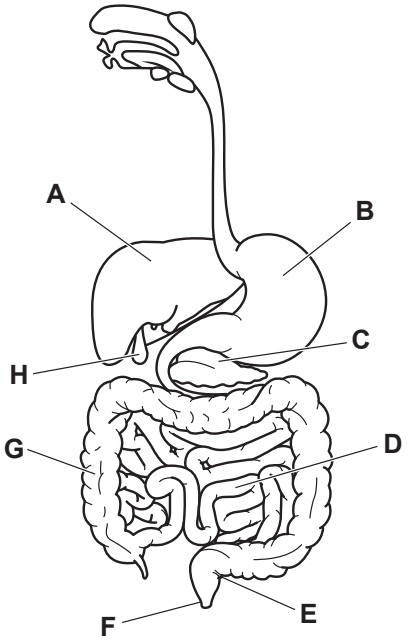


Fig. 7.1

(ii) State the names of parts **A** and **C** in Fig. 7.1.

A

C

（2023 Oct/Nov 0654/32 第7题(a)(ii)）

3. **(e)** Fig. 1.1 is a diagram of the alimentary canal and associated organs in a human.

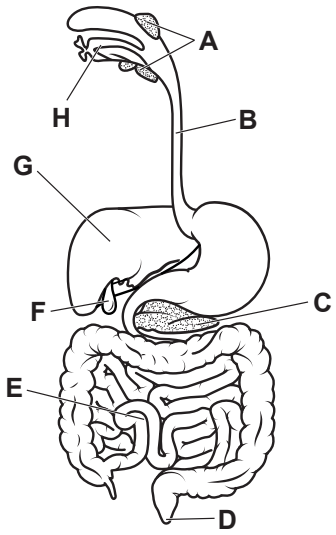


Fig. 1.1

(ii) State the name of part **C** in Fig. 1.1.

（2022 Feb/Mar 0654/32 第1题(e)(ii)）

4. **(a)** Fig. 2.1 is a diagram of the human digestive system.

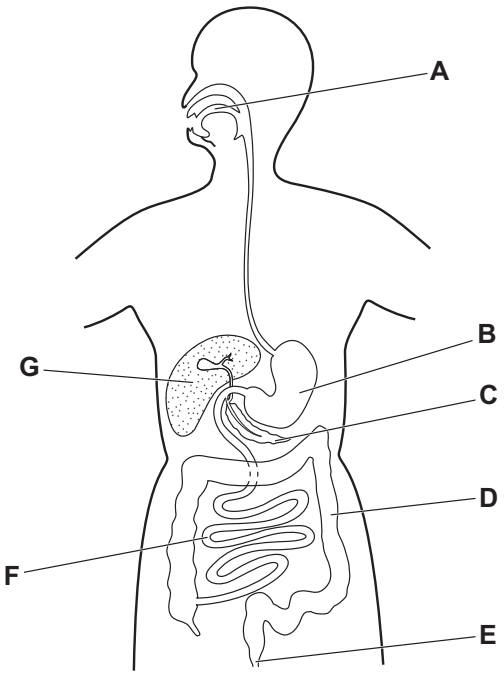


Fig. 2.1

(i) Using letters **A–G** in Fig. 2.1, identify:

the anus

the liver.

（2025 May/Jun 0654/31 第2题(a)(i)）

题型 2：确定牙齿完成的消化类型（考频★★☆☆☆）

知识点 机械消化是把食物分成较小颗粒而不改变其_____组成的过程。

牙齿切断、撕裂和磨碎食物，完成_____消化，并增大食物与消化液接触的表面积。

判定条件是食物只发生大小或形状变化，食物分子没有发生化学变化；消化类型没有单位。

答案：化学；机械

怎么认 题目出现牙齿负责的消化类型时，先看其是否只改变食物大小而不改变化学组成。

例题 1

(ii) State the type of digestion that teeth are responsible for.

（2024 May/Jun 0654/31 第1题(a)(ii)）

解：牙齿切断、撕裂和磨碎食物，使食物颗粒变小，但食物的化学组成不变，故该过程属于机械消化。

答：机械消化。

针对练习

1. **(iii)** State the name of the type of digestion that takes place using teeth.

（2023 Oct/Nov 0654/31 第7题(b)(iii)）

2. **(d)** Teeth are used for one type of digestion.

State the name of this type of digestion.

（2022 Oct/Nov 0654/32 第7题(d)）

题型 3：由过程功能定位消化系统的器官（考频★★☆☆☆）

知识点 摄食是食物经口腔进入消化道，排遗是未消化食物经_____排出体外。
消化是把大而不溶的食物分子分解成小而可溶的分子，可发生在口腔、胃和小肠。
吸收是消化后的小分子穿过肠壁进入血液，食物分子的大部分吸收发生在_____。
唾液由_____产生；胃中的食物经胃的出口进入小肠。

答案：肛门；小肠；唾液腺

怎么认 题目出现消化系统标字母图并询问过程发生处时，先把过程对应到器官，再读该器官的字母。

例题 1

(a) Fig. 1.1 is a diagram of the alimentary canal and associated organs.

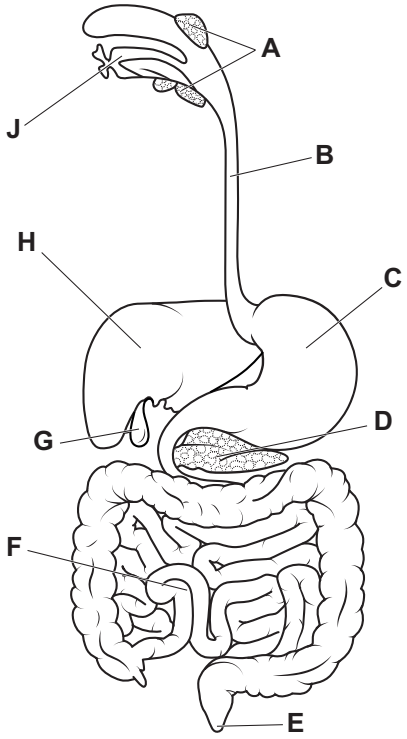


Fig. 1.1

(i) State the letter in Fig. 1.1 that identifies where:

most absorption occurs

egestion occurs

ingestion occurs

saliva is produced.

（2023 May/Jun 0654/31 第1题(a)(i)）

解：食物分子的大部分吸收发生在小肠，图中小肠标为 F。
排遗是未消化食物经肛门排出，图中肛门标为 E。
摄食发生在口腔，图中口腔标为 J；唾液由唾液腺产生，图中唾液腺标为 A。
答：F；E；J；A。

针对练习

1. **(a)** Fig. 2.1 is a diagram of the human digestive system.

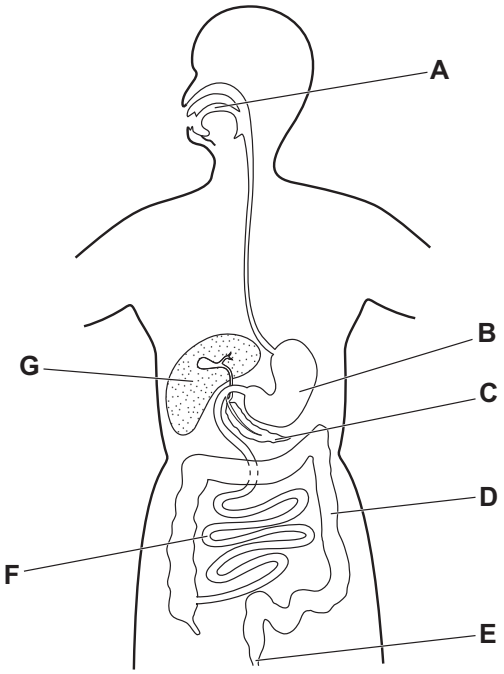


Fig. 2.1

(ii) Using letters **A–G** in Fig. 2.1, identify an organ where these processes occur:

absorption

digestion.

（2025 May/Jun 0654/31 第2题(a)(ii)）

2. **(e)** Fig. 1.1 is a diagram of the alimentary canal and associated organs in a human.

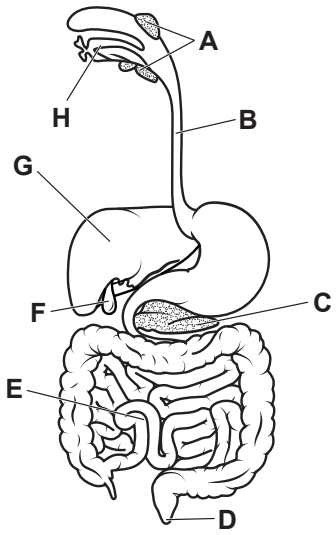


Fig. 1.1

(i) Identify the letter from Fig. 1.1 that represents where:

egestion occurs

the most absorption occurs

ingestion occurs.

（2022 Feb/Mar 0654/32 第1题(e)(i)）

3. **(a)** Fig. 7.1 is a diagram of the alimentary canal and associated organs.

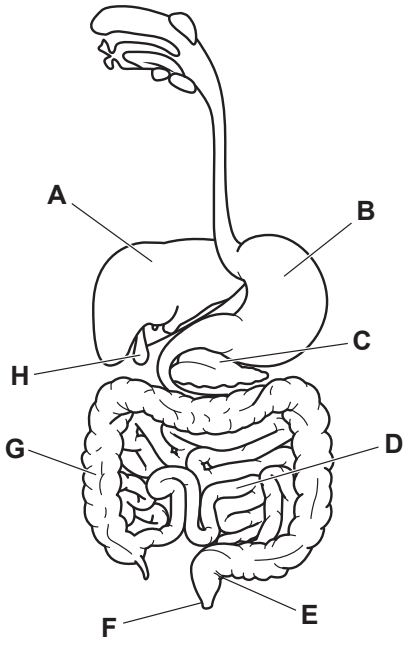


Fig. 7.1

(i) Identify the letter in Fig. 7.1 that represents the part:

where egestion occurs

where most absorption of food molecules occurs

that releases food into the small intestine

（2023 Oct/Nov 0654/32 第7题(a)(i)）

第 8 章 植物中的水分与糖运输

8.1 植物中的水分与糖运输

题型 1：核对韧皮部转运的物质与源汇（考频★★★☆☆）

知识点 转运（translocation）是蔗糖和氨基酸在_____中的运输。
物质由_____运向_____；前者产生或释放物质，后者利用或贮藏物质。
水由根运往叶主要经过木质部，蔗糖不由木质部运输。

答案：韧皮部；源；汇

怎么认 题目出现转运物质、源与汇或木质部与韧皮部时，先判定物质、组织和方向。

一. 确定转运物质、组织和方向

例题 1

What is a definition of translocation?

A the movement of amino acids and sucrose in phloem

B the movement of amino acids and sucrose in xylem

C the movement of glucose and amino acids in phloem

D the movement of glucose and amino acids in xylem

（2025 Feb/Mar · 0654/22 · Question 5 · Extended）

解：转运物质为蔗糖和氨基酸，运输组织为韧皮部。
A 项符合转运的定义。故选 A。

针对练习

1. Which statement about transport in plants is correct?

A Amino acids are moved from source to sink in the xylem.

B Glucose is moved from sink to source in the xylem.

C Sucrose is moved from source to sink in the phloem.

D Starch is moved from sink to source in the phloem.

（2025 Oct/Nov · 0654/23 · Question 5 · Extended）

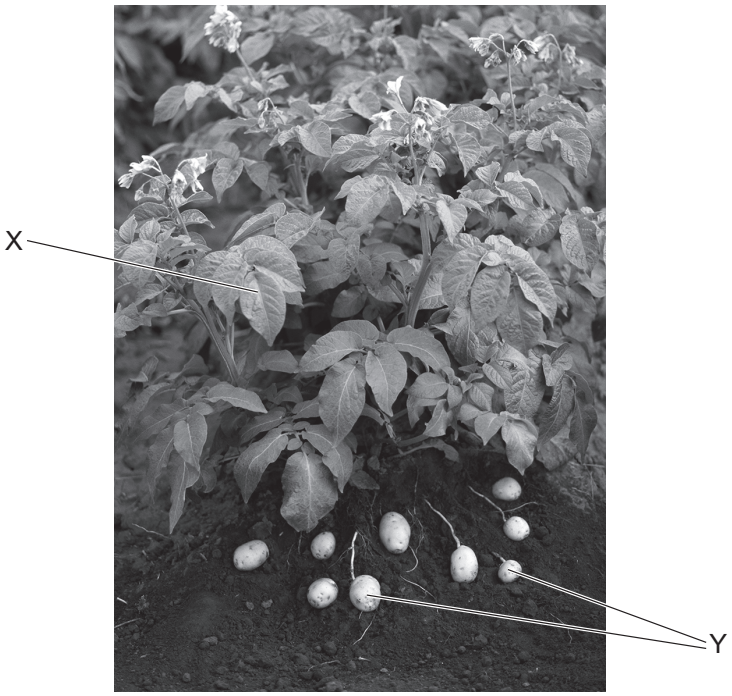
2. Which row about translocation is correct?

	substances transported	source	sink
A	amino acids and glucose	region of production	region of use
B	amino acids and glucose	region of growth	region of production
C	amino acids and sucrose	region of production	region of use
D	amino acids and sucrose	region of growth	region of production

3. Which row correctly describes translocation and transpiration in plants?

	transport method	from	to	transport vessel
A	translocation	leaf	respiring tissue	xylem
	transpiration	root	leaf	phloem
B	translocation	leaf	root	xylem
	transpiration	respiring tissue	leaf	phloem
C	translocation	leaf	respiring tissue	phloem
	transpiration	root	leaf	xylem
D	translocation	leaf	root	phloem
	transpiration	respiring tissue	leaf	xylem

4. The photograph shows a potato plant. Potato plants have storage organs labelled Y.



Which statement correctly describes the transport of sucrose in the potato plant?

A Sucrose is translocated from X to Y in the phloem.

B Sucrose is translocated from Y to X in the xylem.

C Sucrose is transpired from X to Y in the phloem.

D Sucrose is transpired from Y to X in the xylem.

二. 改变通道或季节后追踪转运

知识点 韧皮部把蔗糖从_____运输到_____，这种物质运输称为转运。

源是产生或释放蔗糖的部位，汇是利用或贮藏蔗糖的部位；器官的源汇关系可随生长阶段改变。

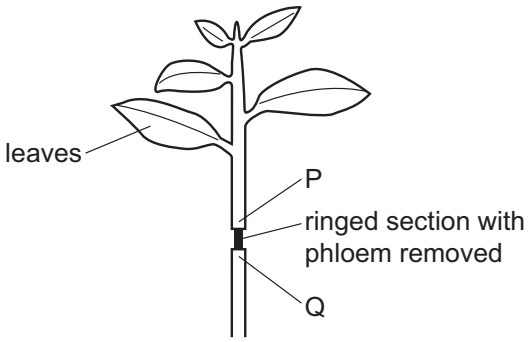
环割除去韧皮部后，蔗糖不能越过环割处；木质部仍连通时，水和溶解的无机盐仍可向上运输。

答案：源；汇

怎么认 题目出现环割去除韧皮部或根跨季节生长时，先判断通道是否中断，再判定器官当时是源还是汇。

例题 2

The diagram shows a plant shoot that is ringed. This removes the phloem from a section of the shoot.



The plant is left in bright light for 24 hours. Plant tissues are then tested for the presence of sucrose above the ringed section at P and below the ringed section at Q.

Which row shows the expected results?

	presence of sucrose	
	P	Q
A	✓	✓
B	✗	✓
C	✓	✗
D	✗	✗

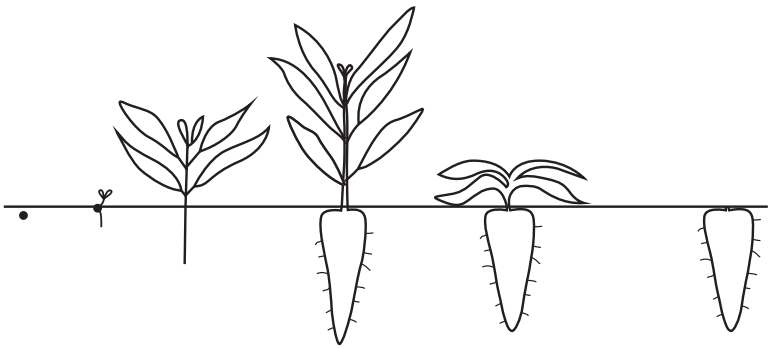
（2022 Feb/Mar · 0654/22 · Question 7 · Extended）

解：叶片在强光下进行光合作用，产生的蔗糖由韧皮部向下转运。

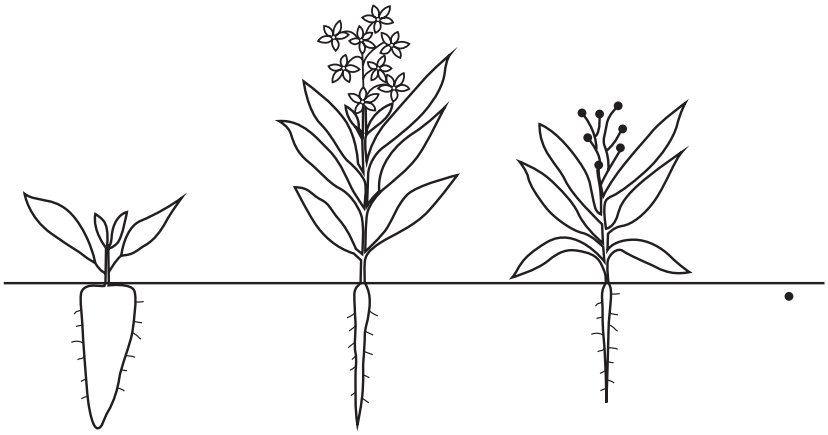
环割处的韧皮部被除去，蔗糖不能越过环割处，因此在 P 处能检测到蔗糖，在 Q 处不能检测到蔗糖。

故选 C。

5. The diagram shows the life cycle of a plant that takes two years to grow from a seed and produce new seeds.



year 1 spring summer autumn winter



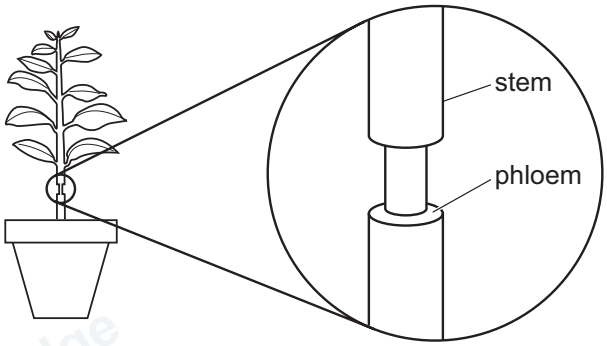
year 2 spring summer autumn winter

Which row about the large root in year 1 and in year 2 is correct?

	in year 1 the root acts as a	in year 2 the root acts as a
A	sink	sink
B	sink	source
C	source	sink
D	source	source

（2024 Oct/Nov · 0654/23 · Question 7 · Extended）

6. The diagram shows the stem of a plant with its outer tissue and phloem removed.



Which statements about transport in this plant are correct?

1 Sucrose can pass to the roots.

2 Dissolved mineral ions and water **cannot** pass to the leaves.

3 Sucrose **cannot** pass to the roots.

4 Dissolved mineral ions and water can pass to the leaves.

A 1 and 2 **B** 1 and 4 **C** 2 and 3 **D** 3 and 4

（2026 Feb/Mar · 0654/22 · Question 6 · Extended）

题型 2：从根、茎、叶横切面定位输导组织（考频★★★☆☆）

知识点 木质部（xylem）运输水和无机盐，运输方向主要由根经茎到叶；韧皮部（phloem）运输蔗糖和氨基酸，可向植物各部位运输。

双子叶植物根的木质部位于中央，常呈_____形；韧皮部分布在木质部各臂之间。

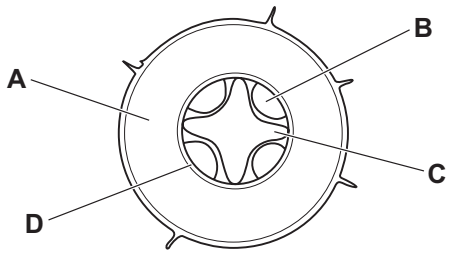
茎的维管束近外侧为韧皮部，近中央为_____；叶脉中木质部通常在上侧，韧皮部在下侧。

以上位置关系用于根、茎和叶的横切面；各图未按同一比例绘制时，仍应根据组织排列辨认。

答案：星；木质部

怎么认 题目出现根、茎或叶横切面并问输导组织位置时，先认器官，再按根中央、茎内侧、叶脉上侧定位木质部。

例题 1 Which label shows the position of the xylem in the cross-section of the root of a dicotyledonous plant?



（2023 Oct/Nov · 0654/11 · Question 7 · Core；同题：2023 Oct/Nov · 0654/21 · Question 7 · Extended）

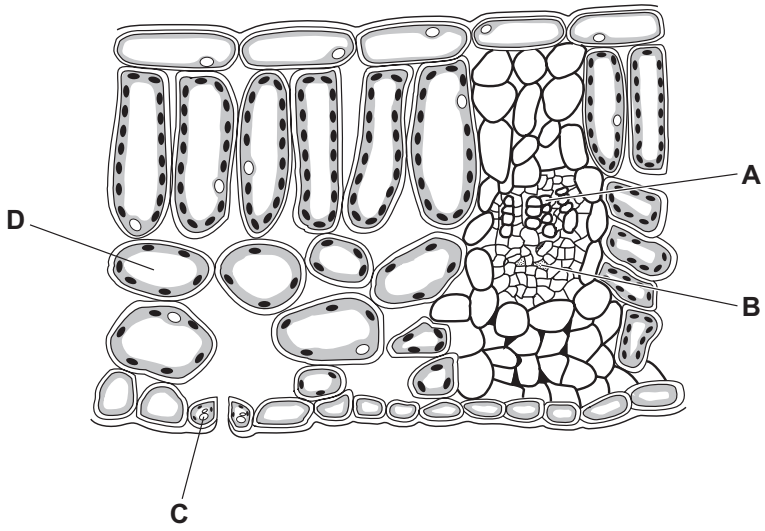
解：由双子叶植物根横切面的组织排列可知，中央星形组织为木质部。

C 所指为中央星形组织，故选 C。

针对练习

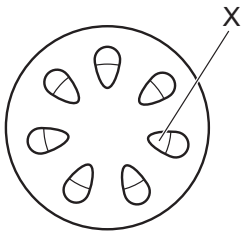
1. The diagram shows a cross-section of a leaf.

Which structure is a xylem cell?



（2025 Oct/Nov · 0654/12 · Question 4 · Core；同题：2025 Oct/Nov · 0654/13 · Question 4 · Core）

2. The diagram shows a cross-section of a plant stem.



Which tissue is X?

A cortex

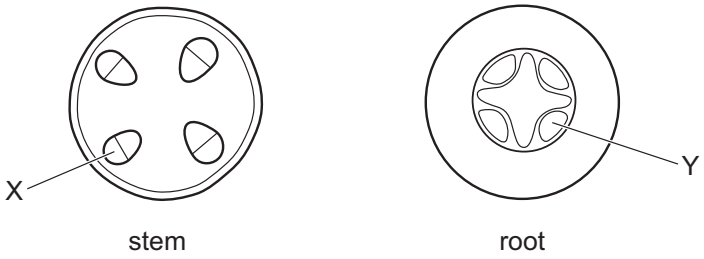
B mesophyll

C phloem

D xylem

（2025 May/Jun · 0654/11 · Question 8 · Core）

3. The diagram shows a cross section of a plant stem and a plant root.

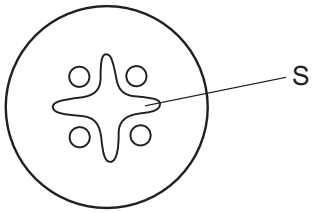


Which row identifies labels X and Y?

	X	Y
A	phloem	phloem
B	phloem	xylem
C	xylem	phloem
D	xylem	xylem

（2025 Feb/Mar · 0654/12 · Question 9 · Core）

4. The diagram shows a cross-section of a plant root.

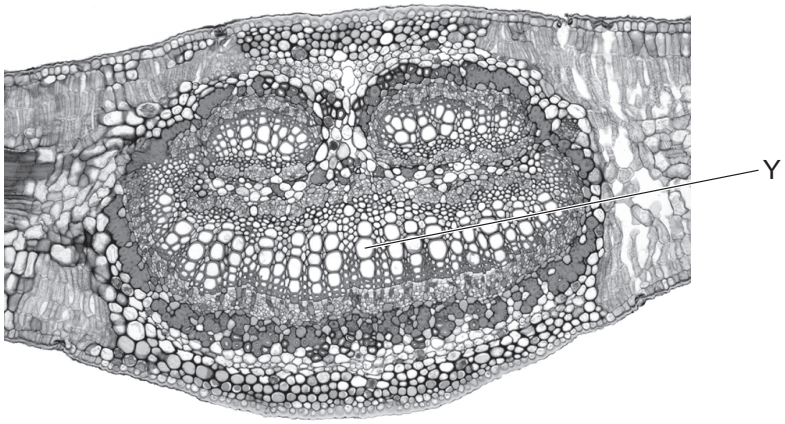


Which row is correct for tissue S?

	name of tissue	substance transported
A	phloem	amino acids and sucrose
B	phloem	water
C	xylem	amino acids and sucrose
D	xylem	water

（2025 May/Jun · 0654/12 · Question 7 · Core；同题：2025 May/Jun · 0654/13 · Question 7 · Core）

5. The light micrograph shows a cross-section through part of a leaf.



What is the name and contents of structure Y?

A phloem containing sucrose

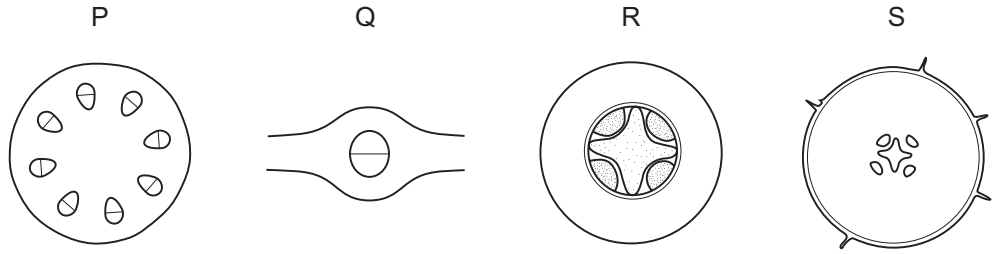
B phloem containing water

C xylem containing sucrose

D xylem containing water

（2026 May/Jun · 0654/22 · Question 7 · Extended）

6. The diagrams represent sections through a root, a stem and a leaf mid-rib, not drawn to the same scale.



In which row are the sections correctly identified?

	root	stem	leaf
A	P	S	R
B	Q	R	S
C	R	P	Q
D	S	Q	P

（2022 Oct/Nov · 0654/11 · Question 7 · Core；同题：2022 Oct/Nov · 0654/12 · Question 7 · Core；同题：2022 Oct/Nov · 0654/13 · Question 7 · Core）

题型 3：核对根吸收与木质部运输功能（考频★★☆☆☆）

知识点 根毛细胞位于根的表面，主要从土壤中吸收_____和_____。

木质部导管由死细胞形成，运输水和溶解的无机离子，方向通常为_____。

蒸腾作用产生的拉力使水沿木质部上升；硝酸根离子随水运输，并用于合成氨基酸。

答案：水；无机离子；从根到叶

怎么认 题目出现根毛、染色水或木质部运输方向时，先判断物质是否随水由根向叶运输。

例题 1

Which row names the substances carried by xylem vessels and the direction of travel?

	substances	direction of travel
A	sucrose only	leaves to roots
B	sucrose only	roots to leaves
C	water and dissolved minerals	leaves to roots
D	water and dissolved minerals	roots to leaves

（2023 Oct/Nov · 0654/13 · Question 7 · Core；同题：2023 Oct/Nov · 0654/23 · Question 7 · Extended）

解：木质部导管运输水和溶解的无机离子，运输方向为从根到叶。故选 D。

针对练习

1. What is a main function of root hairs?

A absorb mineral ions

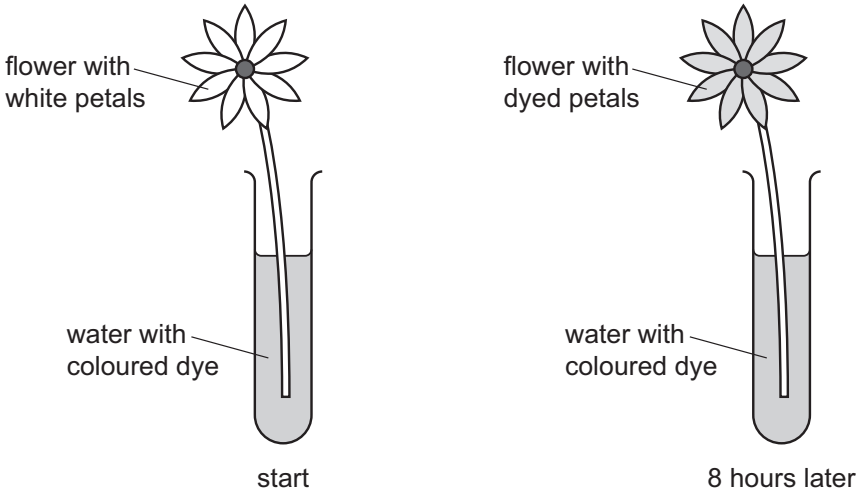
B photosynthesis

C support the stem

D transport water to the leaves

（2025 Oct/Nov · 0654/11 · Question 8 · Core）

2. The diagram shows an investigation into water transport in plants.



Which part of the stem transports the coloured dye from the test-tube to the petals of the flower?

A mesophyll cells

B phloem

C root hair cells

D xylem

（2024 Oct/Nov · 0654/12 · Question 7 · Core；同题：2024 Oct/Nov · 0654/13 · Question 7 · Core）

3. Which statement is correct?

A Xylem vessels are living and are involved in translocation.

B Xylem vessels are living and are involved in transpiration.

C Xylem vessels are dead and are involved in translocation.

D Xylem vessels are dead and are involved in transpiration.

（2024 Feb/Mar · 0654/22 · Question 7 · Extended）

4. Which row shows the transport and use of nitrate ions by plants?

	tissue used to transport nitrate ions around plant	nitrate ions used to make
A	phloem	amino acids
B	xylem	glucose
C	phloem	glucose
D	xylem	amino acids

（2025 May/Jun · 0654/22 · Question 6 · Extended）

题型 4：比较吸水与失水平衡判断萎蔫（考频★★☆☆☆）

知识点 植物的水分净变化速率等于_____减去失水速率。

当失水速率大于吸水速率时，植物净失水，细胞膨压_____并变得松弛，植株萎蔫。

当吸水速率大于失水速率时，植物水分净增加，较不易萎蔫。

比较两种速率时，二者应针对同一叶片和相同时间，单位须一致，如 mm^3min^{-1}。

答案：吸水速率；下降

怎么认 题目出现吸水速率、失水速率及是否萎蔫时，先比较两种速率的大小。

例题 1

What causes a plant to wilt?

A Water gain is greater than water loss.

B Water moves from the leaves to the stem.

C Water moves from the leaves to the flowers.

D Water loss is greater than water gain.

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（2026 May/Jun · 0654/23 · Question 6 · Extended）

解：当水分流失量大于水分吸收量时，植物体内水分净减少，细胞膨压下降，植株萎蔫。故选 D。

针对练习

1. The rates of water uptake and loss are measured in four leaves. The results are shown in the table.

Which leaf is least likely to wilt?

	rate of water uptake /mm^3 per minute	rate of water loss /mm^3 per minute
A	8	15
B	9	11
C	12	13
D	15	10

（2023 Oct/Nov · 0654/12 · Question 7 · Core；同题：2023 Oct/Nov · 0654/22 · Question 7 · Extended）

2. What happens to plant cells when a plant wilts?

A They gain water, decrease in turgor pressure and become flaccid.

B They gain water, increase in turgor pressure and become turgid.

C They lose water, increase in turgor pressure and become turgid.

D They lose water, decrease in turgor pressure and become flaccid.

（2026 May/Jun · 0654/21 · Question 6 · Extended）

题型 5：定位蒸腾的蒸发与水汽逸出（考频★☆☆☆☆）

知识点 蒸腾是叶片中的水蒸发后，以水蒸气形式散失到外界的过程。

水从_____的湿润表面蒸发，进入叶片细胞间的空气空间。

当气孔开放且叶内水蒸气浓度高于外界时，水蒸气经_____向外扩散；蒸发部位与水汽逸出通道不同。

答案：叶肉细胞；气孔

怎么认 题目出现蒸发发生位置或哪种细胞表面失水时，先定位叶肉细胞的湿润表面。

例题 1

Where does evaporation of water occur during transpiration?

A from the air spaces through the stomata

B from the phloem

C from the surfaces of mesophyll cells

D from the xylem

（2022 May/Jun · 0654/11 · Question 7 · Core；同题：2022 May/Jun · 0654/21 · Question 7 · Extended）

解：蒸腾时，水从叶肉细胞的湿润表面蒸发，进入叶片细胞间的空气空间。
水蒸气再经气孔向外扩散，故蒸发发生在叶肉细胞表面。
故选 C。

针对练习

1. Which cells lose water by evaporation from their surfaces during transpiration?

A epidermis cells

B guard cells

C mesophyll cells

D root hair cells

（2023 May/Jun · 0654/23 · Question 7 · Extended）

题型 6：比较环境条件判断蒸腾快慢（考频★★★☆☆）

知识点 蒸腾是植物地上部分的水分以水蒸气形式散失的过程；蒸腾速率表示单位时间内散失的水量或质量。

在其他条件相同且气孔正常开放时，_____、_____和_____一般使蒸腾加快。

蒸腾速率的单位随测量量而定，可用克每小时或立方厘米每分钟。

装置质量减少越多，表明水分散失越多；湿度升高时，蒸腾速率降低。

答案：较高温度；较低湿度；较高风速

怎么认 题目出现温度、湿度、风速、质量损失或湿度曲线时，先把条件换成蒸腾快慢关系。

例题 1

In which conditions will the rate of transpiration be greatest?

A 10 °C and high humidity

B 10 °C and low humidity

C 30 °C and high humidity

D 30 °C and low humidity

（2022 Feb/Mar · 0654/12 · Question 7 · Core）

解：由蒸腾与环境条件的关系，温度越高，蒸腾越快；湿度越低，蒸腾越快。

四种条件中，30 °C且低湿度使蒸腾速率最大。

故选 D。

针对练习

1. In which weather conditions is the rate of transpiration fastest?

A cold and dry

B cold and wet

C warm and dry

D warm and wet

（2024 Oct/Nov · 0654/21 · Question 7 · Extended）

2. Which row shows the conditions that will increase the rate of transpiration from a plant?

	temperature	humidity
A	high	low
B	high	high
C	low	high
D	low	low

（2025 May/Jun · 0654/22 · Question 8 · Extended）

3. Which conditions cause the highest rate of transpiration in a plant?

	temperature	wind speed
A	high	high
B	high	low
C	low	high
D	low	low

（2023 Oct/Nov · 0654/12 · Question 5 · Core）

4. Which changes increase the rate of transpiration?

1 increasing temperature

2 increasing humidity

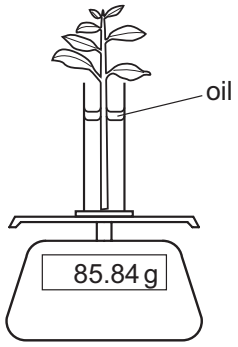
3 decreasing temperature

4 decreasing humidity

A 1 and 2 **B** 1 and 4 **C** 2 and 3 **D** 3 and 4

（2022 May/Jun · 0654/12 · Question 7 · Core；同题：2022 May/Jun · 0654/13 · Question 7 · Core）

5. The diagram shows a shoot at the start of an experiment investigating transpiration. The mass of the shoot, measuring cylinder, water and oil is measured.



The apparatus is left for three days and then the mass recorded for a second time.

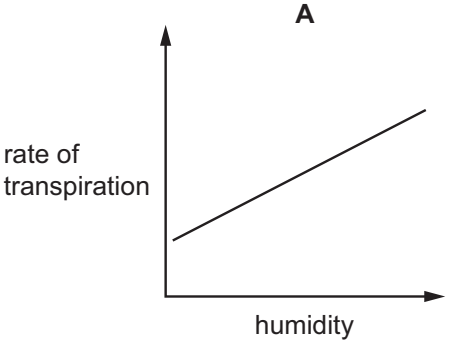
Under which conditions would there be the most loss of mass from the apparatus?

	temperature	humidity
A	high	high
B	high	low
C	low	high
D	low	low

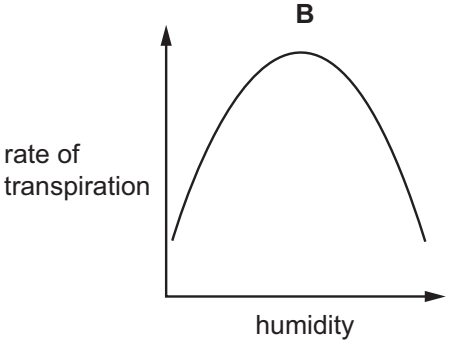
（2023 May/Jun · 0654/12 · Question 7 · Core；同题：2023 May/Jun · 0654/13 · Question 7 · Core）

6. Which graph shows the effect of humidity on the rate of transpiration?

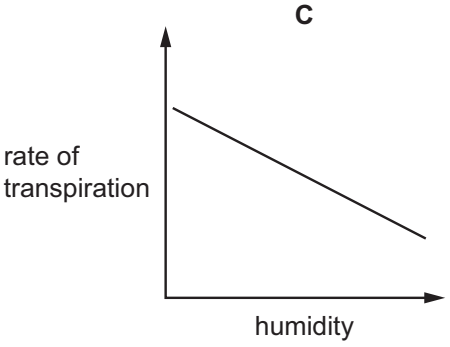
A



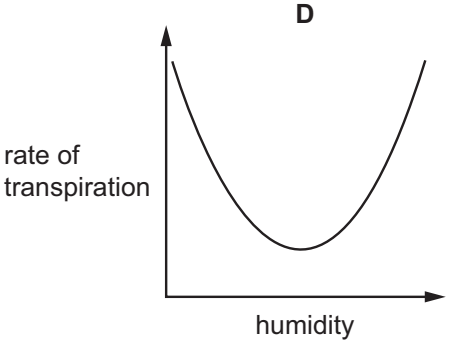
B



C



D



（2024 May/Jun · 0654/22 · Question 7 · Extended）

题型 7：按顺序追踪水从土壤到叶肉（考频★☆☆☆☆）

知识点 植物中水从土壤到叶的完整途径为_____、根皮层细胞、_____、叶肉细胞。
根毛细胞吸收土壤中的水，根皮层细胞将水传向根的内部。
木质部把水由根向上运输至叶，水再进入_____。
该途径表示结构的先后关系，不涉及数值和单位。

答案：根毛细胞；木质部；叶肉细胞

怎么认 题目出现水从土壤到叶的运输路径时，先按根毛、皮层、木质部、叶肉排列。

例题 1

What is the pathway taken by water as it travels from the soil to a leaf?

A root cortex cells → mesophyll cells → root hair cells → xylem

B root cortex cells → root hair cells → mesophyll cells → xylem

C root hair cells → root cortex cells → xylem → mesophyll cells

D root hair cells → xylem → mesophyll cells → root cortex cells

（2026 May/Jun · 0654/12 · Question 7 · Core）

解：水由根毛细胞从土壤中吸收，再穿过根皮层细胞进入木质部，木质部将水向上运输至叶，最后进入叶肉细胞。
故运输顺序为根毛细胞、根皮层细胞、木质部、叶肉细胞。故选 C。

题型 8：用水势与水汽梯度解释蒸腾变化（考频★☆☆☆☆）

知识点 蒸腾是水在叶片内蒸发，并以水蒸气形式经气孔扩散到空气中的过程。
气孔开放且其他条件相同时，温度升高使_____加快，蒸腾速率升高。
空气湿度升高使叶片内外水蒸气扩散梯度变_____，蒸腾速率降低；叶片失水形成的水势梯度使水柱沿_____上升。
蒸腾速率可用单位时间内的失水质量表示，常用单位为g h^{-1}。

答案：蒸发；小；木质部

怎么认 题目出现温度或湿度变化，并问蒸腾、质量变化或运输组织时，先判断蒸发及水蒸气扩散梯度。

例题 1

Which statement explains the effect of a higher temperature on the rate of transpiration?

A More water evaporates from the stomata, creating a water potential gradient that draws a column of water molecules up the xylem.

B Less water evaporates from the stomata, creating a water potential gradient that draws a column of water molecules up the xylem.

C More water evaporates from the stomata, creating a water potential gradient that draws a column of water molecules up the phloem.

D Less water evaporates from the stomata, creating a water potential gradient that draws a column of water molecules up the phloem.

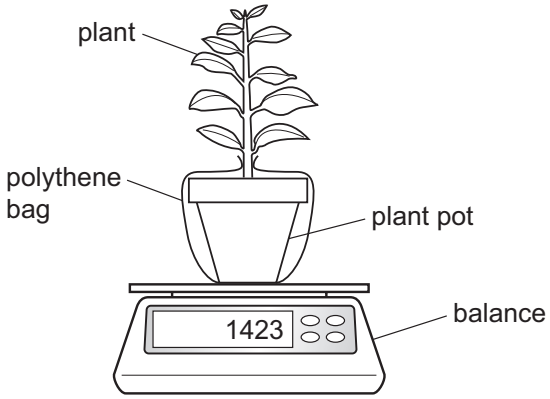
（2022 Oct/Nov · 0654/22 · Question 7 · Extended）

解：温度升高，水的蒸发加快，经气孔散失的水增多，蒸腾速率升高。
叶片失水使水势降低，形成水势梯度，连续水柱沿木质部向上移动。
故选 A。

针对练习

1. A student investigates the effect of humidity on transpiration rate.

A plant is placed on a balance for one hour as shown. The mass of the plant decreases.



The student repeats the experiment in air of higher humidity.

What is the effect of increasing humidity?

A larger decrease in mass due to a steeper diffusion gradient of water

B larger decrease in mass due to a less steep diffusion gradient of water

C smaller decrease in mass due to a steeper diffusion gradient of water

D smaller decrease in mass due to a less steep diffusion gradient of water

（2024 May/Jun · 0654/21 · Question 7 · Extended）

题型 9：由气孔封闭程度排序叶片失水（考频★☆☆☆☆）

知识点 蒸腾作用是水分从植物地上部分以水蒸气形式散失的过程，叶片主要通过_____散失水分。凡士林覆盖叶面会封闭气孔；在其他条件相同时，被封闭的气孔越多，蒸腾失水越_____，叶片失重越小。

下表面气孔多于上表面时，只涂下表面的失重小于只涂上表面的失重。

设初、末质量分别为 $m_{初}$、$m_{末}$，则 $p=\frac{m_{初}-m_{末}}{m_{初}}\times 100\%$，单位为_____。

答案：气孔；少；%

怎么认 题目出现叶片两面涂凡士林及失重数据时，先按气孔封闭程度排序，再匹配失重排名。

例题 1

More stomata are found on the lower surfaces of leaves than on the upper surfaces of leaves.

A student puts petroleum jelly on the surfaces of four leaves.

- One leaf has petroleum jelly on the upper surface.
- One leaf has petroleum jelly on the lower surface.
- One leaf has petroleum jelly on both surfaces.
- One leaf has petroleum jelly on neither surface.

The leaves are weighed and left in the air for one week before being weighed again.

The percentage decrease in mass of each of the leaves is shown in the table.

leaf	percentage decrease in mass
W	45
X	12
Y	17
Z	42

Which leaf has petroleum jelly on its lower surface only?

A W **B** X **C** Y **D** Z

（2025 May/Jun · 0654/23 · Question 5 · Extended）

解：由凡士林封闭气孔，且下表面气孔多于上表面，失重从小到大依次对应两面涂抹、只涂下表面、只涂上表面、两面均不涂。
表中 $12\% < 17\% < 42\% < 45\%$，故 X 对应两面涂抹，Y 对应只涂下表面，Z 对应只涂上表面，W 对应两面均不涂。
只涂下表面的是 Y，故选 C。

8.2 植物中的水分与糖运输：结构题

题型 1：确定水蒸气离开叶片的结构（考频★★☆☆☆）

知识点 蒸腾作用是水以水蒸气的形式从植物地上部分散失的过程。
叶片内的水蒸发后，水蒸气主要经表皮上的_____扩散到叶片外。
题目问水或水蒸气离开叶片的结构时，答案为_____；结构名称没有单位。

答案：气孔；气孔

怎么认 题目出现水或水蒸气从叶片离开的表述时，先确定出口结构为气孔。

例题 1

(c) State the name of the part of the leaf where water exits the plant.

（2022 May/Jun 0654/31 第10题(c)）

解：叶片内的水蒸发形成水蒸气，水蒸气经表皮上的气孔扩散到叶片外。
答：气孔（stomata）。

针对练习

1. **(d)** Gas exchange also occurs in plants.

(i) State the name of the part of the leaf where water vapour exits.

（2023 Oct/Nov 0654/32 第10题(d)(i)）

2. **(d)** Water evaporates inside the leaves to form water vapour.

Water vapour is then lost from the leaves.

(ii) Circle the part where water vapour exits the leaf.

cuticle **palisade** **stomata** **vascular bundles**

（2025 May/Jun 0654/31 第1题(d)(ii)）

题型 2：确定水分子相互连接的作用（考频★★☆☆☆）

知识点 水分子之间相互吸引并保持连接的作用称为_____（cohesion）。

在木质部中，内聚作用使水保持为连续水柱，蒸腾拉力得以沿水柱向上传递；该术语表示水的性质，没有单位。

答案：内聚力

怎么认 题目出现水分子如何保持在一起或水柱如何相连时，先写内聚力（cohesion）。

例题 1 **(b)** Transpiration is the loss of water vapour from the leaves.

(ii) State the term that describes how water molecules are held together.

（2022 May/Jun 0654/42 第7题(b)(ii)）

解：水分子之间存在相互吸引，使水分子彼此保持连接，这种作用称为内聚作用。

答：内聚力（cohesion）。

针对练习

1. **(b)** Water is transported to the leaves by xylem.

(i) State how the water molecules are held together in the xylem.

（2024 May/Jun 0654/41 第4题(b)(i)）

2. **(b)** Xylem vessels can draw up a column of water through transpiration pull.

(ii) State the term used to describe how the water molecules are held together in the column of water.

（2023 Oct/Nov 0654/42 第4题(b)(ii)）

第 9 章 心脏、血管与血液

9.1 心脏、血管与血液

题型 1：辨认心腔并追踪双循环路线（考频★★★★☆）

知识点 哺乳动物心脏有四个腔，心房位于_____，接收流回心脏的血；心室位于_____，把血液泵出心脏。

左心室把血液泵入体循环，输送距离较远，需产生较大压力，因此肌肉壁最_____。

右心室把血液泵向肺，壁比左心室薄；心腔的左右以人体的解剖方向为准，正面图中图左通常对应人体右侧。

答案：上方；下方；厚

怎么认 题目出现心脏剖面图、心腔位置或壁厚时，先按上下区分心房与心室，再按壁厚辨认左右。

一. 按位置和壁厚辨认心腔

例题 1

Which chamber of the human heart has the most muscular wall?

A left atrium

B left ventricle

C right atrium

D right ventricle

（2025 Feb/Mar · 0654/12 · Question 10 · Core）

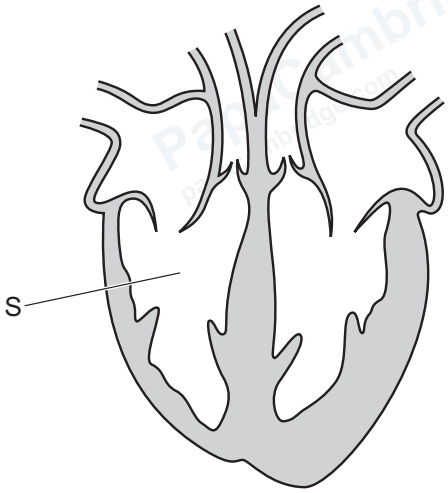
解：心室将血液泵出心脏，心房只将血液送入心室。

左心室把血液泵向全身，所需压力最大，故肌肉壁最厚。

故选 B。

针对练习

1. The diagram shows a mammalian heart.



What is structure S?

A left atrium

B left ventricle

C right atrium

D right ventricle

（2026 May/Jun · 0654/23 · Question 7 · Extended）

二. 确定血管去向和血流顺序

知识点 动脉是把血液带离心脏的血管，静脉是把血液带回心脏的血管；分类依据是血流相对心脏的方向，与血液含氧量无关。

肺循环中，右心室流出的血液经_____到达肺，肺中的血液经_____回到左心房。

体循环中，左心室流出的血液经主动脉到达全身，全身回流的血液经腔静脉进入右心房。

血液在肺获得氧后由肺静脉运送含氧血，在全身组织释放部分氧后由腔静脉运送缺氧血。

完整循环由肺循环和体循环组成，血液每个完整循环两次经过心脏。

答案：肺动脉；肺静脉

怎么认 题目出现心脏、肺、全身或血流箭头时，先按血液相对心脏的方向判定血管并续接路线。

例题 2

Which statement about the human circulatory system is correct?

A Blood flows through the aorta towards the heart.

B Blood flows through the pulmonary artery towards the lungs.

C Blood flows through the pulmonary vein away from the heart.

D Blood flows through the vena cava away from the lungs.

（2025 Oct/Nov · 0654/22 · Question 7 · Extended）

解：动脉把血液带离心脏，肺动脉连接右心室与肺。

肺动脉中的血液由心脏流向肺，故选 B。

2. Which vessels carry blood towards the heart?

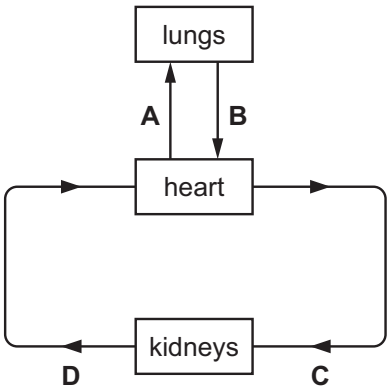
	aorta	pulmonary artery	pulmonary vein	vena cava
A	✓	✓	✗	✗
B	✓	✗	✓	✗
C	✗	✓	✗	✓
D	✗	✗	✓	✓

key
✓ = yes
✗ = no

（2024 May/Jun · 0654/23 · Question 7 · Extended）

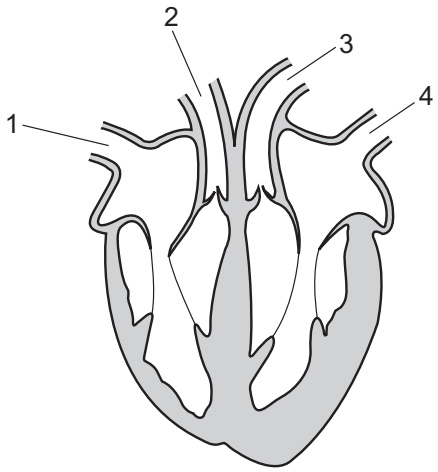
3. The arrows in the diagram represent blood vessels.

Which vessel is the pulmonary vein?



（2023 Feb/Mar · 0654/12 · Question 7 · Core；同题：2023 Feb/Mar · 0654/22 · Question 7 · Extended）

4. The diagram shows a section through the human heart.



Which two blood vessels are arteries?

A 1 and 2 **B** 1 and 4 **C** 2 and 3 **D** 3 and 4

（2025 Feb/Mar · 0654/22 · Question 6 · Extended）

5. Which statement about the mammalian circulatory system is correct?

A The atria contract to send blood directly to the body.

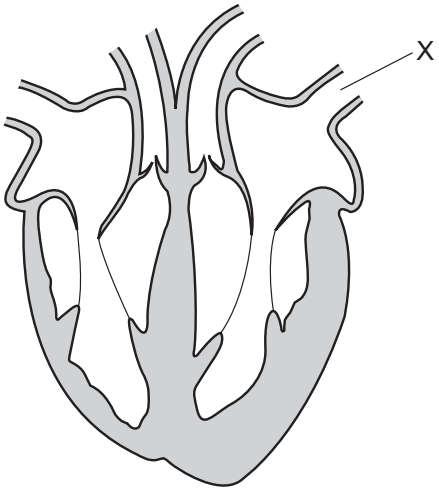
B The blood passes through the heart once for every complete circulation.

C The blood travels from the heart to the lungs and then back to the heart.

D The left ventricle contracts to send blood to the lungs.

(2025 Oct/Nov · 0654/21 · Question 8 · Extended)

6. The diagram shows a section through the human heart and the blood vessels associated with it.



Which row names vessel X and correctly describes the direction of blood flow in vessel X?

	vessel X	direction of blood flow
A	pulmonary vein	away from the lungs and towards the heart
B	pulmonary vein	towards the lungs and away from the heart
C	vena cava	away from the lungs and towards the heart
D	vena cava	towards the lungs and away from the heart

(2024 Feb/Mar · 0654/12 · Question 7 · Core)

7. Which sequence is correct for part of the blood flow pathway in a mammal?

A heart → pulmonary artery → lungs → pulmonary vein

B heart → pulmonary vein → lungs → vena cava

C lungs → pulmonary artery → heart → pulmonary vein

D lungs → pulmonary vein → heart → pulmonary artery

(2022 Oct/Nov · 0654/23 · Question 7 · Extended)

8. Selexipag is a drug used to treat a condition where the blood pressure going to the lungs is too high. The drug works by widening the blood vessel leading to the lungs to reduce the pressure.

Which blood vessel going to the lungs is selexipag widening?

A aorta

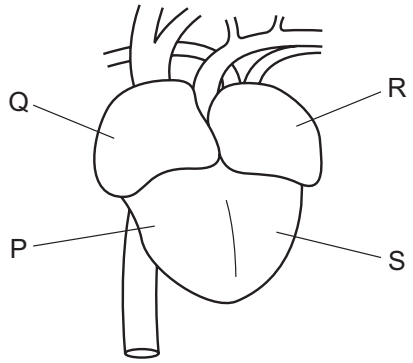
B pulmonary artery

C pulmonary vein

D vena cava

(2024 Oct/Nov · 0654/11 · Question 7 · Core)

9. The diagram shows a front view of a human heart.



What is the sequence in which a blood cell passes through the four chambers of the heart?

A P → S → R → Q

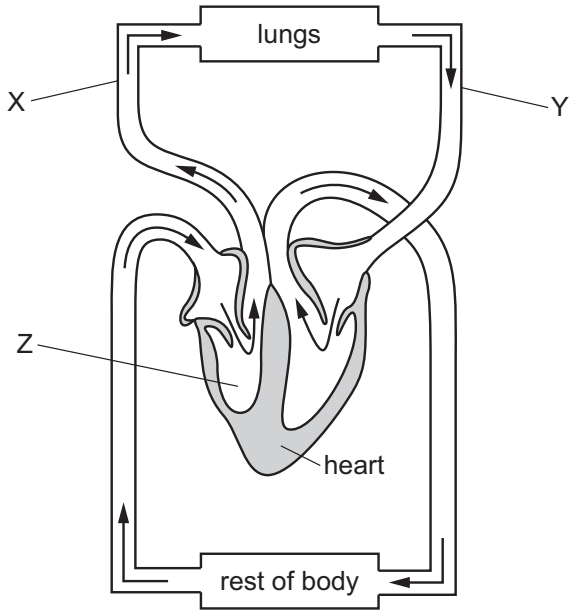
B Q → P → R → S

C R → Q → P → S

D S → R → Q → P

(2025 May/Jun · 0654/22 · Question 9 · Extended)

10. The diagram shows the circulatory system of a mammal.



Which row shows the correct names for blood vessels X and Y and for chamber Z?

	X	Y	Z
A	pulmonary artery	aorta	left ventricle
B	vena cava	pulmonary vein	left ventricle
C	vena cava	aorta	right ventricle
D	pulmonary artery	pulmonary vein	right ventricle

(2023 May/Jun · 0654/22 · Question 7 · Extended)

11. What is the sequence of blood vessels that a red blood cell passes through as it travels from the vena cava to the kidney?

A pulmonary artery → pulmonary vein → aorta → renal artery

B pulmonary artery → pulmonary vein → aorta → renal vein

C pulmonary vein → pulmonary artery → aorta → renal artery

D pulmonary vein → pulmonary artery → aorta → renal vein

（2023 May/Jun · 0654/11 · Question 7 · Core；同题：2023 May/Jun · 0654/21 · Question 7 · Extended）

12. Which row describes part of the circulatory system in mammals?

	name of blood vessel	type of blood transported	comes from	goes to
A	aorta	oxygenated	right ventricle	body
B	pulmonary artery	oxygenated	left ventricle	lungs
C	pulmonary vein	deoxygenated	lungs	left atrium
D	vena cava	deoxygenated	body	right atrium

（2025 Oct/Nov · 0654/23 · Question 7 · Extended）

题型 2：把血液成分与运输、防御或凝血功能对应（考频★★★☆☆）

知识点 血液由血浆、红细胞、白细胞和血小板组成，各成分承担不同功能。

红细胞的细胞质含_____，能运输氧；血浆能运输尿素、营养物质和激素等可溶性物质。

白细胞通过_____和产生抗体防御病原体；血小板参与_____。

答案：血红蛋白；吞噬作用；血液凝固

怎么认 题目出现血液成分及运输、防御或凝血功能时，先按成分与功能的对应关系核对。

一. 由成分核对功能

例题 1

What is transported by red blood cells?

A glucose

B insulin

C oxygen

D urea

（2024 May/Jun · 0654/11 · Question 7 · Core）

解：红细胞的细胞质含血红蛋白，血红蛋白能与氧结合并运输氧。

故选 C。

针对练习

1. Which component of blood transports urea?

A plasma

B platelets

C red blood cells

D white blood cells

（2026 May/Jun · 0654/12 · Question 8 · Core）

2. Which component of blood is matched to its function?

	component	function
A	plasma	clot blood
B	platelets	transport oxygen
C	red blood cells	transport hormones
D	white blood cells	phagocytosis

（2024 Oct/Nov · 0654/22 · Question 7 · Extended）

3. Which feature of a red blood cell allows it to transport oxygen?

A presence of haemoglobin

B presence of a nucleus

C small surface area to volume ratio

D spherical shape

（2025 Feb/Mar · 0654/22 · Question 1 · Extended）

4. Platelets are a component of blood.

What is a function of platelets?

A antibody production

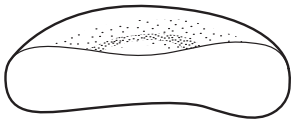
B clotting

C transport of nutrients

D transport of oxygen

（2026 May/Jun · 0654/21 · Question 7 · Extended）

5. The diagram shows a section through a red blood cell.



Which statement is correct for red blood cells?

A The cell has no nucleus to minimise oxygen binding.

B The cell membrane has a small surface area in relation to volume.

C The cytoplasm contains haemoglobin.

D The flat structure makes it easier to be carried through arteries.

（2023 Oct/Nov · 0654/23 · Question 2 · Extended）

6. Which row shows the functions of white blood cells?

	transport of oxygen	phagocytosis	antibody production
A	✓	✗	✗
B	✓	✓	✗
C	✗	✓	✓
D	✗	✗	✓

（2025 Oct/Nov · 0654/11 · Question 9 · Core）

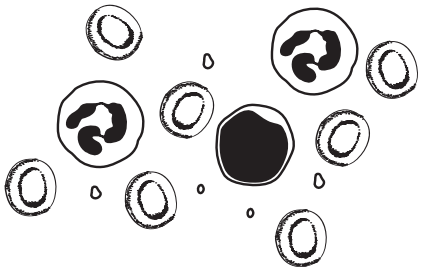
二. 按显微形态辨认或计数血细胞

知识点 血液中的红细胞呈_____状，成熟红细胞没有细胞核，主要运输氧。
白细胞有_____，通常比红细胞大，参与防御；血小板是很小的细胞碎片，参与_____。
显微图中依据细胞核、大小和形状辨认，同一种细胞逐个计数。

答案：双凹圆盘；细胞核；血液凝固

怎么认 题目出现血液显微图并要求辨认或计数细胞时，先按细胞核、大小和形状分类。

例题 2 The diagram shows some blood viewed under a light microscope.



How many red blood cells are shown?

A 1 **B** 2 **C** 5 **D** 7

（2024 May/Jun · 0654/12 · Question 7 · Core；同题：2024 May/Jun · 0654/13 · Question 7 · Core）

解：红细胞呈中央较浅的双凹圆盘状，没有细胞核。
图中符合该形态的细胞共有 7 个。
故选 D。

针对练习

7. The diagram shows some components of blood.



X　　Y　　Z

Which row identifies two of these components?

	red blood cell	white blood cell
A	X	Y
B	Y	X
C	X	Z
D	Z	Y

（2026 May/Jun · 0654/13 · Question 5 · Core）

题型 3：判断冠心病的成因和风险变化（考频★★☆☆☆）

知识点　冠状动脉为心肌输送血液；冠状动脉发生_____时，心肌获得的氧和葡萄糖减少，可能导致冠心病。
吸烟、高脂肪饮食和高盐饮食会使患病风险_____；规律运动、低脂肪饮食和低盐饮食会使患病风险_____。

答案：阻塞；升高；降低

怎么认　题目出现冠心病的成因或风险增减时，先判断冠状动脉是否阻塞，再按生活方式判断风险变化。

例题 1

What increases the risk of coronary heart disease?

A reduced salt diet

B relaxation therapy

C regular exercise

D smoking tobacco

（2025 May/Jun · 0654/12 · Question 8 · Core；同题：2025 May/Jun · 0654/13 · Question 8 · Core）

解：吸烟会损伤血管并增加冠状动脉阻塞的风险，因而使冠心病风险升高。
故选 D。

针对练习

1. What leads to coronary heart disease?

A Coronary arteries become blocked.

B Coronary arteries become enlarged.

C Heart muscles become enlarged.

D Heart muscles do **not** contract.

（2025 Oct/Nov · 0654/12 · Question 7 · Core；同题：2025 Oct/Nov · 0654/13 · Question 7 · Core）

2. What reduces the risk of suffering from coronary heart disease?

1 exercise
2 low fat diet
3 high salt diet
4 smoking

A 1, 2 and 3 **B** 1, 3 and 4 **C** 1 and 2 only **D** 3 and 4 only

（2025 May/Jun · 0654/23 · Question 6 · Extended）

题型 4：把血管壁或瓣膜结构连到功能（考频★☆☆☆☆）

知识点 静脉把血液送回心脏，管腔内的瓣膜使血液沿_____的方向流动，防止血液倒流。
毛细血管连接小动脉与小静脉，其管壁仅由_____层细胞构成，可缩短扩散距离，有利于血液与组织细胞之间进行物质交换。

答案：流向心脏；一

怎么认 题目出现静脉瓣或毛细血管壁厚度时，先把结构与防倒流或缩短扩散距离对应。

例题 1

Veins contain valves along their length.

What is the function of these valves?

A to allow gas exchange
B to carry blood under high pressure
C to ensure one-way flow of blood
D to transport blood to capillaries

（2025 May/Jun · 0654/11 · Question 9 · Core）

解：静脉瓣使血液沿流向心脏的方向运动，可防止血液倒流，保证血液单向流动。
故选 C。

针对练习

1. Which statement about capillaries is correct?

A They connect arteries to the heart.
B The walls are one cell thick to give a short diffusion distance.
C They have muscles to push blood towards the heart.
D They have valves to prevent the backflow of blood.

（2026 May/Jun · 0654/22 · Question 8 · Extended）

题型 5：辨认循环系统所属结构（考频★☆☆☆☆）

知识点 人体循环系统由心脏、_____和血液组成，负责运输氧、养分及代谢废物。
动脉把血液运离心脏；_____使血液保持单向流动，二者都属于循环系统。
细支气管属于_____系统，不属于循环系统。

答案：血管；瓣膜；呼吸

怎么认 题目出现人体结构及所属系统的判断表格时，先区分血管、瓣膜和呼吸道结构。

例题 1

Which row shows structures that are part of the human circulatory system?

	arteries	bronchioles	valves
A	✓	✓	✓
B	✓	✗	✓
C	✗	✓	✗
D	✗	✗	✓

（2026 Feb/Mar · 0654/12 · Question 5 · Core）

解：动脉是血管，属于循环系统；细支气管属于呼吸系统；瓣膜是循环系统中的结构。与题意相符的是 B 行。故选 B。

题型 6：由压差和收缩时相判断瓣膜与射血（考频★☆☆☆☆）

知识点 血液由压强较高处流向压强较低处；心脏瓣膜随两侧压差开闭，使血液单向流动。

心房收缩、心室放松时，心房压强高于心室压强，房室瓣_____；心室压强低于动脉压强，半月瓣_____。

心室收缩时，当心室压强_____动脉压强，半月瓣打开，血液开始离开心脏；同表压强采用相同的任意单位。

答案：打开；关闭；大于

怎么认 题目出现心脏收缩时相或心室与动脉压强表时，先比较瓣膜两侧压强。

例题 1

Which row shows what happens to the heart valves when the atria contract and the ventricles relax?

	valves between the atria and the ventricles	valves between the ventricles and the arteries
A	open	close
B	close	open
C	open	open
D	close	close

（2026 Feb/Mar · 0654/22 · Question 13 · Extended）

解：心房收缩时，心房压强升高；心室放松时，心室压强较低，故房室瓣打开。

心室压强低于动脉压强，故心室与动脉之间的半月瓣关闭。

故选 A。

针对练习

1. The table shows the blood pressures in the left ventricle and aorta at various times in a cardiac cycle.

Which row shows the blood pressures when blood starts to leave the heart?

	pressure in left ventricle / arbitrary units	pressure in aorta / arbitrary units
A	3.0	12.0
B	6.2	6.2
C	16.0	10.0
D	18.0	20.3

（2022 May/Jun · 0654/22 · Question 7 · Extended）

题型 7：从心率时间图求运动后恢复用时（考频★☆☆☆☆）

知识点 心率是心脏每分钟跳动的次数，常用单位为 beats per minute（bpm）。

静息心率是在运动前休息状态下测得的心率；停止运动后，心率降回该值所用的时间称为_____。

读心率随时间变化图时，先读_____，再读心率回到原静息值的时刻。

$\Delta t = t_{\text{回到静息值}} - t_{\text{停止运动}}$，$\Delta t$ 的单位与横轴单位相同。

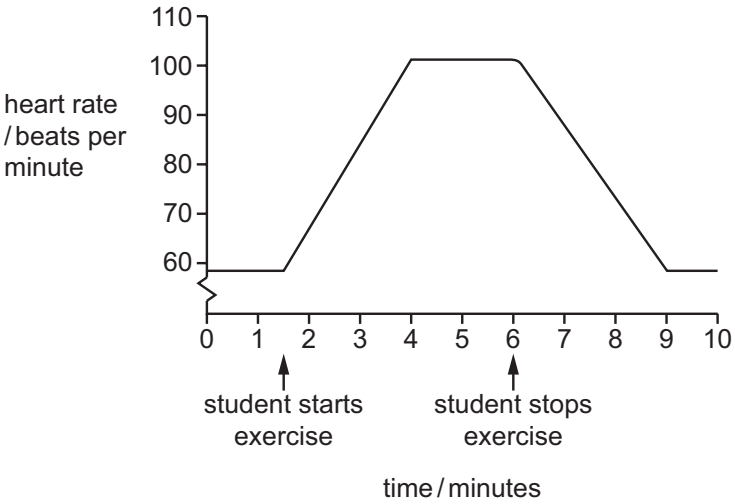
答案：恢复时间；停止运动时刻

怎么认 题目出现心率随时间变化图并求运动后的恢复用时时，先读停止运动和回到原静息值的时刻。

例题 1

Students investigate the effect of exercise on heart rate.

The graph shows the results.



How long does it take for the heart rate to decrease to the resting rate after the student stops exercising?

A 3 minutes

B 5 minutes

C 7.5 minutes

D 9 minutes

（2022 May/Jun · 0654/23 · Question 7 · Extended）

解：由图得，学生在 6 min 停止运动，心率在 9 min 回到运动前的静息值。
$\Delta t = 9\ \text{min} - 6\ \text{min} = 3\ \text{min}$
故选 A。

9.2 心脏、血管与血液：结构题

题型 1：列举血液的主要成分（考频★★☆☆☆）

知识点 血液的主要成分包括_____、红细胞、白细胞和_____。
血浆是血液的液体部分，红细胞、白细胞和血小板悬浮在血浆中。
列举时按题目规定的数量写出不同名称；成分名称没有单位。
答案：血浆；血小板

怎么认 题目出现血液及主要成分，并要求写出若干名称时，先按规定数量列出不同成分。

例题 1

(d) Red blood cells and white blood cells are components of blood.

State the name of one other major component of blood.

（2024 Feb/Mar 0654/42 第1题(d)）

解：由血液的组成可知，主要成分包括血浆、红细胞、白细胞和血小板。
题干已给出红细胞和白细胞，另一个主要成分可写为血浆。
答：血浆。

针对练习

1. **(d)** State the names of **two** main components of blood.

（2023 Feb/Mar 0654/32 第1题(d)）

2. **(c)** The mouth has a good supply of blood.

List **two** main components of blood.

（2024 May/Jun 0654/31 第1题(c)）

题型 2：沿引线辨认心脏结构（考频★★☆☆☆）

知识点 心脏纵剖图中，上方两个腔是心房，下方两个腔是心室；左、右按人体方向命名，纸面右侧常表示心脏左侧。
分隔左右心室的肌肉壁称为_____；左心室壁比右心室壁厚，可据此辨认左心室。
由右心室发出并将血液送往肺的血管是_____，由左心室发出的血管是主动脉。
答案：室间隔；肺动脉

怎么认　题目出现心脏纵剖图、字母引线和结构名称时，先沿引线找到终点，再按腔室位置、肌壁厚度和血管连接辨认。

例题 1

(b) Fig. 1.2 is a diagram of the heart.

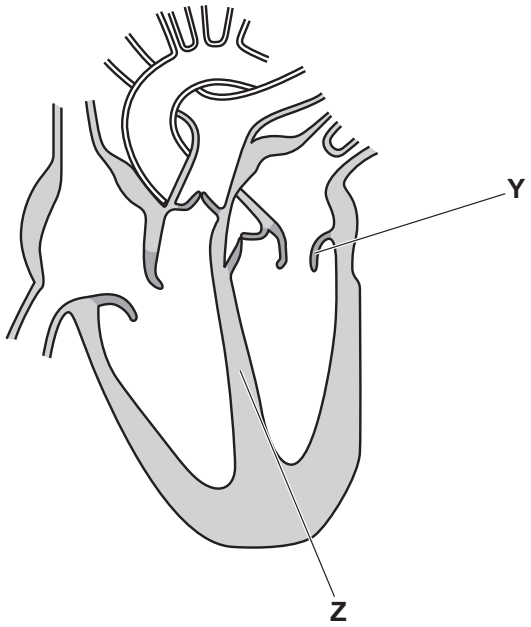


Fig. 1.2

(iii) Identify the part labelled **Z** in Fig. 1.2.

（2022 May/Jun 0654/31 第1题(b)(iii)）

解：沿 Z 的引线可见，终点位于分隔左右心室的肌肉壁，该结构为室间隔。
答：Z 为室间隔。

针对练习

1. Fig. 3.1 is a diagram of a heart.

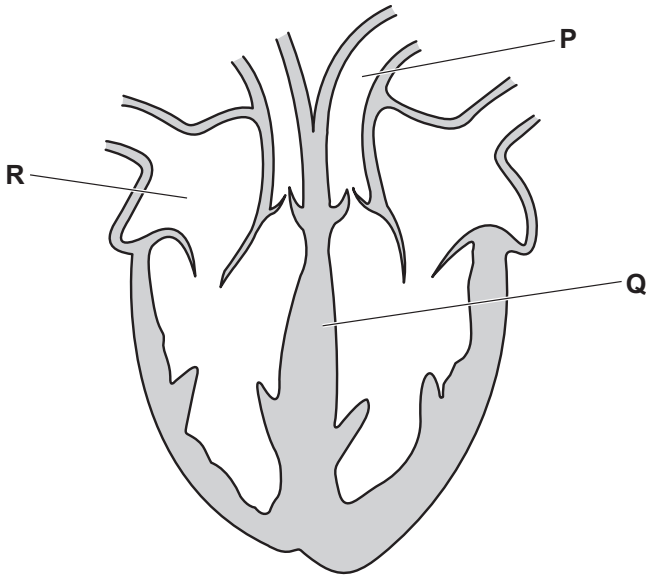


Fig. 3.1

(a) **(i)** Identify the parts labelled **Q** and **R** on Fig. 3.1.

Q

R

（2025 Oct/Nov 0654/31 第3题(a)(i)）

2. **(a)** Figure 2.1 shows a diagram of the heart.

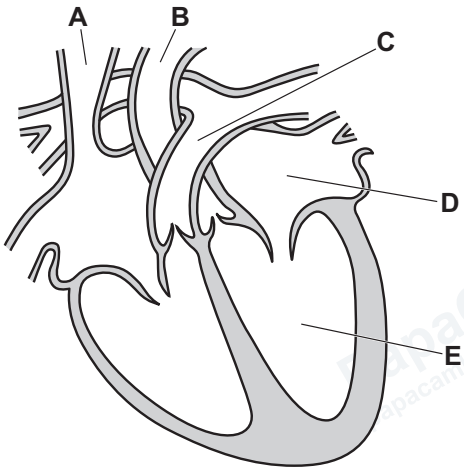


Figure 2.1

Using letters **A**–**E** from Figure 2.1, identify:

the left ventricle

the pulmonary artery.

（2026 May/Jun 0654/43 第2题(a)）

第 10 章 病原体、防御与免疫

10.1 病原体、防御与免疫

题型 1：区分病原体与它引起的疾病（考频★☆☆☆☆）

知识点 病原体（pathogen）是能够引起疾病的_____。

病原体是致病的原因对象，疾病是患病的_____；食物或药物不是生物，不能称为病原体。

答案：生物；结果

怎么认 题目出现病原体的定义并要求选择正确表述时，先找能引起疾病的生物。

例题 1

What is a pathogen?

A a disease caused by an organism

B a food item that causes a disease

C a disease caused by a drug

D an organism that causes a disease

（2026 Feb/Mar · 0654/12 · Question 6 · Core）

解：病原体是能够引起疾病的生物。

A 错，所述对象是疾病；B 错，所述对象是食物；C 错，所述对象是疾病；D 对，所述对象是致病生物。

故选 D。

针对练习

1. What is a pathogen?

A an organism that causes disease

B an organism that makes its own nutrients through photosynthesis

C an organism that gets its energy by eating plants

D an organism that gets its energy from dead organic material in the soil

（2026 May/Jun · 0654/11 · Question 4 · Core）

题型 2：用抗原抗体互补形状解释特异性与治疗（考频★☆☆☆☆）

知识点 病原体表面能引起免疫反应的物质称为_____，抗体是由淋巴细胞产生的蛋白质。
抗体具有与相应抗原形状_____的结合部位，二者只有在形状相配时才能结合。
抗体与病原体表面的抗原结合后，可使病原体被破坏；一种抗体只能识别相应的抗原。

答案：抗原；互补

怎么认 题目出现抗体特异性或抗体治疗后的病原体数量变化时，先判断抗体与抗原的形状是否互补。

例题 1

Which statement describes why antibodies are specific?

A Antibodies have a part that is a complementary shape to the antigen.

B Antibodies have an active site that is the same shape as the antigen.

C Antigens have an active site that fits the shape of the antibody.

D Antigens and antibodies are the same shape.

（2026 May/Jun · 0654/22 · Question 9 · Extended）

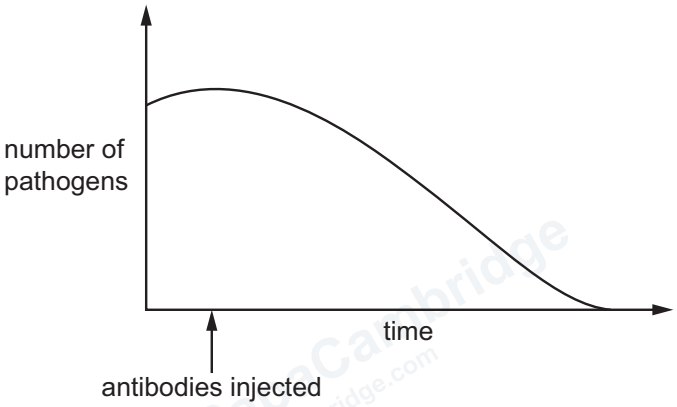
解：抗体的结合部位与相应抗原的形状互补，二者才能发生特异性结合。
选项 A 符合。
故选 A。

针对练习

1. A person is infected with a pathogen.

Antibodies are injected into the person to treat the infection.

The graph shows the number of pathogens present in the blood of this person.



What is a possible explanation for the shape of the graph?

A The antibodies bind to antigens on the pathogens directly destroying the pathogens.

B The antibodies bind to the pathogens making it easier for lymphocytes to engulf and destroy them.

C The antibodies cause the production of memory cells so the patient becomes immune.

D The antibodies have the same antigens as the pathogen and stimulate an immune response.

（2026 May/Jun · 0654/21 · Question 8 · Extended）

题型 3：按抗原进入到记忆细胞排序接种过程（考频★☆☆☆☆）

知识点 接种疫苗时，抗原先被引入体内，并刺激淋巴细胞产生与该抗原相应的_____。
部分淋巴细胞形成_____；再次遇到相同抗原时，它们能迅速产生大量相应抗体。
长期免疫依赖记忆细胞对同种抗原的再次识别。

答案：抗体；记忆细胞

怎么认 题目出现接种后的若干阶段并要求排序时，先排抗原进入，再排抗体、记忆细胞和长期免疫。

例题 1

Some of the stages in protecting a person from a pathogen by vaccination are listed.

1 Antibodies are produced by lymphocytes.

2 Antigens are introduced into the body.

3 Long term immunity is developed.

4 Memory cells are produced.

What is the order of these stages?

A 1 → 3 → 2 → 4

B 2 → 1 → 4 → 3

C 2 → 1 → 3 → 4

D 4 → 2 → 3 → 1

（2026 May/Jun · 0654/23 · Question 8 · Extended）

解： 接种使抗原进入体内，故阶段 2 最先发生。
抗原刺激淋巴细胞产生抗体，故阶段 1 随后发生。
产生记忆细胞后才能形成长期免疫，故阶段 4 在阶段 3 之前。
由此得顺序为 2, 1, 4, 3，故选 B。

题型 4：从用抗生素后的数量曲线判断病原体与抗性（考频★☆☆☆☆）

知识点 抗生素能杀死细菌或抑制其繁殖，对_____感染有效，对病毒感染_____。
细菌种群中若有少数个体具有_____，抗生素杀死敏感细菌后，这些个体仍可存活并繁殖。
病原体数量可用个数或相对数量表示；本题纵轴未标单位，只比较数量随时间的变化。

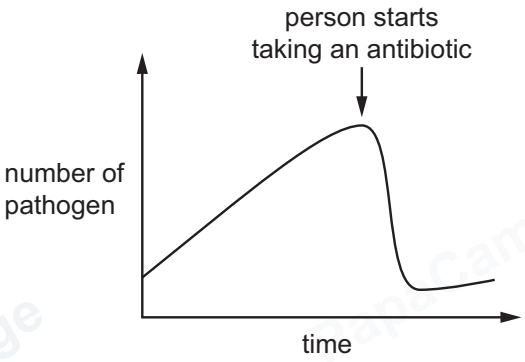
答案：细菌；无效；抗药性

怎么认 题目出现服用抗生素后的数量曲线时，先由数量下降判定为细菌，再看低点后是否保留并回升。

例题 1

A person is infected with a pathogen.

The graph shows the number of the pathogen in the person's blood before and after the person starts taking an antibiotic.



Which statement describes the type of pathogen and the effect of the antibiotic on the pathogen?

A The pathogen is a bacterium and none of the pathogen show resistance to the antibiotic.

B The pathogen is a bacterium and some of the pathogen show resistance to the antibiotic.

C The pathogen is a virus and none of the pathogen show resistance to the antibiotic.

D The pathogen is a virus and some of the pathogen show resistance to the antibiotic.

（2026 May/Jun · 0654/13 · Question 8 · Core）

解：服用抗生素后，病原体数量迅速下降，说明抗生素对该病原体有效，因此该病原体是细菌。
曲线降至低点后未降为零，并再次上升，说明部分细菌具有抗药性，存活后继续繁殖。
故选 B。

题型 5：核对不同地区疫苗接种率曲线（考频★☆☆☆☆）

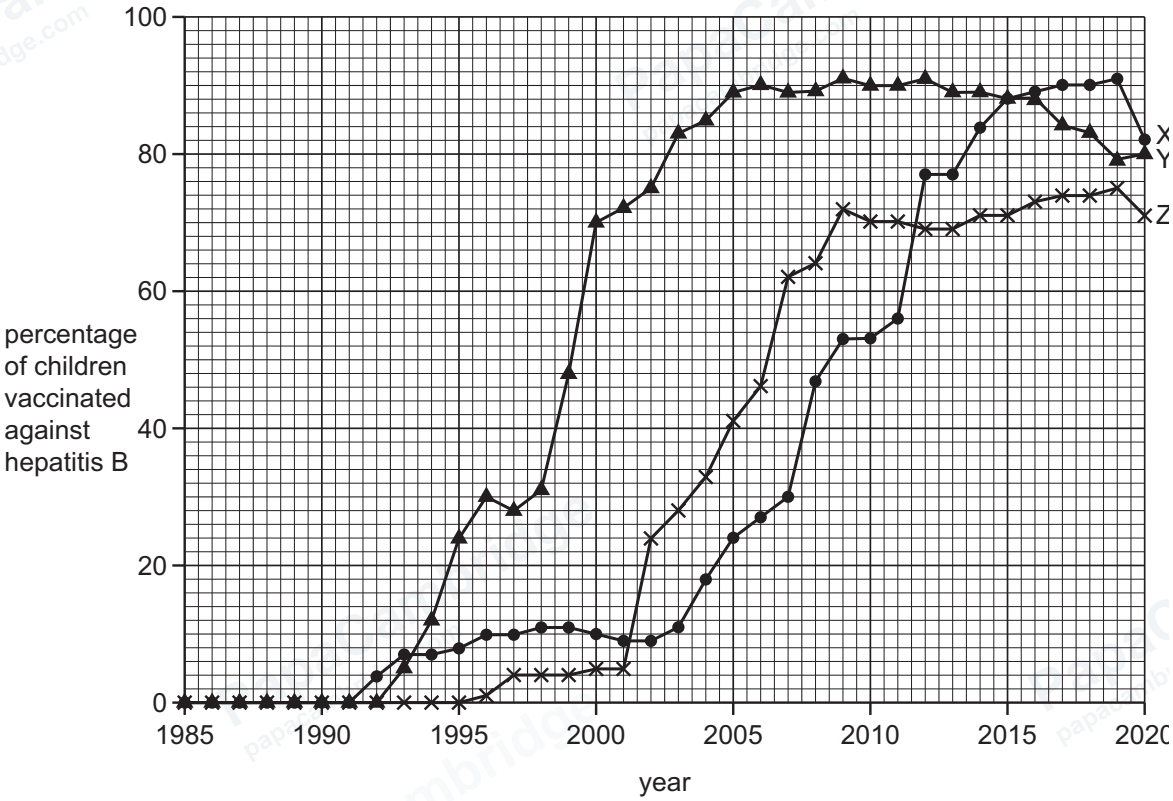
知识点 疫苗接种率表示某地区已接种某种疫苗的儿童人数占该地区儿童总人数的百分比，单位为_____。
读取折线图时，应在同一统计口径下，先按横轴确定年份，再由该地区曲线上的点读出纵轴数值。
比较两地区同年的接种率，倍数等于一个地区的读数除以另一个地区的读数。
两地区同年接种率相同，表示两条曲线在该年份的纵坐标_____；判断逐年增加，必须核对相邻各年的数值均_____。

答案：百分比（%）；相等；大于前一年

怎么认 题目出现多地区接种率折线图并要求判断结论时，先按地区和年份逐点读数，再核对倍数、交点及逐年变化。

例题 1

The graph shows the percentage of children vaccinated against hepatitis B in three regions, X, Y and Z, from 1985 to 2020.



What is a correct conclusion from the graph?

A In 2000, the percentage of children vaccinated against hepatitis B was seven times greater in region Y than region Z.

B In 2015, the percentage of children vaccinated against hepatitis B was the same in regions X and Y.

C The percentage of children vaccinated against hepatitis B increases every year in region X.

D 70% of children were vaccinated against hepatitis B in region Y in 2010.

（2026 Feb/Mar · 0654/22 · Question 2 · Extended）

解：由图可读出，2000 年 Y 区约为 70%，Z 区约为 5%，$\frac{70}{5}=14$，A 错。
2015 年 X 区与 Y 区的曲线相交，接种率均约为 88%，B 对。
X 区接种率在部分相邻年份持平或下降；2010 年 Y 区约为 90%，C、D 错。
故选 B。

第 11 章 肺部气体交换与呼吸动作

11.1 肺部气体交换与呼吸动作

题型 1：从呼吸道层次定位结构与空气路径（考频★★☆☆☆）

知识点 在正常吸气时，空气依次经过喉、_____、支气管、细支气管，最后进入_____。

气管由喉向下延伸，管壁有环状软骨，在胸腔内分成左右支气管。

支气管进入肺后逐级分成较细的细支气管。

横膈位于胸腔_____，在图中通常呈肺下方的拱形薄层。

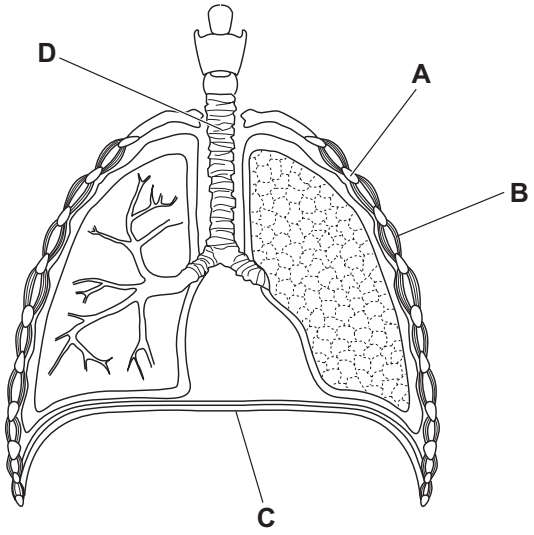
答案：气管；肺泡；底部

怎么认 题目出现呼吸系统结构图、标签或空气路径时，先按喉、气管、支气管、细支气管、肺泡的顺序定位。

例题 1

The diagram shows the human gas exchange system.

Which label shows the diaphragm?



（2025 May/Jun · 0654/11 · Question 10 · Core）

解： 横膈位于胸腔底部，是肺下方的拱形肌性结构。

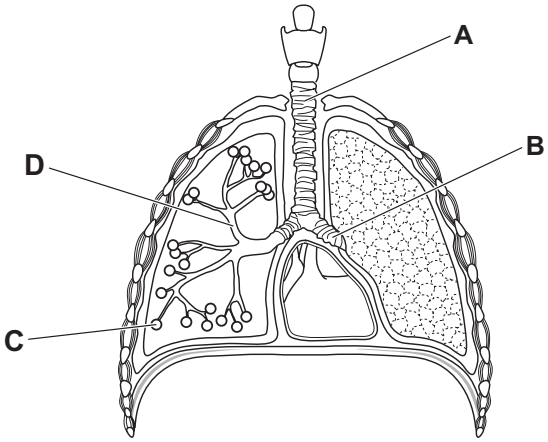
图中 C 指向肺下方的拱形结构。

故选 C。

针对练习

1. The diagram shows part of the breathing system in humans.

Which labelled part is the trachea?



（2025 Oct/Nov · 0654/22 · Question 8 · Extended）

2. What is the correct pathway for air during inspiration?

A alveoli → bronchi → bronchiole → trachea → larynx

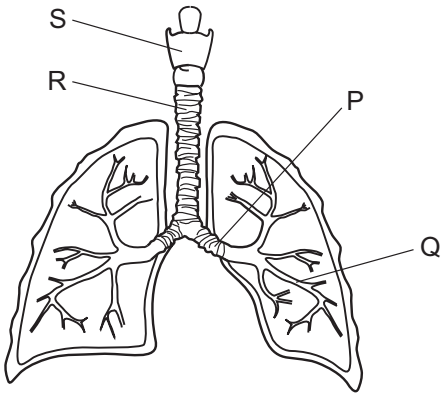
B alveoli → bronchiole → bronchi → trachea → larynx

C larynx → trachea → bronchi → bronchiole → alveoli

D larynx → trachea → bronchiole → bronchi → alveoli

（2026 Feb/Mar · 0654/22 · Question 3 · Extended）

3. The diagram shows the main structures in the breathing system of humans.

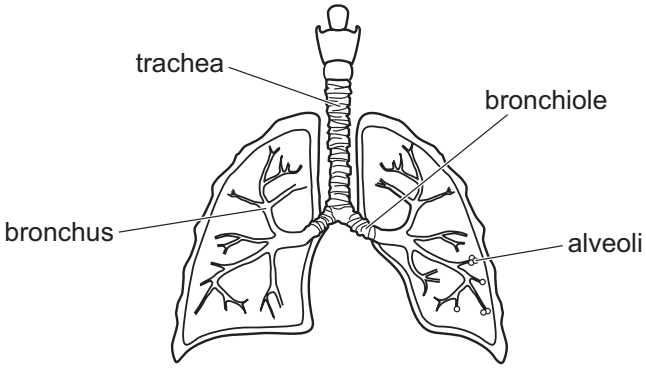


Which row identifies the larynx, bronchus, trachea and bronchioles?

	larynx	bronchus	trachea	bronchioles
A	P	Q	R	S
B	R	P	S	Q
C	S	P	R	Q
D	S	Q	P	R

（2022 Feb/Mar · 0654/12 · Question 8 · Core；同题：2022 Feb/Mar · 0654/22 · Question 8 · Extended）

4. In the diagram of the human breathing system, which structures are correctly labelled?



A alveoli and bronchiole

B alveoli and trachea

C bronchus and bronchiole

D bronchus and trachea

（2023 May/Jun · 0654/11 · Question 8 · Core）

题型 2：由活动或休息判断呼吸频率和深度（考频★★★☆☆）

知识点 呼吸频率是每分钟呼吸的次数，单位为次/min；呼吸深度是每次呼吸吸入或呼出空气的体积，单位可用 cm^3。

运动中，肌肉细胞的呼吸作用增强，需要更多氧气并产生更多二氧化碳，因此呼吸频率_____，呼吸深度_____。

运动结束后的恢复阶段，随身体需求下降，呼吸频率和深度逐渐_____，直至接近安静状态。

答案：增加；增加；减小

怎么认 题目出现运动中或运动结束后的呼吸变化时，先判断所处阶段，再判断频率和深度的增减。

例题 1

When a person exercises for 10 minutes, what is the effect on the depth and rate of their breathing?

	depth of breathing	rate of breathing
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

（2022 May/Jun · 0654/12 · Question 8 · Core；同题：2022 May/Jun · 0654/13 · Question 8 · Core）

解：运动过程中，肌肉细胞的呼吸作用增强，需要更多氧气并产生更多二氧化碳。

为加快气体交换，呼吸深度增加，呼吸频率增加。故选 D。

针对练习

1. A pupil runs to school.

What happens to the rate and depth of their breathing as they run?

	rate	depth
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

（2024 May/Jun · 0654/21 · Question 8 · Extended）

2. A person runs quickly up some stairs.

Which row shows the effect on their breathing?

	depth of breathing	**rate of breathing**
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

（2026 May/Jun · 0654/13 · Question 6 · Core）

3. Which row shows the changes that occur during exercise?

	breathing rate	depth of breathing
A	increases	increases
B	increases	stays the same
C	stays the same	increases
D	stays the same	stays the same

（2024 Oct/Nov · 0654/12 · Question 8 · Core；同题：2024 Oct/Nov · 0654/13 · Question 8 · Core）

4. Which row shows the effect of physical activity on breathing?

	rate of breathing compared to when at rest	depth of breathing compared to when at rest
A	faster	deeper
B	slower	deeper
C	faster	shallower
D	slower	shallower

（2025 Feb/Mar · 0654/12 · Question 11 · Core）

5. A student runs 5 km.

Which statement describes the change in the student's breathing 5 minutes after the run ends?

A Depth decreases and rate decreases.

B Depth decreases and rate increases.

C Depth increases and rate decreases.

D Depth increases and rate increases.

（2025 Oct/Nov · 0654/12 · Question 8 · Core；同题：2025 Oct/Nov · 0654/13 · Question 8 · Core）

题型 3：比较吸入与呼出气体成分（考频★★☆☆☆）

知识点 气体成分常用体积分数表示，单位为 %；正常吸入空气中氧约为 21%，二氧化碳约为 0.04%。气体交换后，呼出空气中的氧含量_____，二氧化碳含量_____；氧按题中选项取 16% 或 17%，二氧化碳约为 4%。

呼出空气经过湿润的呼吸道，水蒸气含量_____，通常达到饱和状态。

答案：降低；升高；升高

怎么认 题目出现吸入空气、呼出空气或吹气后的气体成分时，先核对氧减少、二氧化碳增加、水蒸气饱和。

例题 1

What is the expected concentration of oxygen and the water vapour content in expired air?

	oxygen / %	water vapour
A	16	saturated
B	16	variable
C	21	saturated
D	21	variable

（2023 Oct/Nov · 0654/13 · Question 8 · Core；同题：2023 Oct/Nov · 0654/23 · Question 8 · Extended）

解：气体交换消耗部分氧，呼出空气中氧由约 21% 降至约 16%；呼吸道使呼出空气中的水蒸气达到饱和。故选 A。

针对练习

1. A person inflates a balloon by breathing into it.

What is the composition of the air in the balloon?

	percentage of oxygen	percentage of carbon dioxide
A	0.04	21
B	4	16
C	16	4
D	21	0.04

（2024 May/Jun · 0654/11 · Question 8 · Core）

2. Which gas in expired air has a greater percentage composition than in inspired air?

A carbon dioxide

B methane

C nitrogen

D oxygen

（2025 Oct/Nov · 0654/11 · Question 10 · Core）

3. Which row shows the percentages for inspired air and expired air?

	inspired air / %		expired air / %	
	oxygen	carbon dioxide	oxygen	carbon dioxide
A	21	0.04	17	4
B	21	0.04	21	0.04
C	17	4	17	4
D	17	4	21	0.04

（2025 May/Jun · 0654/12 · Question 9 · Core；同题：2025 May/Jun · 0654/13 · Question 9 · Core）

4. Which statement about the composition of expired air, compared with inspired air, is correct?

A The percentage of carbon dioxide is decreased and the percentage of water vapour is increased.

B The percentage of carbon dioxide is increased and the percentage of water vapour is increased.

C The percentage of oxygen is decreased and the percentage of carbon dioxide is decreased.

D The percentage of oxygen is increased and the percentage of carbon dioxide is decreased.

（2024 May/Jun · 0654/12 · Question 8 · Core；同题：2024 May/Jun · 0654/13 · Question 8 · Core）

题型 4：读呼吸曲线的幅度和频率（考频★☆☆☆☆）

知识点 呼吸曲线的波幅表示_____，波幅越大，每次呼吸移动的空气体积越大。

单位时间内完整波形的个数表示_____，常用单位为次/min。

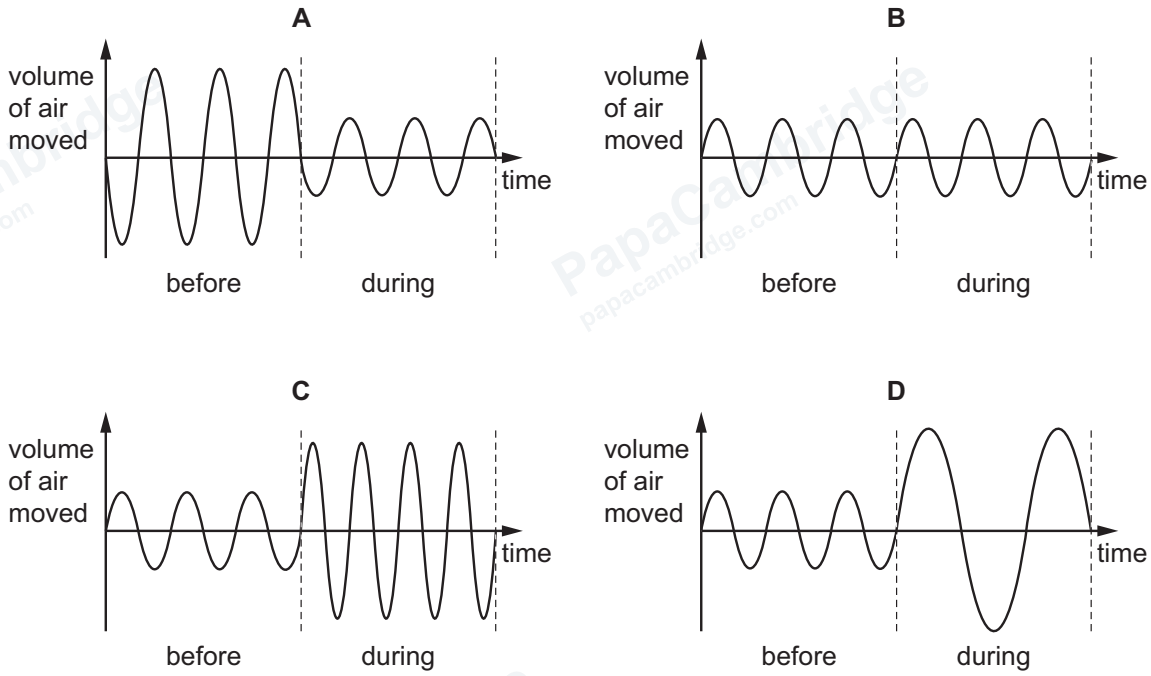
运动时，呼吸深度和呼吸频率均_____。

答案：呼吸深度；呼吸频率；增大

怎么认 题目出现运动前后呼吸曲线时，先比较波幅和单位时间内的波数。

例题 1

Which diagram shows the rate and depth of breathing of a person before and during exercise?



（2026 May/Jun · 0654/11 · Question 5 · Core）

解：曲线波幅表示呼吸深度，单位时间内完整波形的个数表示呼吸频率。
运动时呼吸深度和呼吸频率均增大。
C 图中 during 阶段的波幅增大，单位时间内的波数也增多。故选 C。

题型 5：沿装置追踪空气解释二氧化碳检测（考频★★☆☆☆）

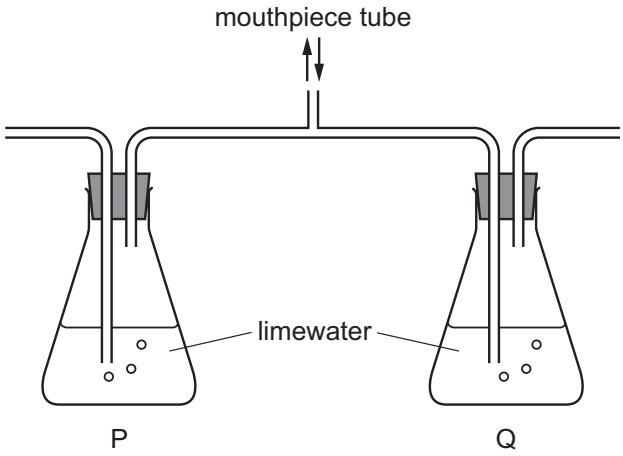
知识点 石灰水用于检验二氧化碳；含较多二氧化碳的气体通入石灰水时，石灰水由无色变为_____。
人体细胞进行_____会产生二氧化碳，因此呼出空气中的二氧化碳含量高于吸入空气。
气体从_____导管进入容器时，先在石灰水中形成气泡，再由短导管排出；装置的通气方向决定空气经过哪瓶石灰水。

答案：乳白色；呼吸作用；长

怎么认 题目出现双瓶石灰水装置、长短导管及吸气或呼气方向时，先沿气流判断空气通入哪瓶。

例题 1

A student breathed gently in and out of the mouthpiece of the apparatus shown.



What were the results after 10 breaths?

	P	Q
A	colourless	colourless
B	colourless	milky
C	milky	colourless
D	milky	milky

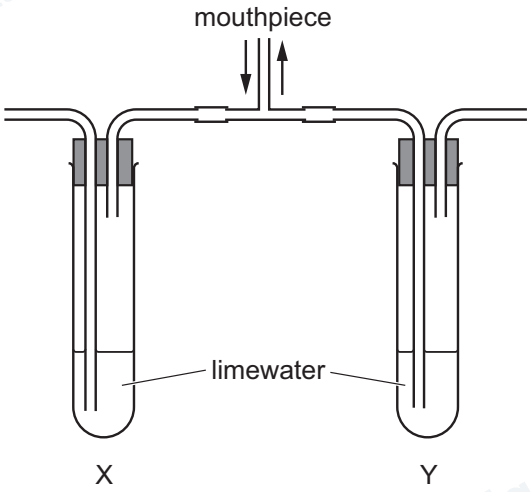
（2024 Oct/Nov · 0654/21 · Question 8 · Extended）

解： 吸气时，外界空气由 P 的长导管通入石灰水，再经短导管到达口含管；呼气时，呼出空气由 Q 的长导管通入石灰水，再经短导管排出。

外界空气中二氧化碳较少，10 次呼吸后 P 中石灰水仍为无色；呼出空气中二氧化碳较多，Q 中石灰水变为乳白色。

故选 B。

1. A student investigates gas exchange using the apparatus shown.



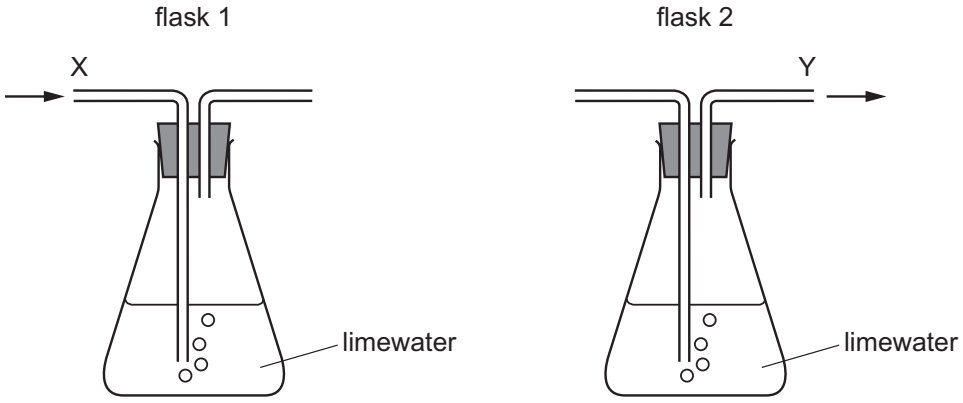
The student breathes in fresh air, then breathes in and out through the mouthpiece of the apparatus. This is repeated a few times for two minutes.

Which row shows the appearance of the limewater in X and in Y after two minutes?

	X	Y
A	milky	milky
B	milky	colourless
C	colourless	milky
D	colourless	colourless

（2026 Feb/Mar · 0654/12 · Question 7 · Core）

2. Two flasks are set up as shown. A student breathes out through tube X of flask 1. Another student breathes in through tube Y of flask 2.



The students obtain different results.

Which body process causes this difference?

A absorption

B assimilation

C digestion

D respiration

（2025 Oct/Nov · 0654/21 · Question 9 · Extended）

题型 6：联结运动、血中二氧化碳与呼吸调节（考频★☆☆☆☆）

知识点 运动时，肌肉细胞呼吸加快，产生的_____（CO_2）增多并进入血液。

血液中二氧化碳浓度升高由_____检测，呼吸频率和呼吸深度随之增大，使更多二氧化碳排出。

呼吸频率的单位可写作次/分钟；变化图未标数值时，应比较变化方向、先后和稳定趋势。

答案：二氧化碳；脑

怎么认 题目出现运动、血中二氧化碳浓度与呼吸变化图时，先判定二氧化碳升高，再核对呼吸升高的时序。

例题 1

During physical activity, the rate and depth of breathing increases.

This increase in breathing is caused by the detection of an increase in carbon dioxide concentration.

Which row describes this detection?

	location where increase is detected	organ that detects the increase
A	alveoli	brain
B	alveoli	lungs
C	blood	brain
D	blood	lungs

（2025 May/Jun · 0654/23 · Question 13 · Extended）

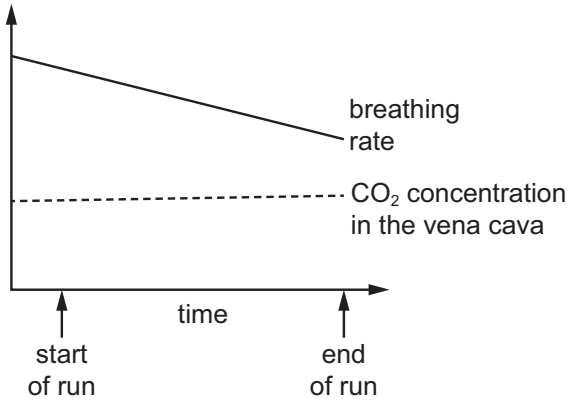
解：运动时肌肉细胞呼吸加快，产生的二氧化碳增多并进入血液，故浓度升高的位置是血液。
血液中二氧化碳浓度的升高由脑检测，脑调节呼吸频率和呼吸深度。
故选 C。

针对练习

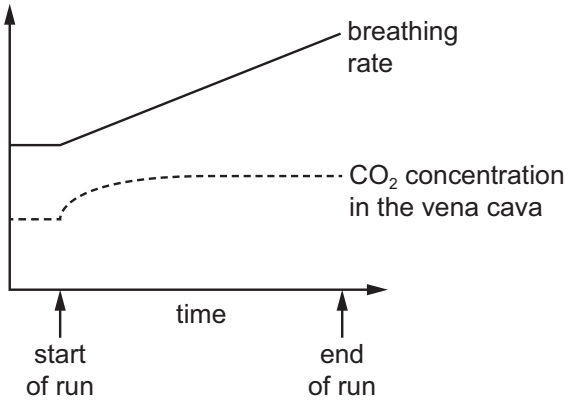
1. An athlete is running 1000 m.

Which graph shows the changes in their breathing rate and the concentration of carbon dioxide in their vena cava during the run?

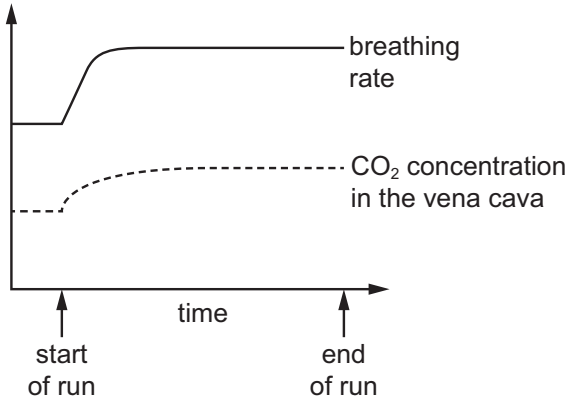
A



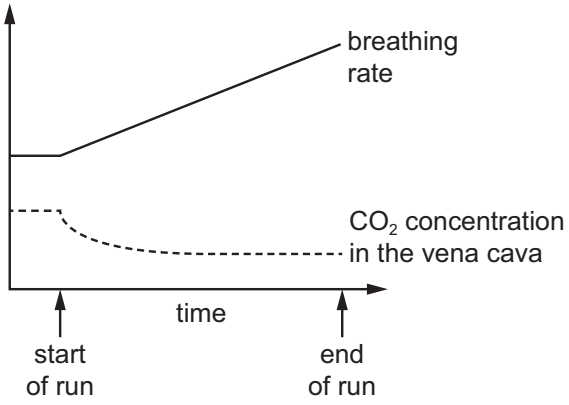
B



C



D



（2022 Oct/Nov · 0654/23 · Question 8 · Extended）

第 12 章 有氧、无氧呼吸与能量

12.1 有氧、无氧呼吸与能量

题型 1：区分无氧呼吸的生物、产物与能量（考频★★★☆☆）

知识点 人体肌肉的无氧呼吸，是葡萄糖在不利用氧的条件下分解并释放能量的过程，产物为_____，不产生二氧化碳。

该过程常在剧烈运动、供氧不能满足需要时发生；每个葡萄糖分子释放的能量比有氧呼吸_____。

剧烈运动后，肌肉中葡萄糖和氧的相对浓度降低，乳酸的相对浓度升高；相对浓度表示高低，不设数值单位。

答案：乳酸；少

怎么认 题目出现肌肉、剧烈运动、供氧不足、乳酸或能量比较时，先判断是否为肌肉无氧呼吸。

一. 人体肌肉缺氧时形成乳酸

例题 1

An athlete runs as fast as possible.

After 200 m, the athlete cannot continue and is breathing deeply.

What accumulated in the athlete's muscles?

A alcohol

B carbon dioxide

C lactic acid

D water

（2025 Feb/Mar · 0654/22 · Question 7 · Extended）

解：200 m 全速跑时肌肉需要大量能量，供氧不能满足需要，肌肉进行无氧呼吸。
人体肌肉无氧呼吸产生乳酸，乳酸在肌肉中积累，故选 C。

针对练习

1. Which statement about anaerobic respiration in muscles is correct?

A It produces carbon dioxide and lactic acid.

B It produces carbon dioxide and water.

C It releases less energy per glucose molecule than aerobic respiration.

D It releases more energy per glucose molecule than aerobic respiration.

（2026 May/Jun · 0654/23 · Question 9 · Extended）

2. Which statement about anaerobic respiration is correct?

A It does not cause an oxygen debt.

B It occurs in the muscles during vigorous exercise.

C It uses oxygen to release energy from nutrient molecules.

D It releases more energy per glucose molecule compared to aerobic respiration.

（2023 May/Jun · 0654/21 · Question 8 · Extended）

3. What is the relative concentration of glucose, lactic acid and oxygen in the muscles immediately after extreme exercise?

	glucose	lactic acid	oxygen
A	high	high	low
B	high	low	high
C	low	high	low
D	low	low	high

（2022 May/Jun · 0654/23 · Question 8 · Extended）

二. 酵母或乳酸菌的无氧呼吸

知识点 无氧呼吸是不使用氧气分解葡萄糖并释放能量的过程。

酵母进行无氧呼吸时，葡萄糖分解产生_____和_____；乳酸菌进行无氧呼吸时，葡萄糖分解产生乳酸。

无氧呼吸释放的能量少于有氧呼吸。

上述关系适用于无氧条件；文字方程式表示物质变化，不涉及物理量单位。

答案：酒精；二氧化碳

怎么认 题目出现酵母、面包制作、酒精或乳酸菌产生乳酸时，先判定对应的无氧呼吸及其产物。

例题 2

What is the word equation for anaerobic respiration in yeast?

A glucose → alcohol + carbon dioxide

B glucose → carbon dioxide + water

C glucose → lactic acid

D glucose + oxygen → carbon dioxide + water

（2023 Feb/Mar · 0654/22 · Question 8 · Extended）

解：酵母在无氧条件下分解葡萄糖，产物为酒精和二氧化碳。

故选 A。

针对练习

4. Yogurt is a food made by adding bacteria to milk. The bacteria feed on sugars in the milk and produce lactic acid. The lactic acid denatures the milk protein.

Which process produces the lactic acid?

A aerobic respiration

B anaerobic respiration

C assimilation

D decomposition

（2025 May/Jun · 0654/21 · Question 8 · Extended）

5. Which equation shows the metabolic process used in bread making?

A carbon dioxide + water → glucose + oxygen

B glucose + oxygen → carbon dioxide + water

C glucose → ethanol + carbon dioxide

D glucose → lactic acid

（2024 Oct/Nov · 0654/23 · Question 8 · Extended）

三. 并列比较有氧和无氧产物及能量

知识点 有氧呼吸是葡萄糖在_____参与下完全分解，生成二氧化碳和水，并释放较多能量。
无氧呼吸在缺少氧气时进行，释放的能量比有氧呼吸_____。
肌肉细胞无氧呼吸生成乳酸；酵母无氧呼吸生成酒精和二氧化碳，因此_____可由两种呼吸产生。

答案：氧气；少；二氧化碳

怎么认 题目出现呼吸反应式或有氧、无氧产物集合图时，先判断氧气条件，再对应产物和能量。

例题 3

Which process releases the most energy?

A carbon dioxide + water → glucose + oxygen

B glucose + oxygen → carbon dioxide + water

C glucose → alcohol + carbon dioxide

D glucose → lactic acid

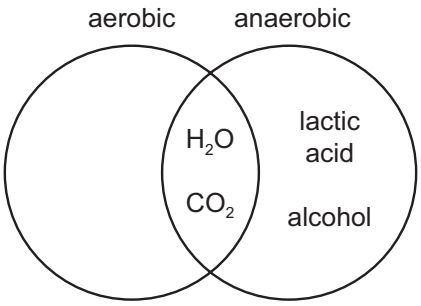
（2024 May/Jun · 0654/23 · Question 8 · Extended）

解：有氧呼吸时，葡萄糖与氧气反应，生成二氧化碳和水，释放的能量多于无氧呼吸。
题中 B 为有氧呼吸，故选 B。

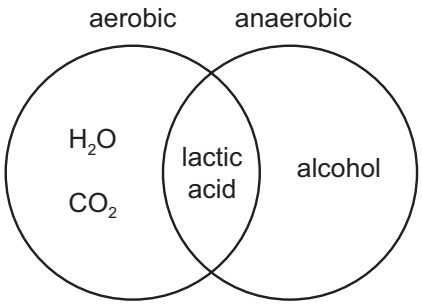
针对练习

6. Which diagram gives the possible products of aerobic respiration and anaerobic respiration?

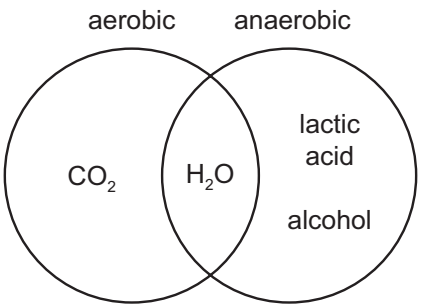
A



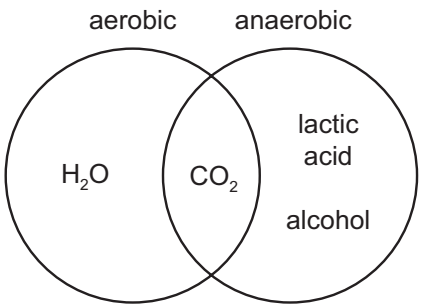
B



C



D



（2022 Oct/Nov · 0654/21 · Question 8 · Extended）

题型 2：核对有氧呼吸方程的物质方向（考频★★★☆☆）

知识点 有氧呼吸是在细胞中利用氧分解葡萄糖并释放能量的化学反应。

葡萄糖和氧是_____，在反应中被消耗；二氧化碳和水是_____，在反应中生成。

密闭装置中生物进行有氧呼吸时，氧浓度降低，二氧化碳浓度_____。

答案：反应物；产物；升高

怎么认 题目出现呼吸方程缺项、物质进出细胞或气体浓度变化时，先判定反应物和产物。

例题 1

What are the products of aerobic respiration?

1 carbon dioxide

2 glucose

3 water

A 1 and 2 only **B** 1 and 3 only **C** 1, 2 and 3 **D** 2 and 3 only

（2022 May/Jun · 0654/11 · Question 8 · Core）

解：有氧呼吸生成二氧化碳和水，葡萄糖是反应物，故产物为 1 和 3。

故选 B。

针对练习

1. What are the products of aerobic respiration?

A carbon dioxide and water

B carbon dioxide and glucose

C oxygen and glucose

D oxygen and water

（2025 Feb/Mar · 0654/12 · Question 12 · Core）

2. The word equation for aerobic respiration is shown.

oxygen + → carbon dioxide + water

Which molecule is missing from the equation?

A glucose

B glycogen

C starch

D sucrose

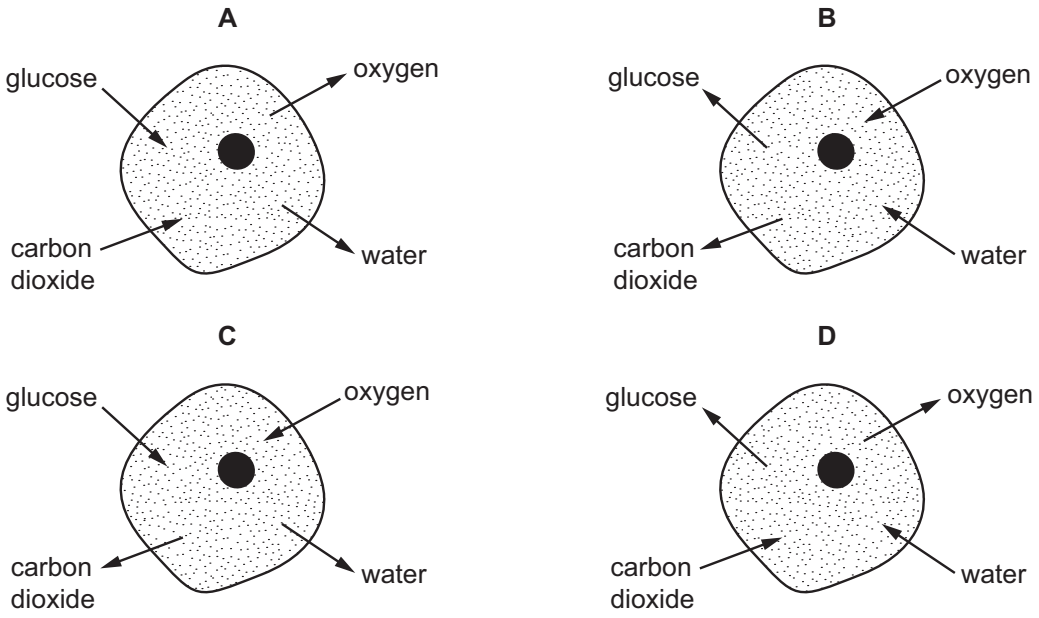
（2026 May/Jun · 0654/11 · Question 6 · Core）

3. Which substances are used and produced in aerobic respiration?

	carbon dioxide	oxygen	glucose	water
A	produced	used	produced	used
B	produced	used	used	produced
C	used	produced	produced	used
D	used	produced	used	produced

（2024 Feb/Mar · 0654/22 · Question 8 · Extended）

4. Which diagram of a cell shows the correct movement of substances for the process of aerobic respiration?



（2022 Oct/Nov · 0654/12 · Question 8 · Core；同题：2022 Oct/Nov · 0654/22 · Question 8 · Extended）

5. A student places an insect in a sealed test-tube and measures the concentration of oxygen and carbon dioxide in the test-tube. The insect is left for 30 minutes.

The concentration of oxygen and carbon dioxide are then measured again. The results are shown in the table.

Which row shows how these concentrations change during the experiment?

	oxygen concentration	carbon dioxide concentration
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

（2022 Oct/Nov · 0654/13 · Question 8 · Core）

题型 3：用检测气体的实验识别呼吸产物（考频★★☆☆☆）

知识点 呼吸作用是细胞分解葡萄糖并释放能量的过程；有氧呼吸需要氧气，产物有二氧化碳和水。

酵母在缺氧条件下进行_____呼吸，产生乙醇和二氧化碳。

二氧化碳可用_____检验；把气体通入其中，液体由澄清变为乳白色。

碳酸氢盐指示剂在大气二氧化碳浓度下呈橙色，在较高浓度下呈_____；上述颜色判断无单位。

答案：无氧；石灰水；黄色

怎么认 题目出现二氧化碳检验、呼吸装置或石灰水变乳白时，先结合气流与氧气条件判断二氧化碳。

例题 1

What is used to test for the presence of carbon dioxide?

A Benedict's solution

B ethanol

C iodine solution

D limewater

（2024 Feb/Mar · 0654/12 · Question 8 · Core）

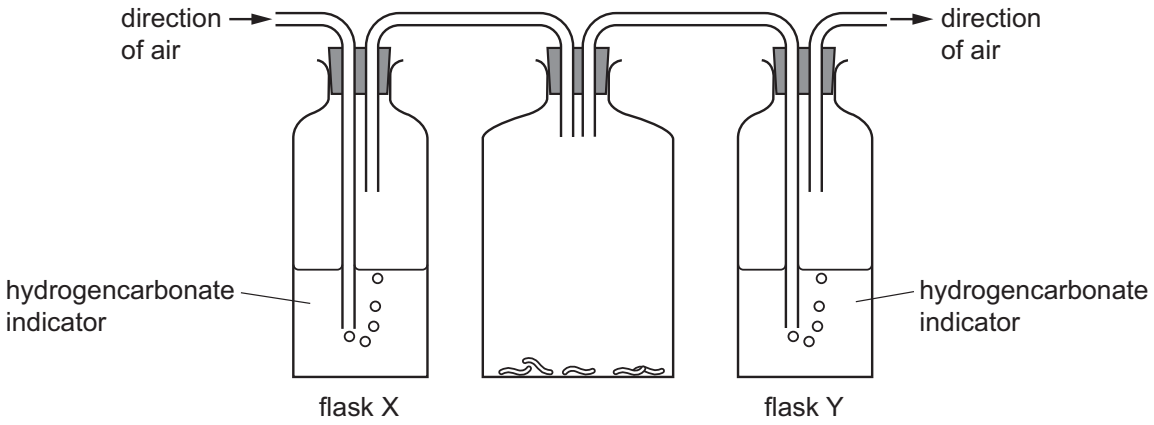
解：将待测气体通入石灰水，若含二氧化碳，石灰水由澄清变为乳白色。
故选 D。

针对练习

1. The diagram shows apparatus used to investigate respiration of blowfly larvae.

Air is sucked through the solutions of hydrogencarbonate indicator as shown.

Hydrogencarbonate indicator turns orange with carbon dioxide at atmospheric concentration. It turns yellow with high carbon dioxide concentration.



What are the colours of the hydrogencarbonate indicator in the flasks after 24 hours?

	flask X	flask Y
A	orange	orange
B	orange	yellow
C	yellow	orange
D	yellow	yellow

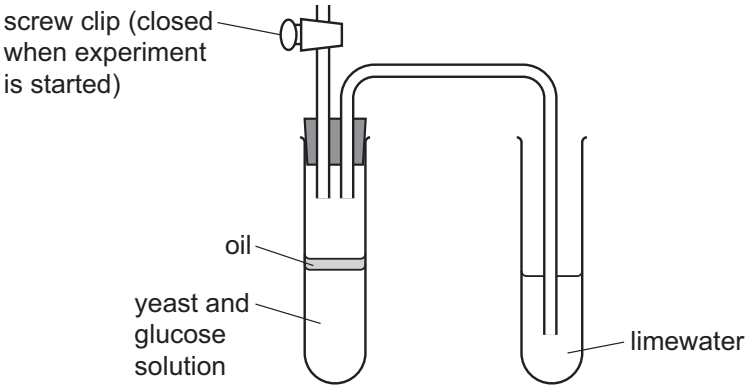
（2022 Oct/Nov · 0654/11 · Question 8 · Core）

2. A student places a mixture of yeast and glucose in a boiling tube, as shown in the diagram.

They cover the mixture with a layer of oil.

A delivery tube is used to bubble gas produced by the yeast through limewater.

After 10 minutes, the limewater is milky.



Why does the limewater go milky?

A The yeast produces carbon dioxide by anaerobic respiration.

B The yeast produces lactic acid by anaerobic respiration.

C The yeast produces carbon dioxide by photosynthesis.

D The yeast produces oxygen by aerobic respiration.

（2024 May/Jun · 0654/22 · Question 8 · Extended）

题型 4：确定呼吸释放能量及其用途（考频★☆☆☆☆）

知识点 呼吸作用是在细胞中分解营养物质并_____能量的一系列化学反应，不是肺的通气过程。

有氧呼吸需要氧气；无氧呼吸不需要氧气，两者均释放能量。

呼吸释放的能量可用于细胞分裂、蛋白质合成和体温调节；能量的单位是_____（J）。

答案：释放；焦耳

怎么认 题目出现呼吸的含义或哪些生命活动使用其能量时，先判断是否为细胞反应及耗能过程。

例题 1

What is meant by respiration?

A protein synthesis

B sweating to lose heat

C the function of lungs

D the release of energy

（2023 May/Jun · 0654/11 · Question 1 · Core；同题：2023 May/Jun · 0654/21 · Question 1 · Extended）

解：呼吸作用是细胞中分解营养物质并释放能量的一系列化学反应，选项 D 符合定义。

故选 D。

针对练习

1. The list shows some processes that occur in the body.

1 cell division

2 oxygen diffusion

3 protein synthesis

4 temperature regulation

Which processes use energy released by respiration?

A 1, 3 and 4 **B** 1 and 2 **C** 2, 3 and 4 **D** 3 and 4 only

（2024 Oct/Nov · 0654/11 · Question 8 · Core）

题型 5：用有氧呼吸方程比例计数分子（考频★☆☆☆☆）

知识点 有氧呼吸是细胞利用氧分解葡萄糖并释放能量的过程，其配平方程式为 $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$。

每个葡萄糖分子需要 _____ 个氧分子，生成 _____ 个二氧化碳分子和 _____ 个水分子。

该比例适用于葡萄糖完全进行有氧呼吸；分子数是计数值，没有单位。

答案：6；6；6

怎么认 题目出现葡萄糖与氧气、二氧化碳或水的分子数时，先写出配平方程式并按系数比计算。

例题 1

The word equation for aerobic respiration is shown.

glucose + oxygen → carbon dioxide + water

How many molecules of carbon dioxide will be produced from the breakdown of four molecules of glucose?

A 4 **B** 8 **C** 16 **D** 24

（2025 Oct/Nov · 0654/22 · Question 9 · Extended）

解： 有氧呼吸的配平方程式为

$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$

由系数比，1 个葡萄糖分子生成 6 个二氧化碳分子，

$4 \times 6 = 24$

故选 D。

针对练习

1. Aerobic respiration releases energy from nutrient molecules.

One molecule of glucose requires 1 molecules of oxygen. The reaction releases 2 molecules of carbon dioxide and 3 molecules of water.

Which row completes gaps 1, 2 and 3?

	1	2	3
A	six	two	two
B	two	six	six
C	two	two	two
D	six	six	six

题型 6：从运动后心率恢复判断氧债清除（考频★☆☆☆☆）

知识点 氧债（oxygen debt）是运动后分解无氧呼吸产生的乳酸所需的额外氧气量，常用 cm^3 或 dm^3 表示。

运动停止后，乳酸尚未清除，心率仍高于静息水平，以输送_____。

当心率降回_____并保持稳定时，额外供氧需求消退；心率常用每分钟心跳次数表示。

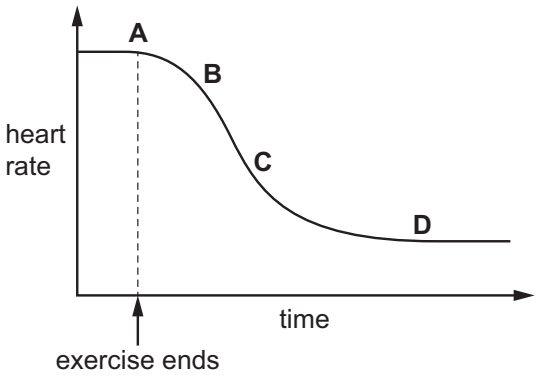
答案：氧气；静息水平

怎么认 题目出现运动后的心率恢复曲线并问氧债何时清除时，先找心率回到静息基线的平台点。

例题 1

Scientists measure the heart rate of an athlete during and after exercise.

Which point on the graph shows the time when the oxygen debt is removed from the athlete?



（2025 Oct/Nov · 0654/23 · Question 6 · Extended）

解：运动结束后，心率仍高于静息水平，说明仍需额外供氧以清除乳酸。

到 D 点时，心率降回静息基线并保持稳定，说明氧债已清除。

故选 D。

题型 7：由耗氧和吸收二氧化碳判断液滴移动（考频★☆☆☆☆）

知识点 有氧呼吸中，昆虫_____氧气并产生二氧化碳，同时释放能量。

装置密闭且温度保持不变时，若二氧化碳被碱吸收，装置内气体总量_____，气压降低。

毛细管中的液滴被外界气压推向装置；U 形管开口端液面下降，连通装置的一端液面上升。

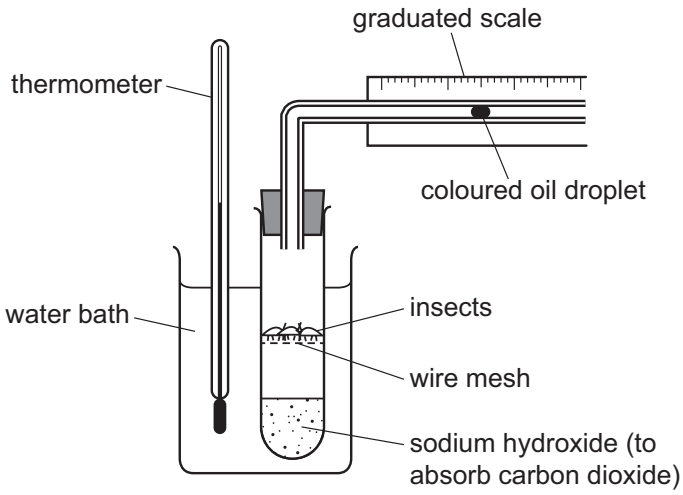
液滴位移按刻度读数，单位由刻度标示；只判断移动方向时不写单位。

答案：消耗；减少

怎么认 题目出现活昆虫、密闭装置和吸收二氧化碳的碱时，先判断装置内气压的变化。

例题 1

The apparatus shown is set up and left for 10 minutes. The insects are able to move around in the test-tube but the wire mesh prevents them from falling into the sodium hydroxide.



In which direction does the oil droplet move and why?

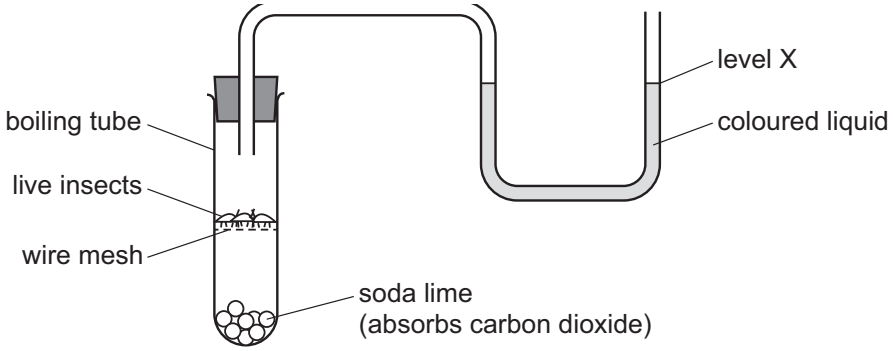
	direction of oil droplet	effect of respiration of insects
A	to the left	use up carbon dioxide and release oxygen
B	to the left	use up oxygen and release carbon dioxide
C	to the right	use up carbon dioxide and release oxygen
D	to the right	use up oxygen and release carbon dioxide

（2023 Oct/Nov · 0654/11 · Question 8 · Core）

解：昆虫进行有氧呼吸，消耗氧气并释放二氧化碳。
二氧化碳被氢氧化钠吸收，装置内气体总量减少，气压降低。
外界气压推动液滴向装置一侧移动，即向左移动。
故选 B。

针对练习

1. An experiment is set up, as shown.



What will happen to the level of coloured liquid at X?

A It goes down.

B It goes up.

C It goes up and then down.

D It stays the same.

（2023 Oct/Nov · 0654/22 · Question 8 · Extended）

题型 8：追踪活动后呼吸产气与通气响应（考频★☆☆☆☆）

知识点 有氧呼吸是在有氧条件下分解葡萄糖、释放能量并生成_____和水的过程；人体无氧呼吸生成乳酸。

身体活动增强且有氧呼吸加快时，血液中二氧化碳浓度_____，从而使呼吸频率_____。

呼吸频率表示每分钟呼吸的次数，单位为次/分。

答案：二氧化碳；升高；增大

怎么认 题目出现活动增强、细胞呼吸及效应的箭头图时，先沿箭头判断二氧化碳与呼吸频率的增减。

例题 1

Changes in the body occur as a result of increased physical activity.

increased physical activity → increased respiration in cells → effect R → effect S

What are effects R and S?

	effect R	effect S
A	decrease in blood carbon dioxide	decrease in breathing rate
B	decrease in blood lactic acid	increase in breathing rate
C	increase in blood carbon dioxide	increase in breathing rate
D	increase in blood lactic acid	decrease in breathing rate

（2024 Oct/Nov · 0654/22 · Question 8 · Extended）

解：身体活动增强，肌肉细胞供能需求增大，有氧呼吸增强。

有氧呼吸产生的二氧化碳增多，故血液中二氧化碳增加，R 为血液中二氧化碳增加。

血液中二氧化碳增加使呼吸频率增加，以加快二氧化碳排出，S 为呼吸频率增加。

故选 C。

题型 9：核对有氧呼吸符号方程的原子守恒（考频★☆☆☆☆）

知识点 化学方程式配平遵循_____：反应前后每种元素的原子总数分别相等。
某元素的原子总数等于右下角数字与式前系数的_____；没有右下角数字时按 1 计。
逐元素比较方程两边，任一种元素的原子总数不同，方程便没有配平。
原子个数是计数值，没有单位。

答案：原子守恒；乘积

怎么认 题目出现有氧呼吸的符号方程并要求判断错误时，先逐元素计算方程两边的原子总数。

例题 1

A student writes down an incorrect symbol equation for aerobic respiration.

$$6C_6H_{12}O_6 + 6O_2 \rightarrow 6H_2O + 6CO_2$$

Which error has the student made in the equation?

A Oxygen is a product **not** a reactant.

B Products are always written as $6CO_2 + 6H_2O$.

C The formula for glucose is $C_6H_6O_6$.

D The equation is **not** balanced.

（2026 Feb/Mar · 0654/22 · Question 4 · Extended）

解：由原子守恒，方程左边的碳原子数为 $6 \times 6 = 36$。
方程左边的氢原子数为 $6 \times 12 = 72$。
方程左边的氧原子数为 $6 \times 6 + 6 \times 2 = 48$。
方程右边的碳原子数为 $6 \times 1 = 6$。
方程右边的氢原子数为 $6 \times 2 = 12$。
方程右边的氧原子数为 $6 \times 1 + 6 \times 2 = 18$。
方程两边三种元素的原子数均不相等。若保持其余系数不变，设葡萄糖前的系数为 x，由碳原子守恒得 $6x = 6$。
$x = 1$，题中写成 6，所以方程没有配平。
故选 D。

第 13 章 神经、激素与稳态

13.1 神经、激素与稳态

题型 1：由情境或生理变化辨认肾上腺素效应（考频★★★☆☆）

知识点 肾上腺素是由肾上腺分泌、经血液运输的激素，在紧张、恐惧或剧烈活动等战斗或逃跑情境中分泌增加。

肾上腺素使呼吸频率和心率_____，并使瞳孔_____，从而提高机体应对紧急情况的能力。

呼吸频率和心率的单位均可写作次/分，瞳孔大小用直径表示。

答案：增加；扩大

怎么认 题目出现肾上腺素、战斗或逃跑、惊吓情境或心率和瞳孔图像时，先找呼吸和心率增加、瞳孔扩大。

例题 1

What happens when adrenaline is released into the blood?

A breathing rate increases

B pupil diameter decreases

C ovary releases egg cell

D heart rate decreases

（2026 May/Jun · 0654/13 · Question 7 · Core）

解：肾上腺素释放入血后，呼吸频率和心率增加，瞳孔扩大。题中符合的是呼吸频率增加，故选 A。

针对练习

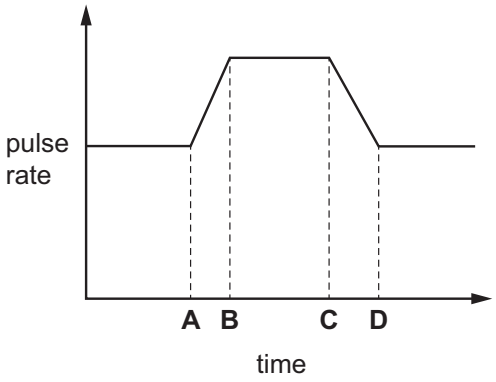
1. Which row shows the effect of adrenaline on the body?

	heart rate	pupil diameter
A	decreases	large
B	decreases	small
C	increases	small
D	increases	large

（2026 May/Jun · 0654/11 · Question 7 · Core）

2. The graph shows the pulse rate over a period of time.

At which point is adrenaline released into the blood?



（2023 Feb/Mar · 0654/12 · Question 9 · Core）

3. What are the effects of adrenaline?

	breathing rate	pulse rate	pupil size
A	decrease	decrease	widens
B	decrease	increase	narrows
C	increase	decrease	narrows
D	increase	increase	widens

（2023 May/Jun · 0654/11 · Question 9 · Core）

4. Which row shows effects of adrenaline?

	heart rate	pupil diameter
A	increases	increases
B	increases	no effect
C	decreases	increases
D	no effect	increases

（2025 May/Jun · 0654/11 · Question 11 · Core）

5. Which row shows the effect of adrenaline?

	effect on pupil diameter	effect on heart rate
A	narrows	decreases
B	widens	decreases
C	narrows	increases
D	widens	increases

（2025 Oct/Nov · 0654/12 · Question 9 · Core；同题：2025 Oct/Nov · 0654/13 · Question 9 · Core）

6. Which activities increase the secretion of adrenaline in the human body?

	running to catch a bus	relaxing in the sun	watching a frightening horror film
A	✓	✗	✓
B	✗	✓	✓
C	✓	✗	✗
D	✗	✓	✗

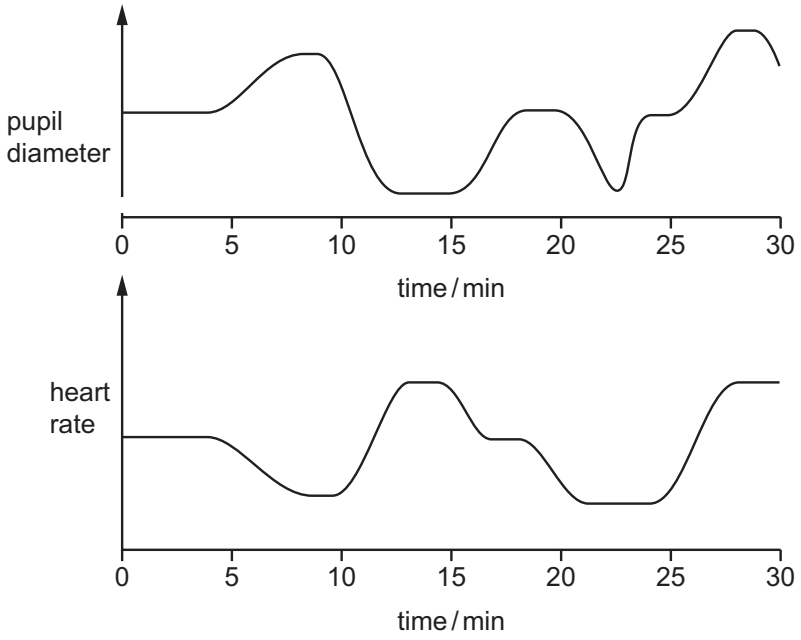
（2024 Oct/Nov · 0654/12 · Question 9 · Core；同题：2024 Oct/Nov · 0654/13 · Question 9 · Core）

7. Which row shows a person's response to a 'fight or flight' situation?

	breathing rate / breaths per minute	pulse rate / beats per minute
A	12	70
B	12	140
C	18	70
D	18	140

（2022 Oct/Nov · 0654/12 · Question 9 · Core）

8. The graphs show the pupil diameter and heart rate of a person over a period of 30 minutes. The person was given an unexpected shock at one point during the 30 minutes.



At which time did the person experience a shock causing them to release adrenaline?

A 5 minutes

B 10 minutes

C 15 minutes

D 25 minutes

（2023 Oct/Nov · 0654/13 · Question 9 · Core）

题型 2：顺着反射弧辨认并排列神经元（考频★★★☆☆）

知识点 反射是机体对刺激作出的快速、自动反应，由反射弧完成。

感受器检测刺激并产生神经冲动；在含联络神经元的反射弧中，冲动依次经过_____神经元、_____神经元和_____神经元。

运动神经元将冲动传至效应器，肌肉或腺体随之产生反应。

答案：感觉；联络；运动

怎么认 题目出现反射动作、神经元图或顺序选项时，先确定感觉、联络、运动神经元。

一. 确定刺激到反应的顺序

例题 1

In which order does an impulse pass along neurones during a reflex action?

A motor → relay → sensory

B motor → sensory → relay

C sensory → motor → relay

D sensory → relay → motor

（2024 Oct/Nov · 0654/11 · Question 9 · Core）

解：感受器检测刺激后，神经冲动先由感觉神经元传入。
冲动经联络神经元传给运动神经元，再传至效应器。
故顺序为感觉神经元、联络神经元、运动神经元。故选 D。

针对练习

1. Which statement about reflex actions is correct?

A Neurones carry out responses.

B Reflex actions are slow.

C Muscles and glands coordinate stimuli.

D Receptors detect stimuli.

（2026 May/Jun · 0654/23 · Question 10 · Extended）

2. A person touches a hot object and pulls their hand away. This is a reflex action.

What is the pathway for the reflex action?

A stimulus → motor neurone → relay neurone → sensory neurone → response

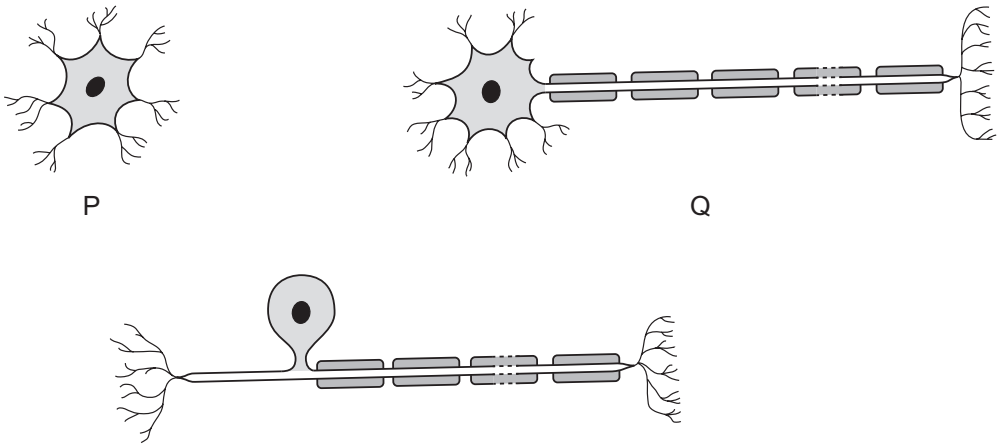
B stimulus → relay neurone → motor neurone → sensory neurone → response

C stimulus → sensory neurone → relay neurone → motor neurone → response

D stimulus → sensory neurone → motor neurone → relay neurone → response

（2024 May/Jun · 0654/22 · Question 9 · Extended）

3. The diagram shows three types of neurone.



Which order do impulses pass through the neurones in a reflex action?

A P → R → Q

B Q → P → R

C R → P → Q

D R → Q → P

（2025 May/Jun · 0654/12 · Question 10 · Core；同题：2025 May/Jun · 0654/13 · Question 10 · Core）

二. 由形态和连接辨认神经元

知识点 感觉神经元把冲动由感受器传向_____，细胞体常位于轴突一侧；联络神经元位于中枢神经系统内，形态较短。

运动神经元的细胞体位于中枢神经系统，长轴突与肌肉或腺体等效应器相连。

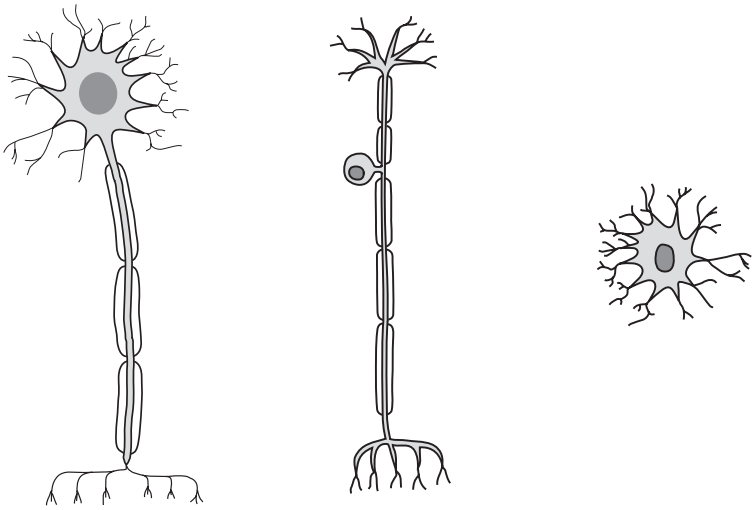
反射弧中，冲动依次经过感受器、感觉神经元、联络神经元、_____和效应器。

答案：中枢神经系统；运动神经元

怎么认 题目出现神经元形态、细胞体位置或肌肉连接时，先沿冲动方向辨认三类神经元。

例题 2

The diagram shows three different neurones which form the reflex arc.



X　　Y　　Z

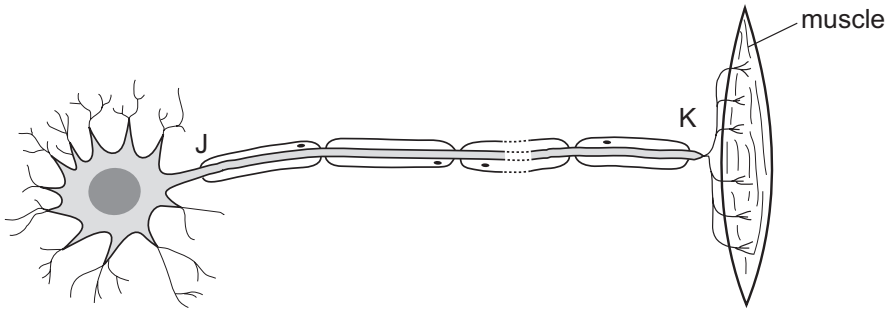
Which row correctly identifies X, Y and Z?

	neurone X	neurone Y	neurone Z
A	motor	relay	sensory
B	motor	sensory	relay
C	sensory	motor	relay
D	sensory	relay	motor

（2024 Feb/Mar · 0654/12 · Question 9 · Core）

解：X 的细胞体位于一端，长轴突末端与效应器相连，故 X 为运动神经元。
Y 的细胞体位于轴突一侧，故 Y 为感觉神经元；Z 有许多短分支且无长轴突，故 Z 为联络神经元。
故选 B。

4. The diagram shows a neurone and associated structures.

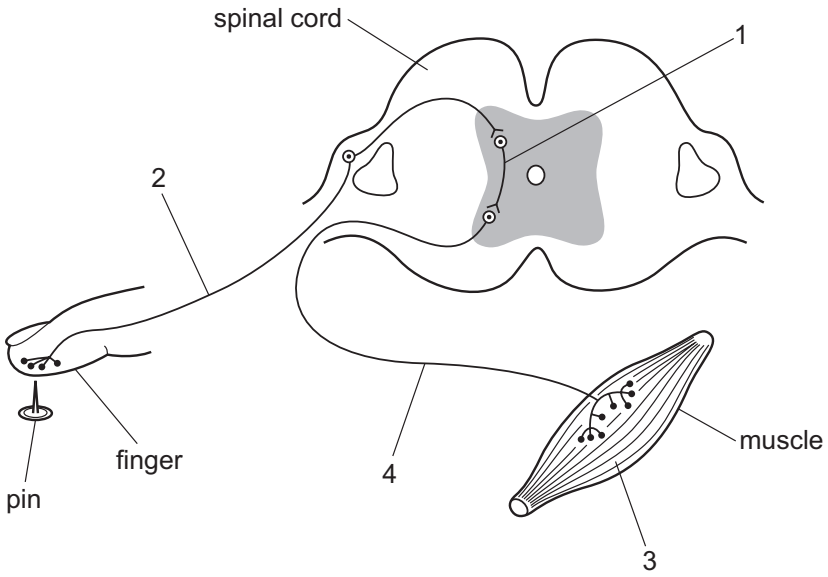


Which type of neurone is shown and in which direction do impulses travel?

	type of neurone	direction of impulse
A	motor	J to K
B	motor	K to J
C	sensory	J to K
D	sensory	K to J

（2024 Feb/Mar · 0654/22 · Question 9 · Extended）

5. The diagram shows a simple reflex arc.



Which row gives the correct labels for the diagram?

	1	2	3	4
A	motor neurone	sensory neurone	receptor	relay neurone
B	motor neurone	relay neurone	receptor	effector
C	relay neurone	motor neurone	effector	sensory neurone
D	relay neurone	sensory neurone	effector	motor neurone

（2025 Oct/Nov · 0654/23 · Question 8 · Extended）

题型 3：核对胰岛素与胰高血糖素的血糖反馈（考频★★☆☆☆）

知识点 胰腺分泌调节血糖浓度的激素，包括_____和_____；葡萄糖、甘油和糖原不是这两种激素。

血糖浓度升高时，胰岛素促进葡萄糖转化为糖原；血糖浓度降低时，胰高血糖素促进糖原转化为葡萄糖，使血糖浓度_____。

运动时，肾上腺素和胰高血糖素都能促使血糖升高；血糖浓度常用 $mmol/dm^3$ 表示。

答案：胰岛素；胰高血糖素；升高

怎么认 题目出现胰腺、血糖浓度变化、进食后储存或运动曲线时，先判断血糖应升高还是降低。

例题 1

What is secreted by the pancreas?

A glucagon

B glucose

C glycerol

D glycogen

（2025 May/Jun · 0654/21 · Question 9 · Extended）

解：胰腺分泌胰高血糖素；葡萄糖和甘油是小分子物质，糖原是多糖，三者均不是胰腺分泌的激素。故选 A。

针对练习

1.

What is the role of glucagon?

A decrease blood glucose

B decrease blood insulin

C increase blood glucose

D increase blood insulin

（2025 May/Jun · 0654/23 · Question 7 · Extended）

2.

A man eats a meal high in carbohydrates. There is only a small change in his blood glucose concentration.

Which statement explains why?

A The pancreas releases insulin and this causes the excess glucose to be stored as glucagon.

B The pancreas releases insulin and this causes the excess glucose to be stored as glycogen.

C The pancreas releases glucagon and this causes the excess glucose to be stored as glycogen.

D The pancreas releases glucagon and this causes the excess glucose to be stored as insulin.

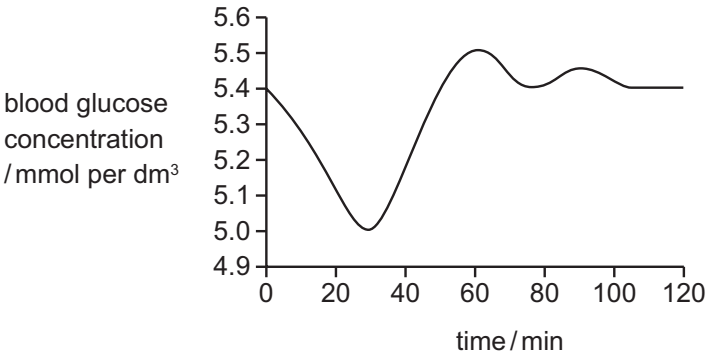
（2025 Oct/Nov · 0654/21 · Question 10 · Extended）

3. Which row names a hormone, the organ that produces it and the hormone's effect on blood glucose concentration?

	hormone	produced by	effect on blood glucose concentration
A	glucagon	liver	decreases
B	glucagon	pancreas	increases
C	insulin	liver	decreases
D	insulin	pancreas	increases

（2025 Feb/Mar · 0654/22 · Question 8 · Extended）

4. The graph shows the changes in blood glucose concentration during two hours of exercise.



What causes the change in blood glucose concentration between 30 and 60 min?

1 increased adrenaline release

2 increased glucagon release

3 increased insulin release

A 1 only **B** 1 and 2 **C** 1 and 3 **D** 2 only

（2022 May/Jun · 0654/21 · Question 9 · Extended）

题型 4：核对激素的类别、分泌和运输（考频★★☆☆☆）

知识点 激素是由_____产生的化学物质，经_____运输到相应部位。
激素作用于特定的_____，并改变其活动；肾上腺素属于激素，不属于酶。

答案：腺体；血液；靶器官

怎么认 题目出现激素、肾上腺素、运输方式或作用部位时，先按腺体、血液、靶器官核对。

例题 1

What is a hormone?

A a chemical substance, produced by a gland, which alters the activity of target organs

B a protein that acts as a biological catalyst

C a thread-like structure of DNA, carrying genetic information in the form of genes

D an electrical signal that travels along a nerve cell to an effector

（2022 May/Jun · 0654/12 · Question 9 · Core；同题：2022 May/Jun · 0654/13 · Question 9 · Core）

解：激素是由腺体产生、经血液运输并改变靶器官活动的化学物质。
故选 A。

针对练习

1. Which type of chemical is adrenaline?

A enzyme

B hormone

C mineral salt

D vitamin

（2023 May/Jun · 0654/23 · Question 9 · Extended）

2. One response to a frightening situation is an increase in heart rate caused by the release of adrenaline.

Which statement about adrenaline is correct?

A It is an enzyme produced by an organ and travels in the blood to the heart.

B It is an enzyme produced by an organ and travels down a nerve to the brain.

C It is a hormone produced by a gland and travels in the blood to the heart.

D It is a hormone produced by a gland and travels down a nerve to the brain.

（2023 Oct/Nov · 0654/11 · Question 9 · Core）

3. Which row about hormones is correct?

	means of transport	where produced	site of action
A	alimentary canal	glands	target organs
B	alimentary canal	organs	all organs
C	blood	glands	target organs
D	blood	organs	all organs

（2024 May/Jun · 0654/12 · Question 9 · Core；同题：2024 May/Jun · 0654/13 · Question 9 · Core）

题型 5：由刺激方向辨认向光性与向地性（考频★★☆☆☆）

知识点 向性是植物器官的生长方向随外界刺激方向而改变的反应，表示反应类型，没有计量单位。

生长朝向刺激称为_____向性，生长背离刺激称为_____向性。

定向刺激为光时称为向光性；定向刺激为重力时称为_____。完全黑暗时，芽的上下弯曲由重力刺激判断。

答案：正；负；向地性

怎么认 题目出现单侧光照或暗处横放后芽、根改变方向时，先判刺激种类，再比较生长方向与刺激方向。

例题 1

A plant in a pot is placed on its side in a dark cupboard. The shoots grow upwards.

What is this an example of?

A decomposition

B gravitropism

C photosynthesis

D phototropism

（2022 May/Jun · 0654/11 · Question 9 · Core）

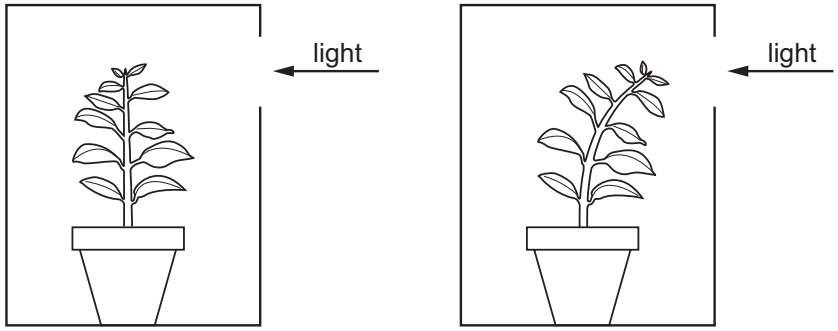
解：植株侧放在黑暗橱柜中，无定向光刺激。
芽向上生长，方向背离重力，属于负向地性。
故选 B。

针对练习

1. A plant is placed in a box.

The box has a hole so that the plant is illuminated from one side.

The plant is observed after one week. The result is shown.



What explains the growth of the plant after one week?

A Plant shoots grow towards light, showing phototropism.

B Plant shoots grow towards gravity, showing gravitropism.

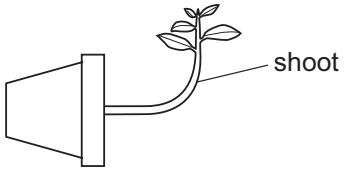
C Plant shoots grow towards light, showing gravitropism.

D Plant shoots grow towards gravity, showing phototropism.

（2024 May/Jun · 0654/11 · Question 9 · Core）

2. A plant was placed horizontally in complete darkness.

The diagram shows how the plant had grown after one week.



Which response has the shoot made?

A gravitropism away from gravity

B gravitropism towards gravity

C phototropism away from light

D phototropism towards light

（2024 Oct/Nov · 0654/22 · Question 9 · Extended）

3. When a seed germinates in the soil, the root grows downwards.

Which type of response is the root exhibiting?

A negative gravitropism

B negative phototropism

C positive gravitropism

D positive phototropism

（2022 Oct/Nov · 0654/11 · Question 9 · Core；同题：2022 Oct/Nov · 0654/21 · Question 9 · Extended）

题型 6：联系散热与呼吸解释体温维持（考频★★☆☆☆）

知识点 恒温动物通过稳态调节使体温保持在较小范围内，维持体温所需能量由细胞_____释放；出汗促进散热，不提供能量。

环境温度降低时，动物与环境的温差增大，散热加快，维持体温所需能量_____，呼吸速率随之升高。

同类动物中，体形较小者单位质量的表面积较大，单位质量散热较快；单位质量耗氧速率可反映呼吸速率，单位可为 $\mathrm{cm^3 g^{-1} h^{-1}}$。

答案：呼吸；增加

怎么认 题目出现恒温动物、环境温度或单位质量耗氧图时，先由散热强弱判断呼吸供能需求。

例题 1

Which process provides the energy for the maintenance of a constant body temperature?

A homeostasis

B photosynthesis

C respiration

D sweating

（2023 Feb/Mar · 0654/12 · Question 8 · Core）

解：细胞呼吸分解有机物并释放能量，维持恒定体温所需能量由细胞呼吸提供。

故选 C。

针对练习

1. During cold weather, warm blooded animals, such as mammals and birds, require more food.

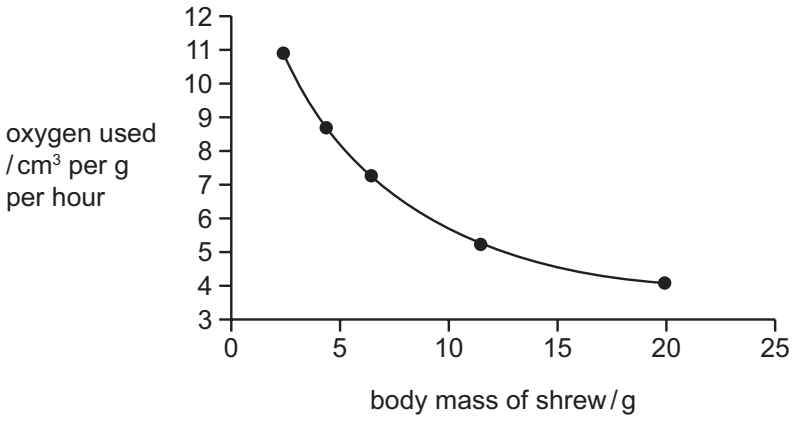
Which statement explains the reason for this?

	energy required to maintain constant body temperature	rate of respiration
A	high	high
B	high	low
C	low	high
D	low	low

（2023 May/Jun · 0654/12 · Question 8 · Core；同题：2023 May/Jun · 0654/13 · Question 8 · Core；同题：2023 May/Jun · 0654/22 · Question 8 · Extended）

2. Small mammals need more energy to maintain a constant body temperature.

The graph shows the rate of oxygen used by species of shrews with different body masses.



Which statements are correct?

1 Heavier shrews use oxygen more slowly than lighter shrews.

2 Heavier shrews respire faster than lighter shrews.

3 Heavier shrews lose heat more slowly than lighter shrews.

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

（2023 Oct/Nov · 0654/12 · Question 8 · Core）

题型 7：从皮肤图辨认汗腺和附属结构（考频★☆☆☆☆）

知识点 汗腺是皮肤内分泌汗液的腺体，由盘曲的_____和通向皮肤表面的导管组成。

皮肤剖面图中，成团盘曲的细管与导管相连时，该结构为_____。

附着在毛囊上的斜带状结构是竖毛肌；与神经相连、末端呈囊状或层叠状的结构是感受器。

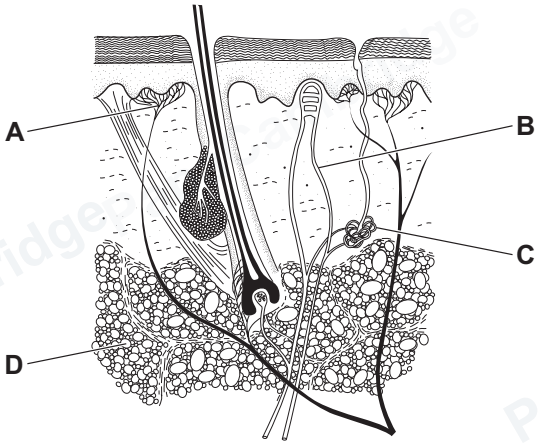
答案：分泌部；汗腺

怎么认 题目出现皮肤剖面图并要求辨认汗腺时，先找盘曲细管及其通向表面的导管。

例题 1

The diagram shows a section through the skin and associated structures.

Which letter indicates the sweat gland?

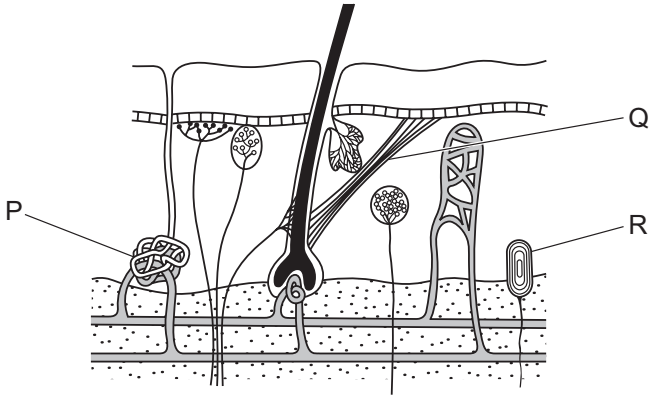


（2026 Feb/Mar · 0654/22 · Question 5 · Extended）

解：汗腺由盘曲的分泌部和通向皮肤表面的导管组成。
图中 C 所指结构呈盘曲管状，并有导管向上通至皮肤表面，故为汗腺。
故选 C。

针对练习

1. The diagram shows a section through the skin.



Which row contains the correct names of the structures labelled P, Q and R?

	P	Q	R
A	sweat gland	hair	blood vessel
B	receptor	hair	receptor
C	sweat gland	hair erector muscle	receptor
D	receptor	hair erector muscle	blood vessel

（2023 Oct/Nov · 0654/12 · Question 9 · Core）

题型 8：辨认神经系统与中枢组成（考频★☆☆☆☆）

知识点 哺乳动物的神经系统由_____组成，可分为中枢神经系统和外周神经系统。
中枢神经系统（central nervous system，CNS）由_____组成；神经属于外周神经系统。
肌肉属于效应器，神经冲动是沿神经元传递的电信号，二者都不是神经系统的_____。

答案：脑、脊髓和神经；脑和脊髓；结构

怎么认 题目出现神经系统结构名称或标有脑、脊髓和神经的示意图时，先分清中枢与外周。

例题 1

Which structures make up the mammalian nervous system?

A brain, muscles, impulses

B brain, nerves, spinal cord

C effectors, muscles, spinal cord

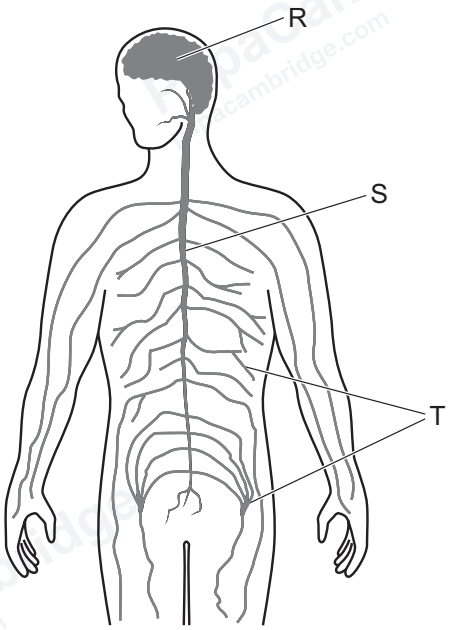
D impulses, effectors, nerves

（2025 Oct/Nov · 0654/11 · Question 11 · Core）

解： 哺乳动物的神经系统由脑、脊髓和神经组成。
肌肉属于效应器，神经冲动是电信号，二者都不是神经系统的结构。
故选 B。

针对练习

1. The diagram shows an outline of the human nervous system.



Which parts make up the central nervous system?

A R, S and T **B** R and S only **C** R only **D** S and T only

（2026 Feb/Mar · 0654/12 · Question 8 · Core）

题型 9：把眼部结构与感光、折光或调焦功能对应（考频★☆☆☆☆）

知识点 视网膜含有感光细胞，其中锥细胞负责辨别不同颜色；红绿色盲与_____的辨色功能有关。角膜是透明结构，使进入眼内的光发生_____；晶状体通过改变形状，使远近物体的像聚焦在视网膜上。

观察不同距离的物体时，由改变晶状体形状完成调焦的过程称为_____（accommodation）。

答案：视网膜；折射；调节作用

怎么认 题目出现眼部结构与辨色、折光或远近调焦的对应时，先按视网膜、角膜、晶状体逐结构核对。

例题 1

A person who is red-green colour blind cannot distinguish between red and green colours.

Which part of the eye is responsible for this?

A cornea

B iris

C lens

D retina

（2022 May/Jun · 0654/22 · Question 9 · Extended）

解：辨别红、绿颜色依靠视网膜中的感光细胞。

红绿色盲不能区分红色与绿色，说明受影响的是视网膜的辨色功能。

故选 D。

针对练习

1. A student looks at an object at a distance and then looks at an object close by. This ability to focus on both objects is brought about by changing the shape of the lens.

What is this called?

A accommodation

B coordination

C pupil reflex

D transmission

（2024 Oct/Nov · 0654/21 · Question 9 · Extended）

题型 10：辨认内环境稳态的定义（考频★☆☆☆☆）

知识点 稳态（homeostasis）是维持身体_____相对稳定的状态。外界条件发生变化时，身体通过调节使内部条件保持在一定范围内；稳态不是维持外部环境，也不专指产热或排出废物。

答案：内环境

怎么认 题目出现稳态的定义并要求判断维持对象时，先判断是否为身体内部环境。

例题 1

What is homeostasis?

A the maintenance of the body's external environment

B the maintenance of the body's internal environment

C the processes that produce heat in the body

D the removal of waste from the body

（2025 Feb/Mar · 0654/22 · Question 11 · Extended）

解：由稳态的定义，稳态维持的是身体的内部环境。
A 错，外部环境不属于身体内部环境；B 对；C、D 均不是稳态的定义。
故选 B。

题型 11：依据冷热变化选择体温反向调节（考频★★★☆☆）

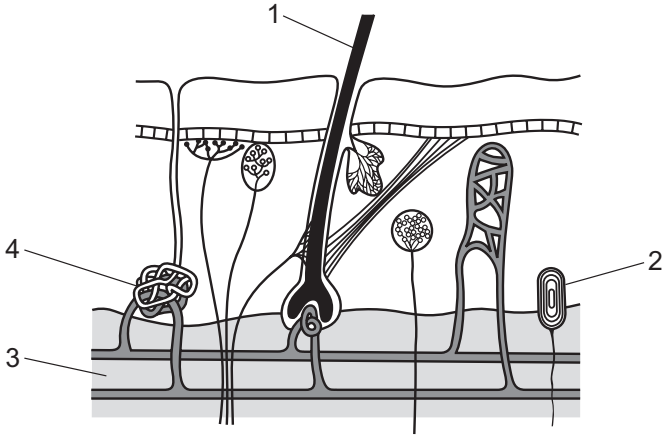
知识点 体温稳态是体内产热量与散热量经负反馈维持的动态平衡，体温用 ℃ 表示。
体温偏高时，皮肤小动脉_____、出汗增多，皮肤血流和蒸发散热均增加。
体温偏低时，皮肤小动脉_____、出汗减少，立毛肌收缩使毛发竖起以减少散热；骨骼肌_____以增加产热。
发生舒缩的是供应皮肤毛细血管的小动脉；温度偏差消除后，调节反应减弱。

答案：扩张；收缩；颤抖

怎么认 题目出现体温升降、环境冷热、皮肤血流或汗腺变化时，先判断应增加散热还是减少散热、增加产热。

例题 1

The diagram shows a section through the skin.



Which labelled structures help to maintain body temperature in the cold?

A 1 and 3 **B** 1 and 4 **C** 2 and 3 **D** 3 and 4

（2022 Feb/Mar · 0654/12 · Question 9 · Core；同题：2022 Feb/Mar · 0654/22 · Question 9 · Extended）

解：1 为毛发，寒冷时立毛肌收缩使毛发竖起，皮肤表面的静止空气层增厚，散热减少；3 为皮下脂肪层，隔热作用使散热减少。故选 A。

针对练习

1. The arterioles that supply blood to the skin's surface capillaries undergo vasodilation.

Which row describes the effect of this on the core body temperature and the volume of blood passing through these capillaries?

	core body temperature	volume of blood
A	decreases	decreases
B	increases	decreases
C	decreases	increases
D	increases	increases

（2024 May/Jun · 0654/23 · Question 9 · Extended）

2. Which statement about temperature control is correct?

A Vasoconstriction near the skin surface and shivering will cool the body down.

B Vasoconstriction near the skin surface and sweating will warm the body up.

C Vasodilation near the skin surface and shivering will warm the body up.

D Vasodilation near the skin surface and sweating will cool the body down.

（2022 May/Jun · 0654/23 · Question 9 · Extended）

3. Which statement about the role of blood vessels in the skin is correct?

A If the environment is too cold, vasoconstriction of capillaries occurs.

B If the environment is too cold, vasodilation of arterioles occurs.

C If the environment is too hot, vasoconstriction of capillaries occurs.

D If the environment is too hot, vasodilation of arterioles occurs.

（2023 Oct/Nov · 0654/23 · Question 9 · Extended）

4. Which statement about blood flow to the skin in the maintenance of a constant internal body temperature is correct?

A If the internal body temperature is too high then vasoconstriction of skin arterioles occurs.

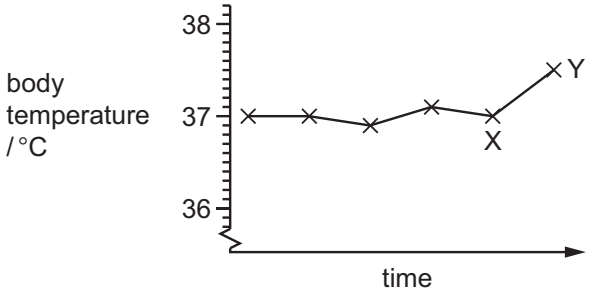
B If the internal body temperature is too low then vasoconstriction of skin capillaries occurs.

C If the internal body temperature is too high then vasodilation of skin arterioles occurs.

D If the internal body temperature is too low then vasodilation of skin capillaries occurs.

（2025 Oct/Nov · 0654/22 · Question 10 · Extended）

5. The graph shows the variation of body temperature over time of a healthy person at rest.



How will the body reverse the temperature change shown between times X and Y?

A decreased breathing rate

B decreased pulse rate

C shivering

D sweating

（2022 Oct/Nov · 0654/13 · Question 9 · Core；同题：2022 Oct/Nov · 0654/23 · Question 9 · Extended）

6. The homeostatic control of body temperature is shown.

constant internal body temperature → increase in body temperature → X → constant internal body temperature

Which processes happen at X?

A vasodilation and increased shivering

B vasodilation and increased sweating

C vasoconstriction and increased shivering

D vasoconstriction and increased sweating

（2025 May/Jun · 0654/22 · Question 10 · Extended）

7. A person leaves an air conditioned building.

The temperature of the air conditioned building is 16 °C.

The outside temperature is 39 °C.

Which statement describes one response to the change in temperature?

A The blood detects the change in temperature and the person starts to shiver.

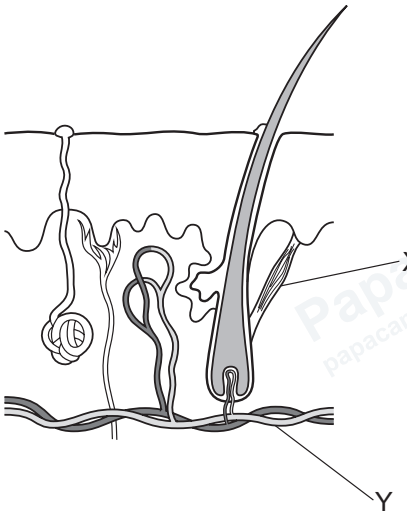
B The blood detects the change in temperature and the person starts to sweat.

C The brain detects the change in temperature and the person starts to shiver.

D The brain detects the change in temperature and the person starts to sweat.

（2023 May/Jun · 0654/12 · Question 9 · Core；同题：2023 May/Jun · 0654/13 · Question 9 · Core）

8. The diagram shows a cross-section of skin in a mammal.



Which row shows the responses of parts X and Y when the environmental temperature increases?

	X	Y
A	contracts	constricts
B	contracts	dilates
C	relaxes	constricts
D	relaxes	dilates

（2026 May/Jun · 0654/21 · Question 10 · Extended）

题型 12：由生长素分布解释单侧伸长（考频★☆☆☆☆）

知识点 生长素（auxin）是主要由芽尖产生、调节植物生长的激素。

在芽尖后方的伸长区，生长素能促进细胞_____；一侧生长素较多时，该侧细胞伸长较_____。

单侧光照时，生长素较多地分布在_____，两侧伸长不等使芽向光弯曲。

答案：伸长；快；背光侧

怎么认 题目出现芽一侧添加生长素或单侧光照图时，先判断两侧生长素分布，再比较细胞伸长。

例题 1

During an experiment, auxin is applied to one side of a shoot just behind the tip.

What will this stimulate?

A decreased cell elongation in all cells

B decreased cell elongation on the side with extra auxin

C increased cell elongation in all cells

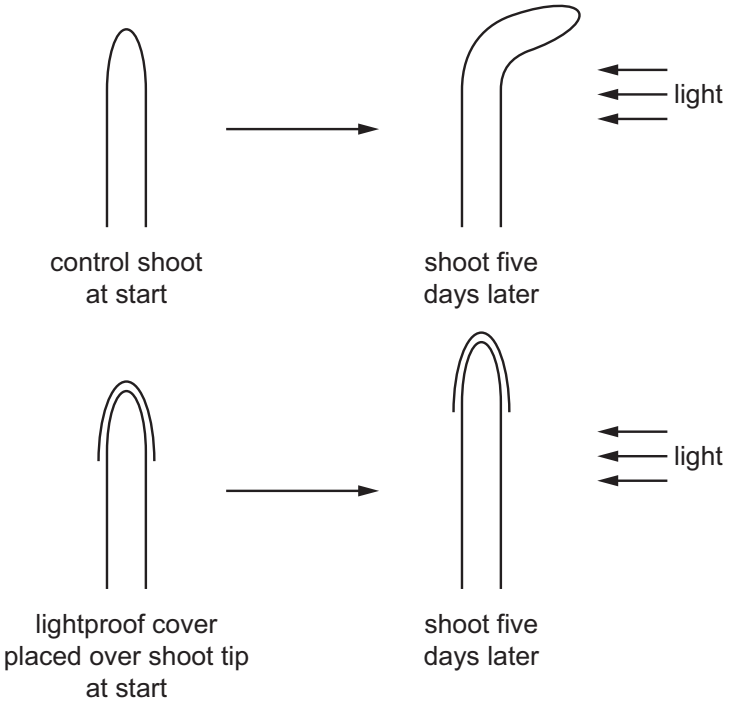
D increased cell elongation on the side with extra auxin

（2023 Oct/Nov · 0654/21 · Question 9 · Extended）

解：芽尖后方为伸长区，生长素促进芽细胞伸长。
一侧添加生长素，使该侧生长素含量增加，该侧细胞伸长增加。
故选 D。

针对练习

1. The diagram shows an experiment using the shoots of seedlings.



Which statement explains why the covered shoot tip does **not** grow towards the light?

A The lightproof cover decreases auxin production by the shoot tip.

B The lightproof cover keeps auxin distribution even on all sides of the shoot.

C The lightproof cover prevents auxin from diffusing from the shoot tip.

D The lightproof cover stimulates cell elongation without requiring auxin.

（2023 May/Jun · 0654/22 · Question 9 · Extended）

题型 13：区分随意动作与不随意反应（考频★☆☆☆☆）

知识点 由意识控制的动作是_____动作；不由意识主动控制、自动发生的反应是_____动作。
瞳孔在暗处扩大和运动时脉搏加快均自动发生；主动收缩肌肉拿起铅笔受_____控制。
判断时应看动作能否由意识发起和停止，不以是否有肌肉参与作为标准。

答案：随意；不随意；意识

怎么认 题目出现多个动作及选项组合时，先判断每个动作是否受意识主动控制，再核对组合。

例题 1

What are examples of involuntary actions?

1 widening of the pupil in dim light

2 increasing the pulse rate during exercise

3 contracting muscles to pick up a pencil

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

（2024 Oct/Nov · 0654/23 · Question 9 · Extended）

解：瞳孔在暗处扩大由神经系统自动调节，不受意识控制，故 1 属于不随意动作。
运动时脉搏加快自动发生，故 2 属于不随意动作。

收缩肌肉拿起铅笔受意识控制，故 3 属于随意动作。
所以不随意动作是 1 和 2。故选 B。

题型 14：根据光线或物距判断眼肌变化（考频★★☆☆☆）

知识点 虹膜内的环肌和辐射肌作用相反，二者通过收缩或放松控制瞳孔大小。

光照增强时，环肌_____、辐射肌_____，瞳孔缩小；光照减弱时，辐射肌收缩、环肌放松，瞳孔_____。

此类判断只比较变化方向，不使用计量单位。

答案：收缩；放松；增大

怎么认 题目出现光线增强或减弱并问瞳孔、环肌和辐射肌变化时，先判断瞳孔增减。

一. 明暗改变瞳孔和虹膜肌

例题 1

When a person moves from a brightly lit room into a dark room, the pupils in their eyes change in size.

Which row correctly describes the change in size and explains what causes this change?

	pupil size	radial muscles	circular muscles
A	decreases	contract	relax
B	decreases	relax	contract
C	increases	contract	relax
D	increases	relax	contract

（2022 Oct/Nov · 0654/22 · Question 9 · Extended）

解：由明亮处进入暗室，光照减弱，瞳孔增大。
辐射肌收缩、环肌放松，使瞳孔增大。故选 C。

针对练习

1. Which statement explains how the iris responds to an increase in light intensity?

A The circular muscles contract and radial muscles relax causing the pupil to decrease in size.

B The circular muscles relax and radial muscles contract causing the pupil to decrease in size.

C The circular muscles contract and radial muscles relax causing the pupil to increase in size.

D The circular muscles relax and radial muscles contract causing the pupil to increase in size.

（2023 Feb/Mar · 0654/22 · Question 9 · Extended）

二. 物距改变睫状肌、韧带和晶状体

知识点 眼睛通过改变晶状体的形状，使来自不同距离物体的光会聚在视网膜上，这种作用称为眼的调节（accommodation）。

看近处物体时，睫状肌_____，悬韧带_____，晶状体_____，折光能力增强；看远处物体时变化相反。

答案：收缩；放松；变厚

怎么认 题目出现由远处转看近处物体时，先判定晶状体需变厚，再判断悬韧带和睫状肌的变化。

例题 2

A person looks at a tree in the distance and then starts to read a book.

Which changes occur in the eye to enable the person to read their book?

	ciliary muscles	suspensory ligaments	lens
A	contract	slacken	becomes fatter
B	contract	tighten	becomes thinner
C	relax	slacken	becomes fatter
D	relax	tighten	becomes thinner

（2024 May/Jun · 0654/21 · Question 9 · Extended）

解：书本比远处的树更近，眼睛需要使晶状体变厚，以增强折光能力。
睫状肌收缩使悬韧带放松，晶状体在弹性作用下变厚。
故选 A。

三. 同时处理物距与明暗两个条件

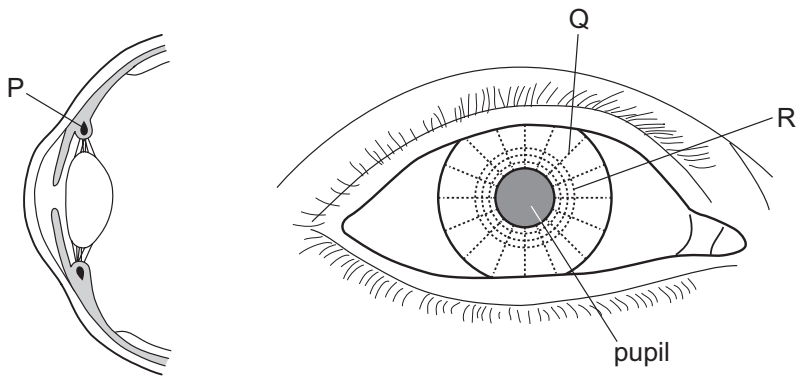
知识点 眼的调节由睫状肌改变晶状体的形状：看远物时，睫状肌_____，悬韧带拉紧，晶状体变薄，折光作用减弱。
瞳孔大小由虹膜肌控制：暗处需要更多光进入眼内，辐射肌_____、环形肌舒张，瞳孔扩大。
物距决定睫状肌的状态，明暗决定虹膜肌的状态；肌肉状态无单位。

答案：舒张；收缩

怎么认 题目出现物距和明暗两个条件并问哪些肌肉收缩时，先分别判断睫状肌和虹膜肌。

例题 3

The diagram shows a section through the front of the eye and a front view of the eye.



Which muscles contract when viewing a distant object in dim light?

A P and R **B** P only **C** Q and R **D** Q only

（2023 Oct/Nov · 0654/22 · Question 9 · Extended）

解：看远物时，睫状肌舒张，故 P 不收缩。
暗处瞳孔扩大，虹膜辐射肌收缩；图中 Q 为辐射肌，故 Q 收缩，R 不收缩。
所以收缩的肌肉只有 Q。故选 D。

第 14 章 药物、抗生素与烟草

14.1 药物、抗生素与烟草

题型 1：判断抗生素适用对象和耐药变化（考频★☆☆☆☆）

知识点 抗生素是治疗由_____引起的感染的药物。

抗生素对病毒感染没有治疗作用，冠心病也不属于其治疗对象。

部分细菌具有_____，使用抗生素后，耐药细菌可存活并繁殖。

答案：细菌；耐药性

怎么认 题目出现疾病类型或抗生素治疗陈述时，先按病因判断是否为细菌感染。

例题 1

Three types of human disease are listed.

1 bacterial infections

2 coronary heart disease

3 viral infections

Which diseases can be treated with antibiotics?

A 1 and 3 **B** 1 only **C** 2 only **D** 3 only

（2026 Feb/Mar · 0654/12 · Question 9 · Core）

解：抗生素用于治疗细菌感染，故 1 可用抗生素治疗。

冠心病与病毒感染均不属于抗生素的治疗对象，故 2、3 不可用抗生素治疗。

故选 B。

针对练习

1. Which statements about antibiotics are correct?

1 Bacterial infections are treated using antibiotics.

2 Some organisms are resistant to antibiotics.

3 Viral infections are treated using antibiotics.

A 1 and 2 **B** 1 and 3 **C** 1 only **D** 2 and 3

（2026 May/Jun · 0654/11 · Question 8 · Core）

题型 2：把烟草成分与危害对应（考频★☆☆☆☆）

知识点 吸入烟草烟雾时，_____与血红蛋白结合，使红细胞携带的氧气减少。

_____使人产生依赖并导致成瘾；_____中含有致癌物，会增加患癌症的风险。

答案：一氧化碳；尼古丁；焦油

怎么认 题目出现烟草成分及运氧、成瘾或致癌作用时，先核对物质与作用的对应关系。

例题 1

Which component of tobacco smoke reduces the amount of oxygen that red blood cells can carry to the cells of the body?

A carbon dioxide

B carbon monoxide

C nicotine

D tar

（2022 May/Jun · 0654/22 · Question 8 · Extended）

解：红细胞依靠血红蛋白携带氧气。
一氧化碳与血红蛋白结合，使红细胞携带的氧气减少。
故选 B。

针对练习

1. Which row is correct about the components of tobacco smoke and their effects?

	component	effect
A	carbon monoxide	addictive
B	nicotine	carcinogen
C	smoke particle	addictive
D	tar	carcinogen

（2022 May/Jun · 0654/21 · Question 8 · Extended）

题型 3：核对 HIV 感染与 AIDS 死亡趋势（考频★☆☆☆☆）

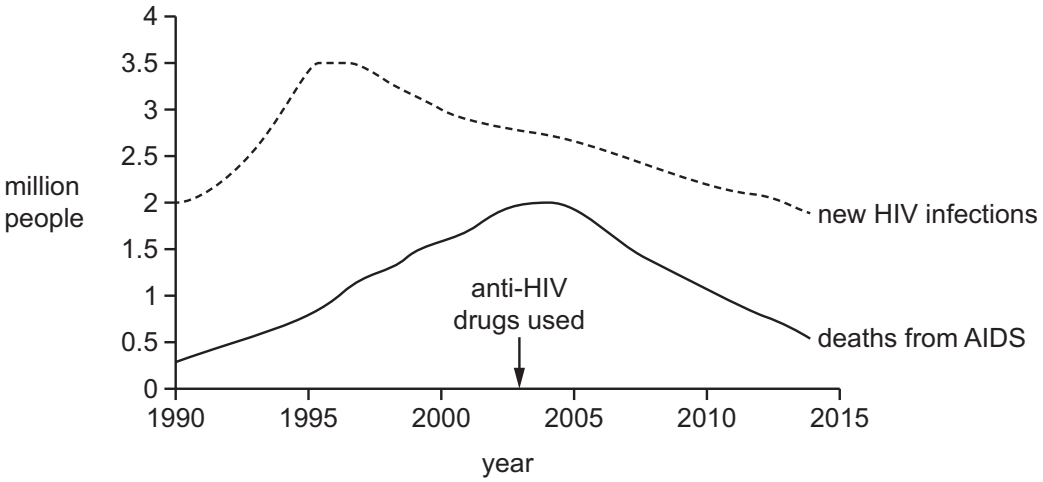
知识点 折线图中的横坐标表示时间，纵坐标表示人数，曲线的升降表示数量随时间的_____。判断某措施的影响，应核对措施实施时点，再比较该时点前后的曲线变化；本图纵坐标单位为_____。曲线最高点对应观察期内该指标的_____，两条曲线应分别读取。

答案：变化趋势；百万人；最大值

怎么认 题目出现两条 HIV 趋势曲线及用药时点时，先分别读峰值与用药后的变化。

例题 1

The graph shows the change in number of new HIV infections and deaths from AIDS between 1990 and 2014.



What does the graph show?

1 The number of new HIV infections fell after condom use was promoted.

2 The use of anti-HIV drugs has led to a decrease in deaths from AIDS.

3 The highest rate of deaths from AIDS occurred in 1995.

A 1 and 2 only **B** 3 only **C** 1, 2 and 3 **D** 2 only

（2022 Oct/Nov · 0654/11 · Question 10 · Core）

解：图中未给出推广使用避孕套的时点，不能得出 1。
抗 HIV 药物开始使用后，艾滋病死亡人数在约 2004 年达到峰值，随后由约 200 万人降至约 50 万人，2 正确。
死亡人数最高点约在 2004 年，不是 1995 年，3 错误。
故选 D。

第 15 章 无性与有性生殖

15.1 无性与有性生殖

题型 1：核对有性与无性生殖的亲本、配子与变异（考频★★★★☆）

知识点 有性生殖由两个配子核发生_____形成合子，通常有两个亲本；后代在遗传上彼此不同。
无性生殖只需_____个亲本，不发生配子核融合；后代在遗传上与亲本_____。
两种生殖都包含亲本和后代；是否发生配子核融合，是判别两者的条件。

答案：融合；一；相同

怎么认 题目出现亲本数、配子核融合、合子或后代遗传关系时，先核对是否发生配子核融合。

一. 核对生殖定义中的必要条件

例题 1

Which row describes sexual reproduction?

	zygote produced	genetically identical offspring always produced
A	✓	✓
B	✓	✗
C	✗	✓
D	✗	✗

（2025 Oct/Nov · 0654/11 · Question 12 · Core）

解：有性生殖中两个配子核融合形成合子，故能产生合子。
后代在遗传上彼此不同，并非总是遗传相同。故选 B。

针对练习

1. Which row is correct for sexual reproduction?

	number of parents	offspring
A	one	genetically different
B	one	genetically identical
C	two	genetically different
D	two	genetically identical

（2024 May/Jun · 0654/11 · Question 10 · Core）

2. In a plant, what leads to offspring that are genetically identical to the parent?

A asexual reproduction

B insect pollination

C seed germination

D sexual reproduction

（2023 May/Jun · 0654/11 · Question 10 · Core；同题：2023 May/Jun · 0654/21 · Question 10 · Extended）

3. Which statement describes one similarity between asexual and sexual reproduction?

A They both involve gametes.

B They both involve parent and offspring.

C They both produce genetically identical individuals.

D They both require fertilisation to take place.

（2024 Oct/Nov · 0654/21 · Question 10 · Extended）

4. Which statement about asexual reproduction is correct?

A It involves the fusion of gametes from one parent.

B It involves the fusion of gametes from two parents.

C It produces offspring which are genetically different.

D It produces offspring which are genetically identical.

（2022 May/Jun · 0654/11 · Question 10 · Core；同题：2022 May/Jun · 0654/12 · Question 10 · Core；同题：2022 May/Jun · 0654/13 · Question 10 · Core）

5. Which statement about reproduction is correct?

A Sexual reproduction involves the fusion of two gamete nuclei.

B Sexual reproduction results in the production of genetically identical offspring.

C Asexual reproduction involves the fusion of two gamete nuclei.

D Asexual reproduction results in the production of genetically different offspring.

（2025 May/Jun · 0654/12 · Question 11 · Core；同题：2025 May/Jun · 0654/13 · Question 11 · Core）

6. Which row describes asexual reproduction?

	only one parent	fusion of nuclei	genetically identical offspring
A	✓	✓	✓
B	✓	✓	✗
C	✓	✗	✓
D	✗	✓	✓

key

✓ = yes

✗ = no

（2024 May/Jun · 0654/21 · Question 10 · Extended）

7. Which statements about asexual reproduction are correct?

1 It involves gametes.

2 It produces genetically identical offspring.

3 It only requires one parent.

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

（2024 Feb/Mar · 0654/12 · Question 10 · Core）

二. 由具体生命周期辨认生殖方式

知识点 无性生殖是由一个亲本产生后代且不发生配子细胞核融合的过程，后代在遗传上与亲本_____。

有性生殖是雄配子与雌配子的_____发生融合并形成受精卵的过程，后代在遗传上存在差异。

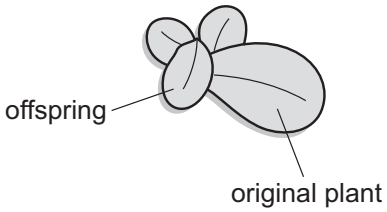
判断生命周期中的某一阶段时，以该阶段是否发生_____为依据：未发生的是无性生殖，发生的是有性生殖。

答案：相同；细胞核；受精

怎么认 题目出现芽生图或生命周期各阶段是否受精时，先按有无受精判断生殖方式，再判断后代遗传关系。

例题 2

A certain aquatic plant reproduces by forming offspring from the original plant.



Which statement describes the reproduction of this aquatic plant?

A asexual reproduction which produces genetically different plants

B asexual reproduction which produces genetically identical plants

C sexual reproduction which produces genetically different plants

D sexual reproduction which produces genetically identical plants

（2025 Oct/Nov · 0654/12 · Question 10 · Core；同题：2025 Oct/Nov · 0654/13 · Question 10 · Core）

解：图中子体由原植物长出，未发生配子细胞核融合，属于无性生殖。
无性生殖产生的植株在遗传上相同。
故选 B。

针对练习

8. Aphids are insects. The information shown describes part of the lifecycle of the aphid.

stage 1 In the spring, wingless females reproduce without fertilisation to produce many female offspring.

stage 2 In late summer, both males and females are produced. The female's eggs are fertilised by the male's sperm.

Which row shows the type of reproduction occurring at stages 1 and 2?

	stage 1	stage 2
A	asexual	asexual
B	asexual	sexual
C	sexual	asexual
D	sexual	sexual

（2022 Oct/Nov · 0654/12 · Question 10 · Core）

三. 比较快速繁殖和遗传变异的优势

知识点 无性生殖由_____产生后代，不发生配子核融合，后代通常与亲本遗传上相同。
有性生殖由两个_____的细胞核融合形成合子，后代具有遗传差异。
在环境适宜时，无性生殖可迅速增加个体数量；环境变化时，有性生殖产生的遗传差异使_____后代较可能适应。

答案：一个亲本；配子；部分

怎么认 题目出现无性或有性生殖、繁殖速度、遗传差异或环境变化时，先判断是否发生配子核融合及后代遗传上是否相同。

例题 3

Which statement gives an advantage of sexual reproduction over asexual reproduction?

A The offspring are genetically different and therefore it is more likely that some can adapt to a changing environment.

B The offspring are genetically different so all can adapt to a changing environment.

C The offspring are genetically identical and therefore it is more likely that some can adapt to a changing environment.

D The offspring are genetically identical so all can adapt to a changing environment.

（2022 May/Jun · 0654/22 · Question 10 · Extended）

解：有性生殖使后代具有遗传差异。
环境发生变化时，后代的性状不同，其中部分个体适应新环境的可能性较大。
故选 A。

针对练习

9. Which statement is correct?

A Asexual reproduction produces offspring which can adapt quickly to changes in the environment.

B Asexual reproduction produces genetically different offspring much faster than sexual reproduction.

C Sexual reproduction produces genetically different offspring enabling natural selection to occur.

D Sexual reproduction produces genetically identical offspring by the production of gametes.

（2025 Oct/Nov · 0654/22 · Question 11 · Extended）

10. What are the advantages of a plant reproducing asexually?

1 increased variety of genetic material
2 only small flowers need to be produced
3 rapid increase in population size

A 1 only **B** 2 only **C** 3 only **D** 1, 2 and 3

（2022 Oct/Nov · 0654/23 · Question 10 · Extended）

题型 2：定位人体生殖器官并对应功能（考频★★★☆☆）

知识点 睾丸产生_____，阴囊位于体外并容纳睾丸；前列腺分泌精子游动所需的液体，输精管把精子输送至尿道。
卵巢产生并释放卵细胞；输卵管连接卵巢附近与子宫，正常情况下受精发生在输卵管。
胚胎植入_____内膜，胎儿在其中发育；未受精的卵细胞依次经过输卵管、子宫、子宫颈和阴道排出体外。

答案：精子；子宫

怎么认 题目出现人体生殖系统图、器官名称或功能配对时，先按位置确定器官，再对应其功能。

例题 1

Which row correctly matches a structure with its function in the human reproductive system?

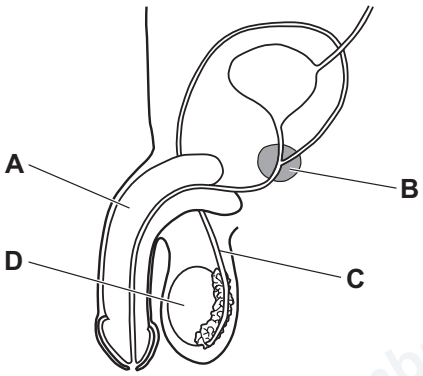
	structure	function
A	cervix	where the fetus develops
B	oviduct	releases the female gamete
C	sperm duct	secretes fluids that make semen
D	testes	produces the male gametes

（2023 Feb/Mar · 0654/12 · Question 10 · Core）

解：A 错，胎儿在子宫中发育；B 错，雌性配子由卵巢释放；C 错，精液中的液体由前列腺分泌；D 对，睾丸产生雄性配子。故选 D。

针对练习

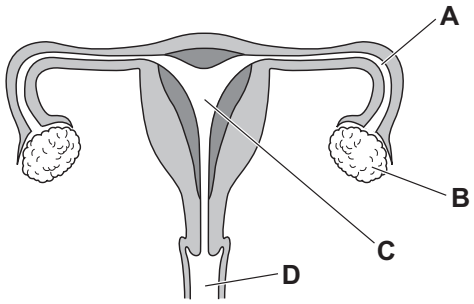
1. Which structure secretes fluids in which the sperm swim in the human male reproductive system?



（2026 May/Jun · 0654/11 · Question 9 · Core）

2. The diagram shows the human female reproductive system.

Which label shows the oviduct?



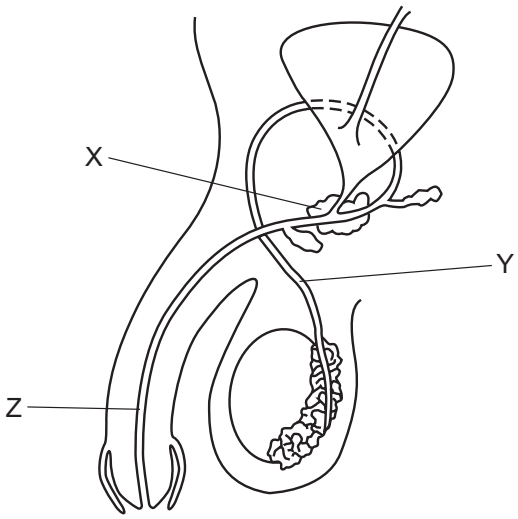
（2025 Feb/Mar · 0654/22 · Question 10 · Extended）

3. Which part of the male reproductive system is correctly matched to its function?

	part	function
A	prostate gland	transfers sperm to the urethra
B	scrotum	holds the testes outside of body
C	testes	secrete fluids for sperm to swim in
D	urethra	transfers semen to ovary

（2023 Oct/Nov · 0654/11 · Question 10 · Core；同题：2023 Oct/Nov · 0654/21 · Question 10 · Extended）

4. The diagram shows the human male reproductive system.



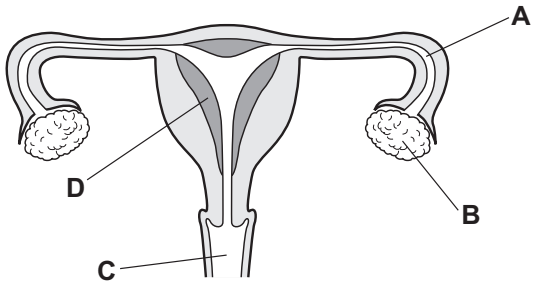
Which row identifies structures X, Y and Z?

	urethra	sperm duct	prostate gland
A	X	Y	Z
B	X	Z	Y
C	Z	X	Y
D	Z	Y	X

（2024 May/Jun · 0654/22 · Question 10 · Extended）

5. The diagram shows the human female reproductive system.

Where is the embryo normally implanted to enable it to develop into a healthy fetus?



（2024 May/Jun · 0654/12 · Question 10 · Core；同题：2024 May/Jun · 0654/13 · Question 10 · Core）

6. During the menstrual cycle, an egg is released at ovulation.

The egg passes out of the body if it is not fertilised.

What is the correct order of structures through which the egg passes?

A cervix → oviduct → uterus → vagina

B oviduct → uterus → cervix → vagina

C oviduct → vagina → cervix → uterus

D uterus → oviduct → vagina → cervix

(2022 Feb/Mar · 0654/12 · Question 10 · Core)

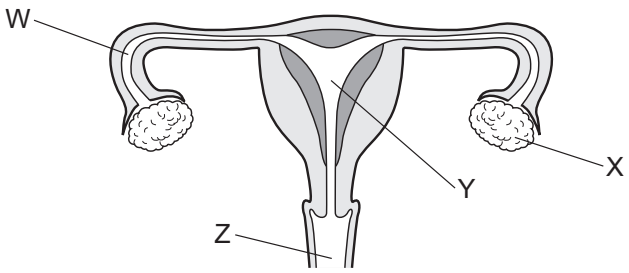
7. There are different conditions which may prevent a successful pregnancy.

1 failure of ovulation

2 failure of embryo to implant into uterus lining

3 blockage of oviducts preventing fertilisation

The diagram shows the human female reproductive system.

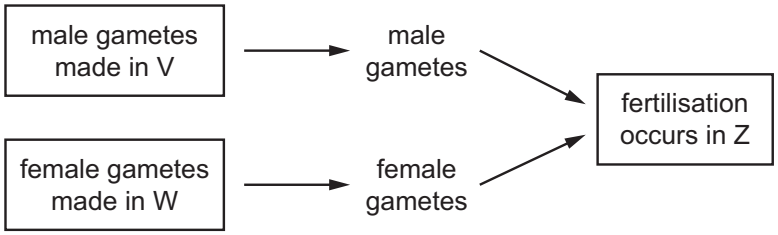


Which locations are involved in each condition?

	1	2	3
A	W	X	Z
B	W	Y	X
C	X	Y	W
D	X	Z	W

(2023 Oct/Nov · 0654/13 · Question 10 · Core)

8. The diagram shows human gamete formation and fertilisation.



Which row is correct?

	structure V	structure W	structure Z
A	scrotum	uterus	oviduct
B	testes	oviduct	ovary
C	testes	ovary	oviduct
D	scrotum	oviduct	uterus

（2023 Oct/Nov · 0654/22 · Question 10 · Extended）

题型 3：定位花器官并区分传粉与受精（考频★★★☆☆）

知识点 传粉是花粉从花药转移到_____的过程；受精是雄性细胞核与卵细胞核融合。

雄蕊由花药和花丝组成，花药产生花粉；雌蕊由柱头、花柱和_____组成，子房内含胚珠。

传粉后，花粉在柱头萌发形成花粉管，花粉管穿过_____到达胚珠，雄性细胞核沿花粉管移动。

识图时，顶端接受花粉的是柱头，中部细长的是花柱，基部膨大且含胚珠的是子房。

答案：柱头；子房；花柱

怎么认 题目出现花的剖面图、器官标注或传粉路径时，先按各结构的上下位置和连接关系定位。

一. 按位置和传粉路径辨认花器官

例题 1

Before fertilisation in flowering plants, which structure must the pollen nucleus pass through to reach the nucleus in the ovule?

A filament

B petal

C stamen

D style

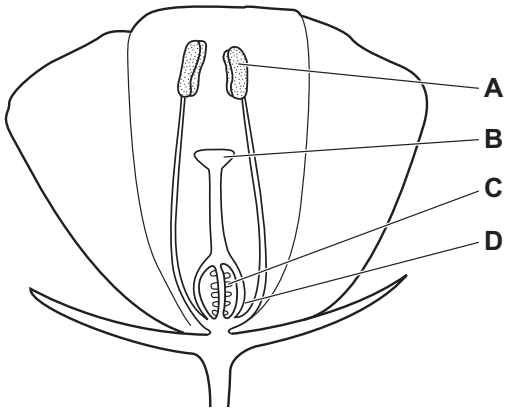
（2024 Oct/Nov · 0654/11 · Question 10 · Core）

解：传粉后，花粉在柱头萌发形成花粉管，花粉管沿花柱向子房内的胚珠生长。
花粉核随花粉管穿过花柱，才能到达胚珠内的卵细胞核。故选 D。

针对练习

1. The diagram shows a section through an insect-pollinated flower.

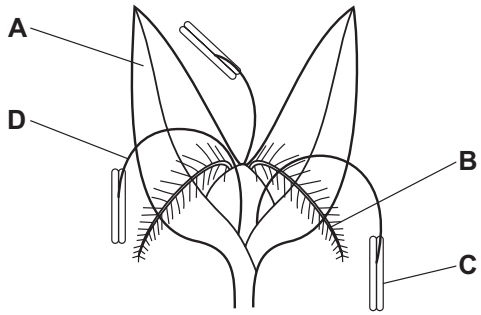
When pollination occurs, where must the pollen grains reach?



（2023 May/Jun · 0654/23 · Question 10 · Extended）

2. The diagram shows a wind-pollinated flower.

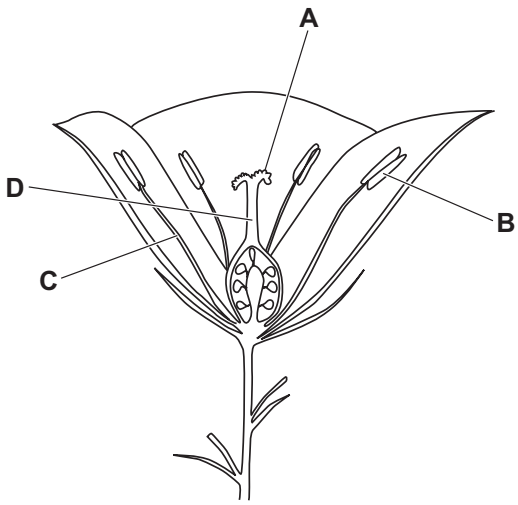
Which structure is adapted to receive pollen?



（2022 May/Jun · 0654/21 · Question 10 · Extended）

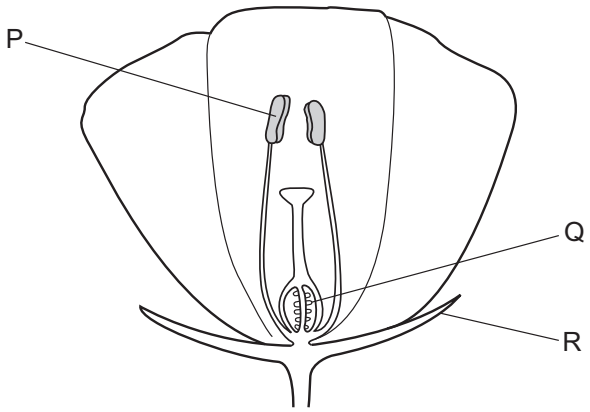
3. The diagram shows a cross section of a flower.

Which labelled part is the style?



（2025 Feb/Mar · 0654/12 · Question 13 · Core）

4. The diagram shows a flower.

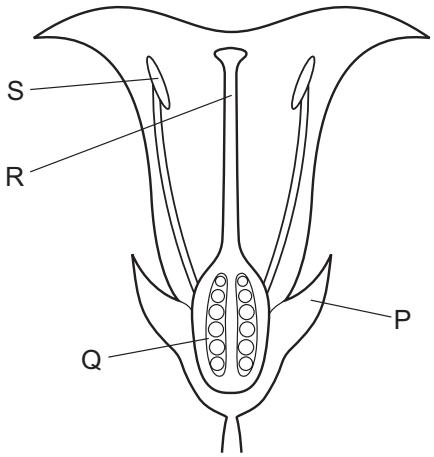


Which row names the structures labelled P, Q and R?

	P	Q	R
A	anther	ovary	sepal
B	anther	style	carpel
C	filament	ovary	carpel
D	filament	style	sepal

（2024 Oct/Nov · 0654/23 · Question 10 · Extended）

5. The diagram shows a section through a flower.



Which labelled structures are the anther and the ovary?

	anther	ovary
A	R	P
B	R	Q
C	S	P
D	S	Q

（2023 May/Jun · 0654/12 · Question 10 · Core；同题：2023 May/Jun · 0654/13 · Question 10 · Core、2023 May/Jun · 0654/22 · Question 10 · Extended）

二. 检查花粉位置和核是否融合

知识点 传粉是花粉粒从_____转移到柱头的过程；花粉粒已落在柱头上，说明传粉已经发生。

受精是花粉核与胚珠内的卵细胞核_____的过程；两核必须在_____内相遇并融合，才能判定受精发生。

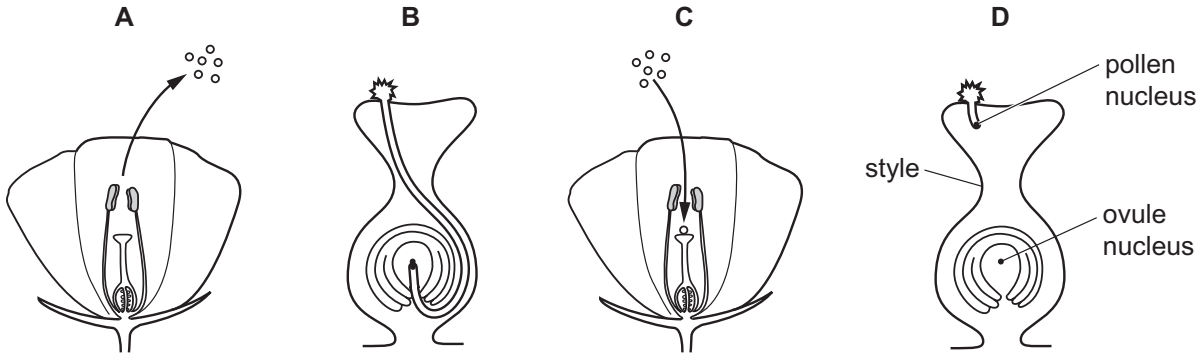
花粉管在花柱内生长或花粉核仍在途中，均不能说明受精已经发生。

答案：花药；融合；胚珠

怎么认 题目出现花粉粒、花粉管及细胞核的位置图时，先看花粉是否到达柱头，再看两核是否在胚珠内融合。

例题 2

Which diagram shows fertilisation occurring in a flower?



（2023 Oct/Nov · 0654/12 · Question 10 · Core）

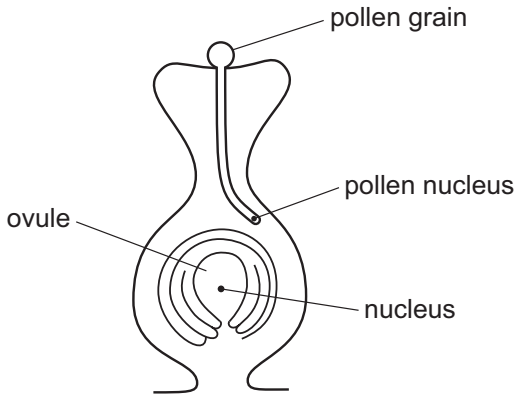
解：受精要求花粉核进入胚珠，并与胚珠内的卵细胞核融合。

图 B 中花粉管已伸入胚珠，管端的花粉核已到达卵细胞核，图示两核正在融合。

故选 B。

针对练习

6. The diagram shows a cross-section of a carpel of an insect-pollinated flower.



Which row correctly shows the processes that have taken place?

	pollination	fertilisation
A	✓	✓
B	✓	✗
C	✗	✓
D	✗	✗

key

✓ = has occurred

✗ = has not occurred

（2022 Oct/Nov · 0654/13 · Question 10 · Core）

题型 4：把配子结构与形成、运动和受精功能对应（考频★★☆☆☆）

知识点 人的精子和卵细胞都是配子，由减数分裂形成，细胞核中各含一套染色体，属于单倍体。

精子头部前端的_____含有酶，在受精时帮助精子消化并穿过卵细胞的外层；细胞核含遗传物质，不储存这些酶。

精子的_____推动精子运动；卵细胞有食物储备，并由胶状外层包围。

受精后卵细胞膜发生变化，阻止其他精子进入；人的受精通常发生在输卵管。

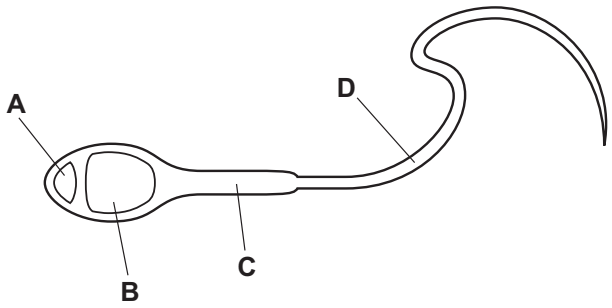
答案：顶体；鞭毛

怎么认 题目出现精子结构图，问消化卵细胞外层的酶位于何处时，先找精子头部前端的顶体。

例题 1

The diagram shows a sperm cell.

Which structure contains enzymes to digest the outer jelly layer of an egg cell?



（2025 May/Jun · 0654/23 · Question 8 · Extended）

解：图中 A 指向精子头部前端的顶体。

顶体含有酶，可消化卵细胞的胶状外层，故选 A。

针对练习

1. Which statements correctly describe the human male gamete?

1 contains enzymes

2 food stores present

3 flagellum present

4 surrounded by a jelly coating

A 1 and 2 **B** 1 and 3 **C** 2 and 3 **D** 3 and 4

（2022 Feb/Mar · 0654/22 · Question 10 · Extended）

2. Which statements about human egg and sperm cells are correct?

1 The egg cell's membrane changes to prevent other sperm from entering it after fertilisation.

2 The egg and sperm cells have a diploid nucleus.

3 The sperm's enzymes allow it to penetrate the egg to fertilise it.

4 The process of fertilisation occurs in the ovary.

A 1 and 3 **B** 1 and 4 **C** 2 and 3 **D** 2 and 4

（2024 May/Jun · 0654/23 · Question 10 · Extended）

题型 5：区分胎盘和羊水的作用（考频★☆☆☆☆）

知识点 胎盘连接母体和胎儿，是两者进行物质交换的器官；母体血液与胎儿血液_____。
氧和营养物质由母体进入胎儿，二氧化碳和尿素由胎儿进入母体；胎盘还构成_____，可阻挡部分毒物和病原体。
羊水包围胎儿，主要作用是_____，减小碰撞造成的伤害。

答案：彼此分隔，不相混合；选择性屏障；缓冲震动

怎么认 题目出现胎盘、羊水的作用或母胎血液关系时，先区分物质交换、选择性屏障与缓冲震动。

例题 1

What is a function of the placenta?

A It acts as a barrier to toxins.

B It cushions the fetus from bumps.

C It maintains a constant temperature.

D It exchanges blood between the fetus and the mother.

（2022 Oct/Nov · 0654/21 · Question 10 · Extended）

解：胎盘构成选择性屏障，可阻挡部分毒物，A 对；羊水可缓冲碰撞并有助于维持稳定温度，B、C 错；母体血液与胎儿血液彼此分隔，不相混合，D 错。
故选 A。

题型 6：根据花结构比较虫媒与风媒传粉（考频★★★☆☆）

知识点 传粉是花粉从花药转移到同种花的柱头上的过程。
虫媒花依靠昆虫传粉，通常具有_____的花瓣，花药和柱头位于花内，花粉较大且有黏性。
风媒花依靠风传粉，通常花瓣小，花药较大且_____，柱头外露并呈_____。

答案：大而鲜艳；外露；羽毛状

怎么认 题目出现花药位置、花瓣大小或柱头形态时，先按虫媒花与风媒花的结构特征逐项核对。

一. 以花药、花瓣和柱头形态判传播方式

例题 1

Which row shows a characteristic of an insect-pollinated flower and of a wind-pollinated flower?

	insect-pollinated	wind-pollinated
A	anthers inside flower	anthers outside flower
B	petals small	petals large
C	smooth pollen	sticky pollen
D	stigma outside flower	stigma inside flower

（2026 May/Jun · 0654/12 · Question 9 · Core）

解：虫媒花的花药通常位于花内，风媒花的花药通常伸到花外。
表中 A 行的两项特征均符合。
故选 A。

针对练习

1. Which row identifies some features of wind-pollinated flowers?

	anthers hanging outside petals	feathery stigma
A	✗	✗
B	✗	✓
C	✓	✗
D	✓	✓

（2026 Feb/Mar · 0654/12 · Question 10 · Core）

2. The table shows some features of insect-pollinated flowers and wind-pollinated flowers.

Which rows are correct?

	insect-pollinated flowers	wind-pollinated flowers
1	anthers dangle outside the flower	anthers are inside the flower
2	large petals	small petals
3	not scented	scented
4	stigma inside the flower	stigma dangles outside the flower

A 1 and 2 **B** 1 and 3 **C** 2 and 4 **D** 3 and 4

（2023 Oct/Nov · 0654/23 · Question 10 · Extended）

3. What is most likely to describe a flower that is wind-pollinated?

A Anthers are small and inside the flower.

B Anthers are large and outside the flower.

C Stigmas are large and inside the flower.

D Stigmas are small and outside the flower.

（2022 Oct/Nov · 0654/22 · Question 10 · Extended）

4. Three features of flowers are listed.

1 anthers located within the petals

2 large colourful petals

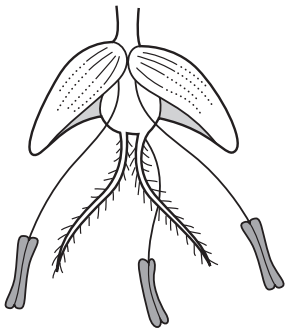
3 feathery stigma

Which features are adaptations for wind pollination?

A 1 and 2 **B** 1 only **C** 2 and 3 **D** 3 only

（2025 Oct/Nov · 0654/21 · Question 11 · Extended）

5. The diagram shows a flower.



What is the method of pollination for this flower and the structural adaptation that enables this?

A insect pollination because the anthers are feathery

B insect pollination because the stigmas are feathery

C wind pollination because the anthers are feathery

D wind pollination because the stigmas are feathery

（2025 May/Jun · 0654/22 · Question 12 · Extended）

二. 按图同时辨认器官与传粉方式

知识点 雄蕊由花药和花丝组成，花丝（filament）是支撑花药的细长结构；柱头（stigma）是雌蕊顶端接受花粉的结构。

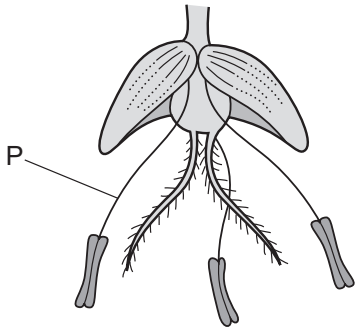
风媒花的花药和柱头常伸出花外，柱头呈_____，以增大接收空气中花粉的机会。

图中支撑花药的细长结构是_____；出现上述特征时，传粉方式为_____。

答案：羽毛状；花丝；风媒传粉

怎么认 题目出现花的结构图并同时问器官和传粉方式时，先辨认羽毛状柱头，再结合外露花药判断风媒传粉。

例题 2 The diagram shows a flower.



What is structure P and which type of pollination is used by the flower?

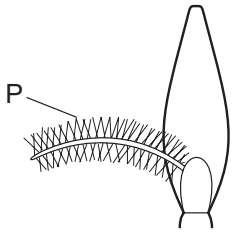
	structure P	type of pollination
A	filament	insect
B	filament	wind
C	stigma	insect
D	stigma	wind

（2025 May/Jun · 0654/21 · Question 10 · Extended）

解：图中央的羽毛状结构为柱头，P 指向支撑花药的细长结构，故 P 为花丝。
柱头呈羽毛状且花药悬垂在花外，有利于接收和散出风中的花粉，故为风媒传粉。
故选 B。

针对练习

6. The diagram shows part of a flower.



What is structure P and which type of pollination is used by the flower?

	structure P	type of pollination
A	stamen	insect
B	stamen	wind
C	stigma	insect
D	stigma	wind

（2025 Oct/Nov · 0654/23 · Question 10 · Extended）

题型 7：把配子核融合与染色体倍数对应（考频★☆☆☆☆）

知识点 无性生殖不发生配子核融合，通常由一个亲本产生后代。
有性生殖中，两个_____配子的细胞核融合，形成_____合子；这一过程称为受精。
单倍体（haploid）含一套染色体，记作n；二倍体（diploid）含两套染色体，记作$2n$，染色体倍数无单位。

答案：单倍体；二倍体

怎么认 题目出现生殖方式、配子融合和染色体倍数时，先核对是否有核融合，再由$n+n=2n$判断倍数。

例题 1

Which statement about reproduction is correct?

A In asexual reproduction, a diploid offspring is formed after fusion of haploid gametes.

B In asexual reproduction, a haploid offspring is formed after fusion of diploid gametes.

C In sexual reproduction, a diploid offspring is formed after fusion of haploid gametes.

D In sexual reproduction, a haploid offspring is formed after fusion of diploid gametes.

（2023 Feb/Mar · 0654/22 · Question 10 · Extended）

解：有性生殖发生配子核融合。
两个单倍体配子融合后，染色体组数为
$n+n=2n$
所得合子为二倍体，并发育成二倍体后代。故选 C。

题型 8：从子宫内膜厚度图读月经周期（考频★☆☆☆☆）

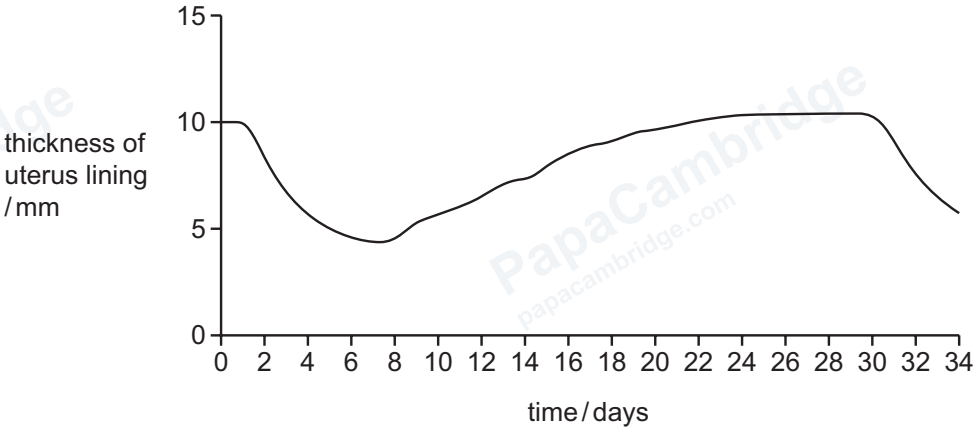
知识点 月经周期是从一次月经开始到下一次月经_____的时间间隔，单位为_____。
在子宫内膜厚度图中，内膜开始明显变薄表示内膜开始脱落；周期等于相邻两次脱落开始时刻之差。

答案：开始；天

怎么认 题目出现子宫内膜厚度随时间变化图并求周期时，先找相邻两次厚度开始下降的时刻。

例题 1

The graph shows the thickness of a woman's uterus lining.



What is the duration of this woman's menstrual cycle?

A 10 days **B** 26 days **C** 29 days **D** 34 days

（2026 May/Jun · 0654/13 · Question 9 · Core）

解：图中子宫内膜第一次开始脱落约在第 1 天，下一次开始脱落约在第 30 天。
月经周期为 $30-1=29$ 天。
故选 C。

题型 9：由多组萌发实验确定必要条件（考频★☆☆☆☆）

知识点 种子萌发是胚恢复生长并长出幼根的过程。种子萌发通常需要_____、_____和适宜温度，光通常不是必要条件。
探究某因素是否为必要条件时，应只改变该因素并保持其余条件相同；缺少该因素时不萌发而具备时萌发，才能说明该因素为必要条件。

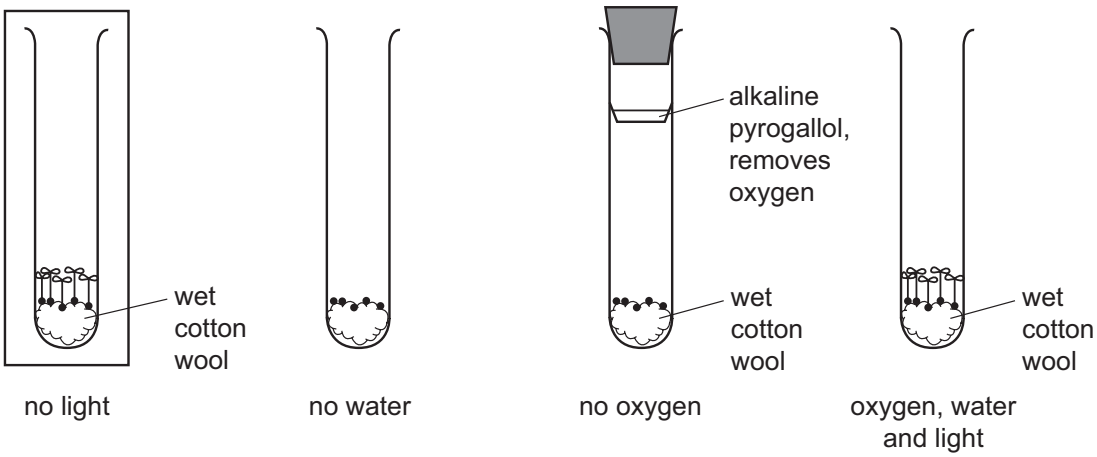
答案：水；氧气

怎么认 题目出现多组萌发装置及有无幼根的结果时，先比较条件齐全组与各缺失因素组。

例题 1

The roles of oxygen, water and light in seed germination are investigated.

The results of the experiment are shown.



Which factors are shown to be needed for germination?

A light and water only

B light and oxygen only

C oxygen and water only

D oxygen, water and light

（2024 Oct/Nov · 0654/12 · Question 10 · Core；同题：2024 Oct/Nov · 0654/13 · Question 10 · Core）

解：无水组没有长出幼根，而氧气、水和光均有的组长出幼根，故水是萌发的必要条件。
无氧组没有长出幼根，而氧气、水和光均有的组长出幼根，故氧气是萌发的必要条件。
无光组仍长出幼根，故实验未显示光是萌发的必要条件。
因此，实验显示萌发需要氧气和水。故选 C。

题型 10：从 HIV 感染与 AIDS 死亡柱图核对趋势（考频★☆☆☆☆）

知识点 柱形图中，柱高表示纵轴对应的数量；比较两组数据时，应按图例分清柱的类别，并使用同一纵轴刻度读数。

峰值是某组数据在全部年份中的_____，达到该数值的年份可以有一个或多个。

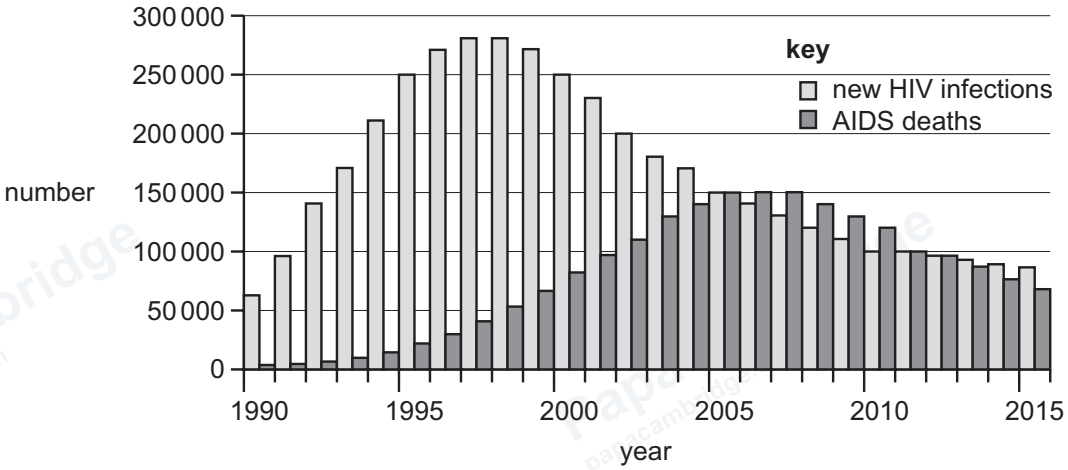
判断一组数据是否始终较大时，应逐年比较；若有一年两者_____或前者较小，该说法不成立。图中人数的单位为_____。

答案：最大值；相等；人

怎么认 题目出现两组年度柱形数据并判断峰值或始终大小关系时，先按图例分组，再逐年核对。

例题 1

The graph shows the number of new HIV infections and AIDS deaths in a country.



Which statements can be concluded from the graph?

1 The number of AIDS deaths peaks in 2006–2008.

2 The number of AIDS deaths peaks at 150 000.

3 The number of new HIV infections peaks in 1997–1998.

4 The number of new HIV infections is always greater than the number of AIDS deaths.

A 1, 2 and 3 **B** 1, 3 and 4 **C** 2 and 3 only **D** 2 and 4

（2026 May/Jun · 0654/21 · Question 11 · Extended）

解：按图例读取深色柱，AIDS 死亡数的最大值为 150000，在 2005 年和 2007 年达到，故陈述 1 不成立，陈述 2 成立。
按图例读取浅色柱，新增 HIV 感染数在 1997 年和 1998 年均达到最大值 280000，故陈述 3 成立。
2011 年两组数据均为 100000，新增 HIV 感染数并非每年都大于 AIDS 死亡数，故陈述 4 不成立。
成立的是 2 和 3，故选 C。

第 16 章 基因、细胞分裂与遗传概率

16.1 基因、细胞分裂与遗传概率

题型 1：由单倍体与二倍体关系判断细胞和数目（考频★★★☆☆）

知识点 单倍体细胞核含_____套不成对的染色体，记作 n；二倍体细胞核含两套染色体，记作 $2n$。
在同一种生物中，二倍体细胞核的染色体数是单倍体的_____倍，染色体数以条计。
人的配子核有 23 条染色体，体细胞核有 46 条染色体；配子核为单倍体，体细胞核通常为_____倍体。
配子由减数分裂产生，不由有丝分裂产生。

答案：一；二；二

怎么认 题目出现单倍体、二倍体、配子、体细胞或染色体图时，先按染色体套数判断。

一. 判断套数与细胞性质

例题 1

What is a difference between a haploid nucleus and a diploid nucleus from the same plant?

A The diploid nucleus has more chromosomes.

B The diploid nucleus is the result of meiosis.

C The haploid nucleus is the result of mitosis.

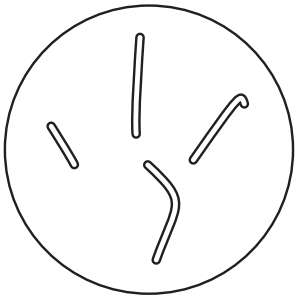
D The haploid nucleus has more alleles.

（2023 Oct/Nov · 0654/23 · Question 11 · Extended）

解：同一植物中，单倍体细胞核含一套染色体，二倍体细胞核含两套染色体。
所以二倍体细胞核含有更多染色体。
故选 A。

针对练习

1. The diagram shows a nucleus from a cell of an organism. The structures shown within the nucleus are chromosomes.



Why is the nucleus haploid?

A because each chromosome contains only one copy of the DNA

B because there are only four chromosomes

C because there are two sets of chromosomes

D because there is a single set of unpaired chromosomes

（2022 Oct/Nov · 0654/23 · Question 11 · Extended）

2. Which row about the nucleus of human cells is correct?

	description of nucleus	number of chromosomes	example of cell
A	diploid	23	gamete
B	diploid	46	body
C	haploid	23	body
D	haploid	46	gamete

(2024 May/Jun · 0654/22 · Question 11 · Extended)

3. The table gives statements about a human haploid nucleus.

Which row is correct?

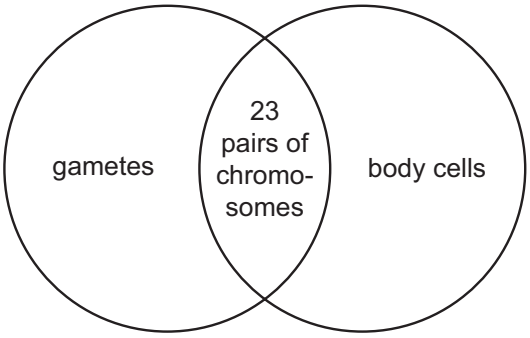
	a single set of unpaired chromosomes	found in gametes	produced by mitosis
A	✗	✗	✓
B	✓	✓	✗
C	✗	✓	✓
D	✓	✗	✗

key
✓ = true
✗ = false

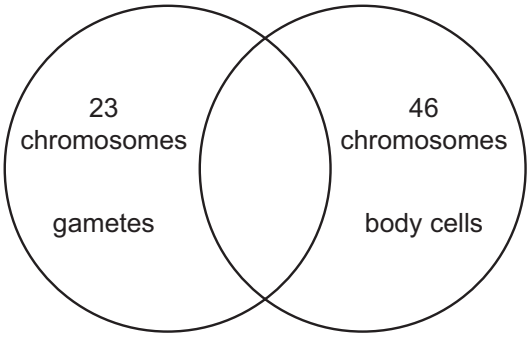
(2022 Feb/Mar · 0654/22 · Question 11 · Extended)

4. Which diagram about haploid and diploid cells in humans is correct?

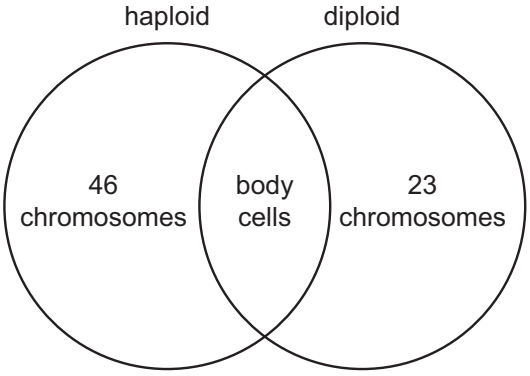
A



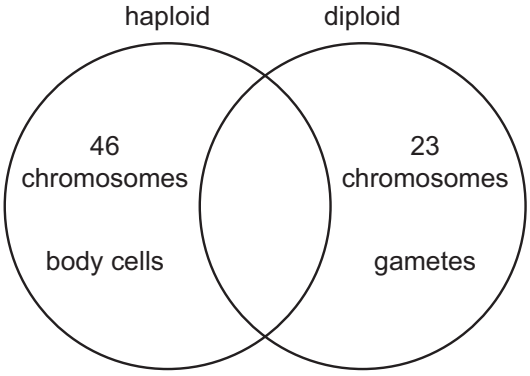
B



C



D



(2022 May/Jun · 0654/23 · Question 11 · Extended)

二. 在体细胞与配子之间换算

知识点 有细胞核的体细胞通常含两套染色体，称为二倍体，染色体数记作 $2n$；配子只含一套染色体，称为_____，染色体数记作 n。

对同一物种，配子的染色体数是体细胞的_____；卵细胞和精子均属于配子。

受精时，卵细胞核与精子核融合，合子的染色体数等于_____；染色体数的单位为条。

合子经有丝分裂形成子代体细胞，染色体数保持不变。

答案：单倍体；一半；卵细胞与精子染色体数之和

怎么认 题目出现体细胞、卵细胞、精子、合子或子代的染色体数时，先判定细胞是二倍体还是单倍体。

例题 2

Sheep have 54 chromosomes in their body cells.

Which row is correct for a female sheep?

	number of chromosomes in egg cells	egg cells
A	27	haploid
B	54	haploid
C	27	diploid
D	54	diploid

（2025 Oct/Nov · 0654/23 · Question 9 · Extended）

解：羊的卵细胞是配子，为单倍体。

由配子的染色体数是体细胞的一半，得

$\frac{54}{2} = 27$

故选 A。

针对练习

5. Kangaroos have 16 chromosomes in their skin cells.

How many chromosomes are there in a kangaroo sperm cell?

A 4 **B** 8 **C** 16 **D** 32

（2025 May/Jun · 0654/23 · Question 9 · Extended）

6. The body cells of tigers have 38 chromosomes.

Which row shows the numbers of chromosomes involved during sexual reproduction in tigers?

	egg cell	sperm cell	zygote	offspring body cell
A	38	38	19	38
B	19	19	38	76
C	19	19	38	38
D	38	38	76	76

（2024 Feb/Mar · 0654/22 · Question 10 · Extended）

7. Chimpanzee gametes contain one more chromosome than human gametes.

What is the chromosome number in a chimpanzee diploid cell?

A 23 **B** 24 **C** 46 **D** 48

（2025 Oct/Nov · 0654/21 · Question 12 · Extended）

8. Some information about a donkey and a horse is shown.

- The sperm from a donkey is able to fertilise the egg from a horse.
- The nucleus of a body cell from a horse has 64 chromosomes.
- The nucleus of a sperm cell from a donkey has 31 chromosomes.
- The offspring from a cross between a donkey and a horse is called a mule.

How many chromosomes are in the nucleus of a body cell from a mule?

A 31 **B** 63 **C** 64 **D** 95

（2025 May/Jun · 0654/22 · Question 11 · Extended）

题型 2：核对人的体细胞和配子性染色体（考频★★★☆☆）

知识点 性染色体是与人的性别决定有关的染色体。

人的体细胞含有一对性染色体；通常女性为_____，男性为_____。

每个配子只含一条性染色体，不含一对性染色体。

卵细胞都含 X 染色体，精子含 X 或 Y 染色体；卵细胞在卵巢中形成，精子在睾丸中形成。

答案：XX；XY

怎么认 题目出现人的体细胞或配子所含性染色体时，先判断是体细胞还是配子。

例题 1

Which sex chromosomes are found in a healthy male human?

A XO **B** XX **C** XY **D** YY

（2022 Oct/Nov · 0654/11 · Question 11 · Core）

解：健康男性的体细胞含有一对性染色体，通常为 XY。

故选 C。

针对练习

1. Which combination of chromosomes produces a male in humans?

A XO **B** XY **C** YY **D** XX

（2025 Oct/Nov · 0654/22 · Question 12 · Extended）

2. Which combination of sex chromosomes are present in the body cells of a human male?

A XX **B** XY **C** Y only **D** YY

（2023 Oct/Nov · 0654/13 · Question 11 · Core）

3. Which row shows the sex chromosomes in humans?

	female	male
A	XX	XY
B	XY	XX
C	YY	XX
D	XX	YY

（2024 May/Jun · 0654/23 · Question 11 · Extended）

4. Which statement about human gametes is correct?

A All egg cells contain an X chromosome.

B All sperm cells contain a Y chromosome.

C All egg cells contain X and Y chromosomes.

D All sperm cells contain X and Y chromosomes.

（2026 Feb/Mar · 0654/12 · Question 11 · Core）

5. Which statement about human gametes is correct?

A There is an X chromosome in all egg cells.

B There is a Y chromosome in all egg cells.

C There is an X chromosome in all sperm cells.

D There is a Y chromosome in all sperm cells.

（2026 May/Jun · 0654/11 · Question 10 · Core）

6. Which row is correct for a human gamete?

	name of gamete	chromosome carried by gamete	where gamete is produced
A	egg cell	X	testes
B	egg cell	Y	ovaries
C	sperm	X	testes
D	sperm	Y	ovaries

（2025 May/Jun · 0654/12 · Question 12 · Core；同题：2025 May/Jun · 0654/13 · Question 12 · Core）

题型 3：区分等位基因、基因型、表现型与显隐性（考频★★★☆☆）

知识点 基因是编码一种蛋白质的一段 DNA，等位基因（allele）是同一基因的不同版本。

个体所含等位基因的组合称为_____，由遗传组成与环境共同形成的可观察特征称为表现型。

同一基因的两个等位基因相同时为纯合，不同时为_____；字母 T 与 t 表示该基因的两个等位基因。

_____等位基因存在时便可在表现型中表达；隐性等位基因仅在没有显性等位基因时表达。

答案：基因型；杂合；显性

怎么认 题目出现等位基因、基因型、表现型、显性、隐性或成对字母时，先按定义判断所指概念。

例题 1

Which statement is correct?

A An allele is a version of a gene.

B DNA is only found in gametes.

C A gene is a length of DNA that codes for fats.

D Cells of human males contain two X chromosomes.

（2022 Feb/Mar · 0654/12 · Question 11 · Core）

解：等位基因是同一基因的不同版本，A 对；DNA 并非仅存在于配子中，B 错；基因是一段编码蛋白质的 DNA，不编码脂肪，C 错；人类男性体细胞含一条 X 染色体和一条 Y 染色体，D 错。故选 A。

针对练习

1. What is the correct term for an allele that is always expressed in the phenotype if it is present?

A dominant

B heterozygous

C homozygous

D recessive

（2024 Feb/Mar · 0654/12 · Question 11 · Core）

2. In terms of the alleles present, which word describes the genetic make-up of an organism?

A dominant

B genotype

C phenotype

D recessive

（2023 Feb/Mar · 0654/12 · Question 11 · Core）

3. A monohybrid cross between tall (TT) and short (tt) pea plants produces 100% tall (Tt) offspring.

What do the letters T and t represent?

A alleles

B chromosomes

C genes

D genotypes

（2026 May/Jun · 0654/12 · Question 10 · Core）

4. Which statement describes a heterozygous genotype?

A not pure breeding with two different alleles

B not pure breeding with two identical alleles

C pure breeding with two different alleles

D pure breeding with two identical alleles

（2024 May/Jun · 0654/12 · Question 11 · Core；同题：2024 May/Jun · 0654/13 · Question 11 · Core）

5. A type of chicken has either red feathers or black feathers.

Which statements explain why a chicken with the allele for red feathers is born with black feathers?

1 The chicken also has a black feather allele.

2 The chicken is heterozygous for feather colour.

3 The red feather allele is recessive.

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

（2026 May/Jun · 0654/23 · Question 13 · Extended）

题型 4：由分裂过程追踪染色体套数和遗传关系（考频★★★☆☆）

知识点 染色体数按条计；同一种生物的体细胞通常为二倍体 $2n$，配子为单倍体 n。

有丝分裂产生与母细胞遗传上_____的细胞，染色体套数保持不变。

减数分裂使染色体数由 $2n$ 减为 n，产生的细胞遗传上_____。

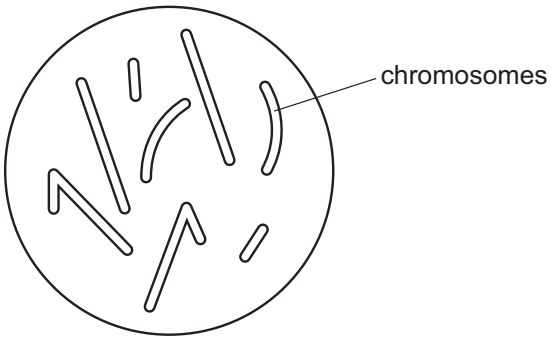
受精时两个单倍体配子融合，形成_____合子；合子随后经有丝分裂增加细胞数。

有配子融合的是有性生殖；不经配子融合、由有丝分裂产生后代的是无性生殖。

答案：相同；不同；二倍体

怎么认 题目出现分裂前后的染色体数、套数或遗传关系时，先判定有丝分裂、减数分裂或受精。

例题 1 The diagram shows the chromosomes present in a cell.



The cell divides by meiosis.

What correctly describes the cells that are produced?

A genetically identical, 8 chromosomes, diploid

B genetically different, 4 chromosomes, haploid

C genetically identical, 4 chromosomes, diploid

D genetically different, 8 chromosomes, haploid

（2022 Oct/Nov · 0654/21 · Question 11 · Extended）

解： 图中原细胞有 8 条染色体。

减数分裂使染色体数减半，$8 \div 2 = 4$。

产生的细胞为单倍体，且遗传上不同。

故选 B。

针对练习

1. What processes occur in the oviduct?

A fertilisation and then the zygote undergoes meiosis

B fertilisation and then the zygote undergoes mitosis

C zygote undergoes meiosis and then fertilisation occurs

D zygote undergoes mitosis and then fertilisation occurs

（2024 Oct/Nov · 0654/22 · Question 10 · Extended）

2. Growing new plants from cuttings is asexual reproduction.

Growing new plants from seeds is sexual reproduction.

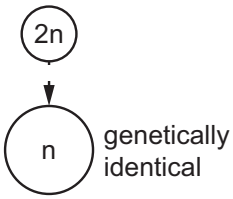
Which row is correct for both cuttings and seeds?

	cuttings		seeds	
	nucleus of cells	offspring	nucleus of cells	offspring
A	diploid	genetically different	haploid	genetically identical
B	diploid	genetically identical	diploid	genetically different
C	haploid	genetically different	haploid	genetically different
D	haploid	genetically identical	diploid	genetically identical

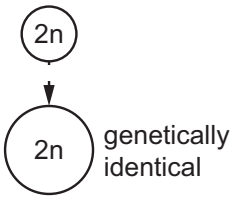
（2025 Feb/Mar · 0654/22 · Question 9 · Extended）

3. If 2n is the diploid number of chromosomes in a nucleus, which diagram is correct for meiosis?

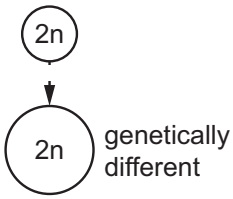
A



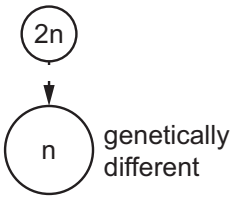
B



C



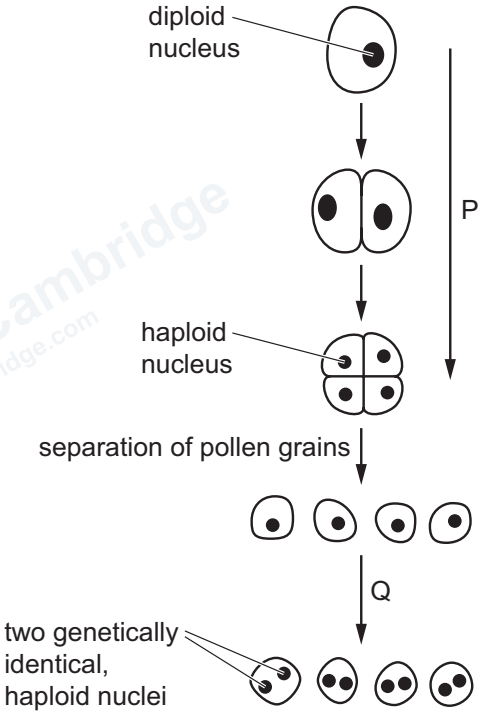
D



（2022 Oct/Nov · 0654/22 · Question 11 · Extended）

4. The diagram shows how pollen grains are produced.

Mature pollen grains contain two haploid nuclei.



Which row identifies the types of cell division shown at stages P and Q?

	P	Q
A	meiosis	meiosis
B	meiosis	mitosis
C	mitosis	meiosis
D	mitosis	mitosis

(2026 May/Jun · 0654/22 · Question 10 · Extended)

5. A student makes three statements about processes in cell division.

1 Process 1 is involved in the production of gametes.

2 The cells produced by process 2 are genetically different.

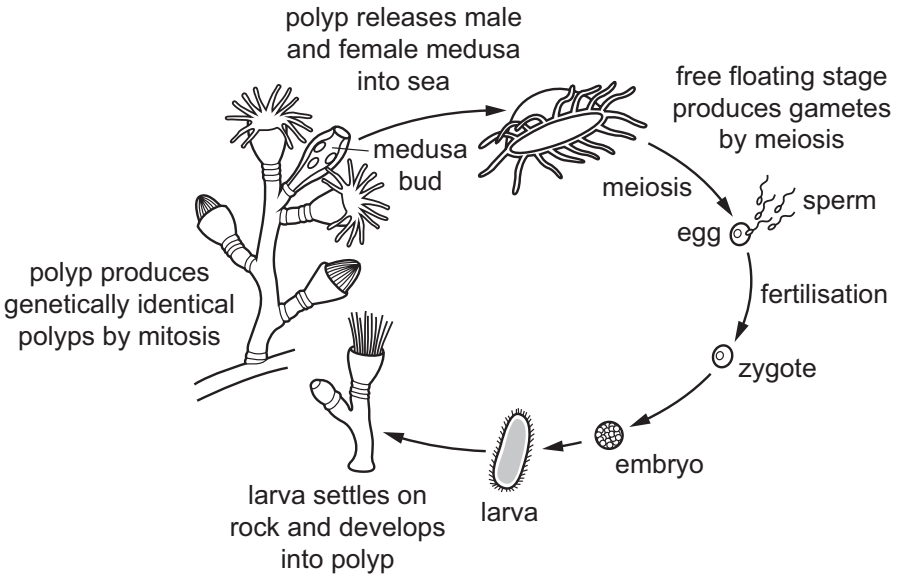
3 The zygote then divides by process 3, which leads to growth.

Which row identifies each process?

	process 1	process 2	process 3
A	meiosis	meiosis	mitosis
B	meiosis	mitosis	meiosis
C	mitosis	mitosis	meiosis
D	mitosis	meiosis	mitosis

(2025 Oct/Nov · 0654/23 · Question 11 · Extended)

6. The diagram shows the life cycle of a marine organism called a hydrozoan.



Which statements about the life cycle of hydrozoa are correct?

1 Hydrozoa reproduce asexually.

2 Hydrozoa reproduce sexually.

3 Fusion of haploid gametes produces a diploid zygote.

A 1 and 2 only **B** 1 and 3 only **C** 2 and 3 only **D** 1, 2 and 3

（2022 May/Jun · 0654/23 · Question 10 · Extended）

题型 5：用单基因交配组合预测或反推后代（考频★★★☆☆）

知识点 同一基因的不同形式称为等位基因，显性等位基因用大写字母表示，隐性等位基因用小写字母表示。

个体含两个相同等位基因时为_____，含两个不同等位基因时为_____；杂合子表现显性性状。

单基因交配中，每个亲本形成配子时，每个配子只含这一对等位基因中的一个；雌雄配子随机结合形成子代基因型。

在单基因完全显性且各类配子结合机会相等时，子代概率按_____相乘，可写成比或百分数，总百分数为 100%。

答案：纯合子；杂合子；配子概率

怎么认 题目出现亲本基因型或纯合、杂合及显隐性关系，并求子代比例时，先列亲本可形成的配子。

一. 给定亲本求子代比例

例题 1

Two parents with genotypes of BB and Bb are crossed.

What is the predicted ratio of genotypes in the offspring?

A 1 BB : 1 Bb **B** 1 Bb : 1 bb **C** 3 BB : 1 Bb **D** 3 Bb : 1 BB

（2025 Oct/Nov · 0654/12 · Question 11 · Core；同题：2025 Oct/Nov · 0654/13 · Question 11 · Core）

解：亲本 BB 形成的配子均含 B；亲本 Bb 形成含 B、b 的配子，概率各为 $\frac{1}{2}$。

子代组合为 $B \times B$ 或 $B \times b$。

BB : $1 \times \frac{1}{2} = \frac{1}{2}$

Bb：$1 \times \frac{1}{2} = \frac{1}{2}$

故子代基因型之比为 BB：Bb $= \frac{1}{2} : \frac{1}{2} = 1 : 1$。故选 A。

针对练习

1. A plant species has yellow or white flowers. The allele for yellow flowers is dominant to the allele for white flowers.

A heterozygous plant with yellow flowers is crossed with a plant with white flowers.

What is the expected percentage of yellow flowers and white flowers in the offspring?

A 100% yellow flowers and 0% white flowers

B 75% yellow flowers and 25% white flowers

C 50% yellow flowers and 50% white flowers

D 25% yellow flowers and 75% white flowers

（2026 Feb/Mar · 0654/22 · Question 7 · Extended）

2. In a plant, the allele for red flowers is dominant to the allele for yellow flowers. A heterozygous red-flowered plant is crossed with a homozygous yellow-flowered plant.

Which statement about the offspring is correct?

A 25% will have red flowers and 75% will have yellow flowers.

B 50% will have red flowers and 50% will have yellow flowers.

C 75% will have red flowers and 25% will have yellow flowers.

D 100% will have red flowers and 0% will have yellow flowers.

（2024 Oct/Nov · 0654/12 · Question 11 · Core；同题：2024 Oct/Nov · 0654/13 · Question 11 · Core）

3. The allele for red flowers is dominant to the allele for white flowers.

A homozygous red-flowering plant and a homozygous white-flowering plant are crossed.

What are the expected phenotypes of their offspring?

A 1 : 1 red to white

B 3 : 1 red to white

C all red

D all white

（2026 May/Jun · 0654/13 · Question 10 · Core）

二. 给定目标后代比例选择亲本

知识点 在单基因遗传且等位基因完全显性时，设显性等位基因为 A，隐性等位基因为 a；AA、Aa 表现显性，aa 表现隐性。

每个后代从两个亲本各获得一个等位基因，亲本所产生的配子组合决定后代基因型。

要保证后代全为隐性，两个亲本都只能产生含 a 的配子，亲本组合为 _____。

$Aa \times aa$ 的表现型比为 _____，$Aa \times Aa$ 的表现型比为 _____；比例无单位。

答案：$aa \times aa$；1 : 1；3 : 1

怎么认 题目出现目标后代表型或比例并要求选择亲本时，先写亲本配子，再组合后代基因型。

例题 2

Purple flower colour is dominant to white flower colour.

Which parents must be crossed to make sure all the offspring have white flowers?

A homozygous dominant × heterozygous

B homozygous dominant × homozygous dominant

C homozygous recessive × heterozygous

D homozygous recessive × homozygous recessive

（2022 May/Jun · 0654/11 · Question 11 · Core）

解： 设显性等位基因为 A，隐性等位基因为 a。
白花基因型为 aa；要使全部后代为白花，每个后代须从两亲本各得到一个 a。
两亲本均只能产生含 a 的配子，故亲本组合为 $aa \times aa$。
子代基因型均为 aa，表现为白花。故选 D。

针对练习

4. Which row shows the monohybrid crosses that produce predicted phenotype ratios of 1 : 1 and 3 : 1?

	1 : 1 ratio	3 : 1 ratio
A	AA × aa	Aa × aa
B	Aa × Aa	Aa × aa
C	Aa × aa	Aa × Aa
D	Aa × aa	AA × Aa

（2025 Oct/Nov · 0654/23 · Question 12 · Extended）

题型 6：用卵和精子染色体组合判断子代性别（考频★☆☆☆☆）

知识点 人的体细胞中有一对性染色体，女性为 _____，男性为 _____。

形成配子时，每个卵细胞只含一条 X 染色体；每个精子含一条 X 或一条 Y 染色体。
X 卵与 X 精结合形成 XX 女性子代，X 卵与 Y 精结合形成 XY 男性子代；交配表去重后只有这两种组合。
上述关系适用于人类正常的性染色体遗传，性染色体的组合不带单位。

答案：XX；XY

怎么认 题目出现卵、精子的性染色体或遗传交配表时，先排除不合法配子，再配成 XX 与 XY。

例题 1

Which diagram correctly shows sex inheritance in humans?

A

male gametes

female gametes	X	X
Y	XY	XY
Y	XY	XY

B

male gametes

female gametes	X	Y
X	XX	XY
Y	XY	YY

C

male gametes

female gametes	X	Y
X	XX	XY
X	XX	XY

D

male gametes

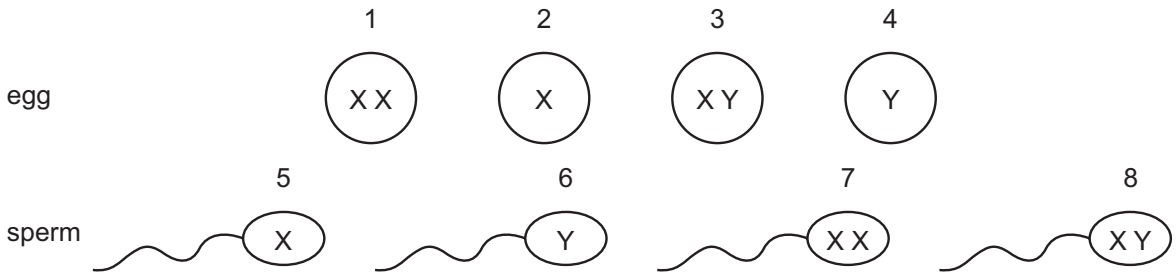
female gametes	Y	Y
X	XY	XY
X	XY	XY

（2022 Oct/Nov · 0654/13 · Question 11 · Core）

解：形成配子时，每个卵细胞只含一条 X 染色体，每个精子含一条 X 或 Y 染色体。
图 C 中雌性配子均为 X，雄性配子分别为 X 和 Y。
X 卵与 X 精结合，子代为 XX；X 卵与 Y 精结合，子代为 XY。
故选 C。

针对练习

1. The diagram shows eggs and sperm containing sex chromosomes.



Which row gives the correct combination of sex chromosomes for a male and female offspring?

	male offspring	female offspring
A	1 and 8	3 and 7
B	2 and 6	2 and 5
C	3 and 8	1 and 7
D	4 and 6	2 and 5

（2023 May/Jun · 0654/11 · Question 11 · Core；同题：2023 May/Jun · 0654/21 · Question 11 · Extended）

题型 7：由后代表现型反推显隐性与亲本基因型（考频★★☆☆☆）

知识点 等位基因成对存在，子代的一对等位基因分别来自父本和母本。

在完全显性且由一对等位基因控制性状时，显性表型可对应纯合显性或杂合基因型，隐性表型只对应_____。

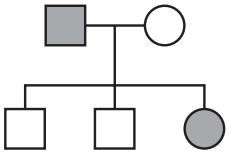
隐性后代要求双亲各提供一个_____；显性双亲生出隐性后代时，双亲均为_____。

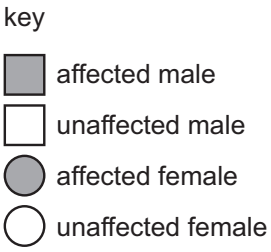
答案：纯合隐性基因型；隐性等位基因；杂合子

怎么认 题目出现显性双亲生出隐性后代、灰白后代或家系图时，先由隐性后代反推双亲所含等位基因。

例题 1

Cystic fibrosis is a genetic disease caused by a recessive allele.





What is the genetic composition of the parents?

	male parent	female parent
A	heterozygous	heterozygous
B	heterozygous	homozygous
C	homozygous	heterozygous
D	homozygous	homozygous

（2022 May/Jun · 0654/21 · Question 11 · Extended）

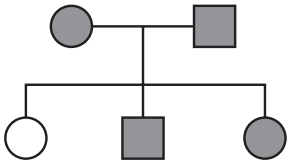
解：设正常等位基因为 A，囊性纤维化等位基因为 a，患病个体的基因型为 aa。

父亲患病，故父亲为纯合子 aa；女儿患病，母亲必提供 a，而母亲未患病，故母亲为杂合子 Aa。

因此男性亲本为纯合子，女性亲本为杂合子。故选 C。

针对练习

1. The diagram shows the inheritance of a disease.



key

- unaffected female
- unaffected male
- affected female
- affected male

Which row is correct for the parents and the allele for the disease?

	parents	allele for the disease
A	heterozygous	dominant
B	heterozygous	recessive
C	homozygous	dominant
D	homozygous	recessive

（2024 May/Jun · 0654/21 · Question 11 · Extended）

2. Albinism is a genetic condition which results in an absence of pigment in the skin, hair and eyes.

If two black mice produce an albino offspring, which Punnett square shows the correct cross?

A

	B	b
B	BB	Bb
B	BB	Bb

B

	B	b
B	BB	Bb
b	Bb	bb

C

	B	b
b	Bb	bb
b	Bb	bb

D

	b	b
b	bb	bb
b	bb	bb

key

B dominant allele for black

b recessive allele for albinism

（2024 Oct/Nov · 0654/11 · Question 11 · Core）

3. The diagrams show some crosses between mice.

Which cross indicates that the allele for grey fur **must** be dominant to the allele for white fur?

A



B



C

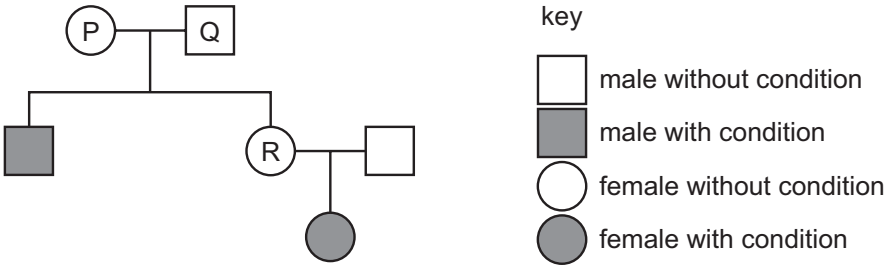


D



（2026 May/Jun · 0654/21 · Question 12 · Extended）

4. The pedigree diagram shows the inheritance of a recessive condition.



Which statements are correct with reference to this condition?

1 P and Q are both heterozygous for the condition.

2 Q and R have different genotypes.

3 P and R have the same genotype.

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

（2024 Oct/Nov · 0654/22 · Question 11 · Extended）

题型 8：在家系中找确定杂合个体并计数（考频★★☆☆☆）

知识点 同一性状由一对等位基因控制时，子代从双亲各获得一个等位基因；两个等位基因不同的个体称为杂合子。

设显性等位基因为 A，隐性等位基因为 a，隐性表型的基因型一定是 _____，显性表型的基因型可能是 AA 或 _____。

显性表型个体若有隐性表型亲本，或生有隐性表型子代，则该个体一定能提供 a，其基因型为 _____。

没有亲子关系证据的显性表型个体，不能确定是纯合子还是杂合子。

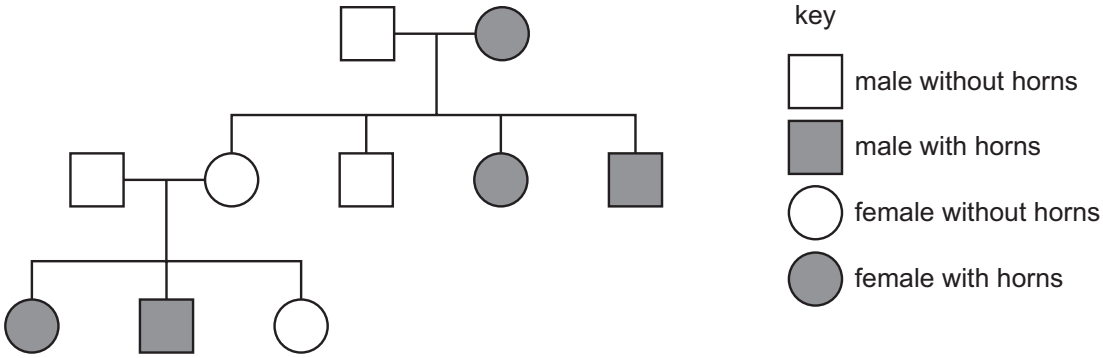
答案：aa；Aa；Aa

怎么认 题目出现显隐性关系、家系图和确定杂合个体数时，先标隐性纯合，再沿亲子关系判定杂合。

例题 1

Horn development in some cattle is controlled by a pair of alleles. The allele for not developing horns is dominant to the allele for developing horns.

The pedigree diagram shows cattle with and without horns.



How many of the cattle are definitely heterozygous?

A 2 **B** 3 **C** 4 **D** 5

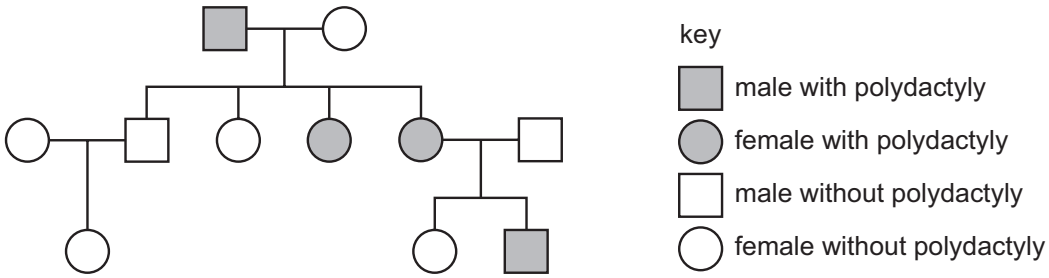
（2024 Oct/Nov · 0654/21 · Question 11 · Extended）

解：设无角显性等位基因为 A，有角隐性等位基因为 a，有角牛的基因型均为 aa。
第一代有角母牛为 aa，其两个无角子代均从母方得到 a，故均为 Aa。
第一代无角公牛与有角母牛生出有角子代，故该公牛为 Aa。
第二代左侧无角母牛与无角公牛生出有角子代，故该公牛为 Aa；其余无角个体可能为 AA 或 Aa。
确定为杂合的共有 $2+1+1=4$ 头。故选 C。

针对练习

1. Polydactyly is the possession of additional fingers or toes. It is caused by a dominant allele.

The pedigree diagram shows the inheritance of polydactyly by a family.

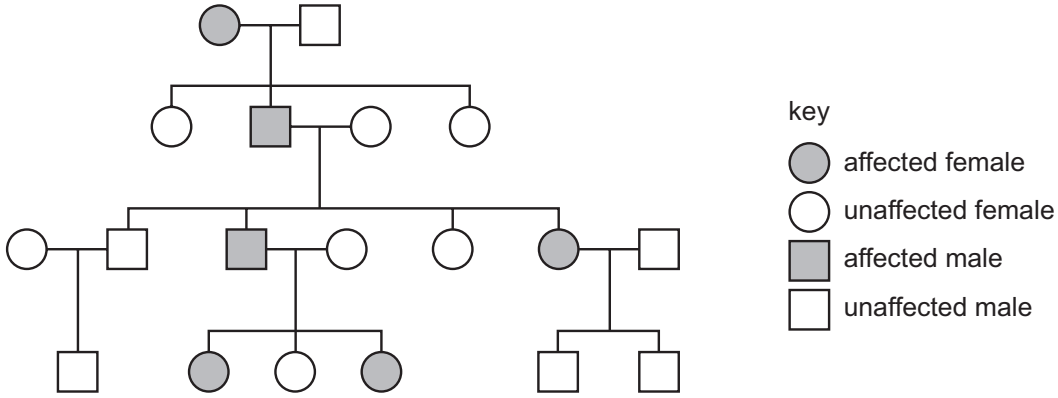


How many people in this family are heterozygous?

A 3 **B** 4 **C** 6 **D** 7

（2025 May/Jun · 0654/21 · Question 11 · Extended）

2. Polydactyly is a condition that causes babies to be born with extra fingers or toes. The allele that causes polydactyly is dominant.



How many individuals on the pedigree diagram are heterozygous for polydactyly?

A 5 **B** 6 **C** 7 **D** 8

（2025 Feb/Mar · 0654/22 · Question 12 · Extended）

题型 9：由家系先定亲本再求下一胎概率（考频★☆☆☆☆）

知识点 对由一对等位基因控制的性状，个体从双亲各获得一个等位基因；显性性状可由纯合显性或杂合基因型表现，隐性性状仅由_____基因型表现。
由后代出现隐性性状可知，双亲都提供了_____等位基因；未表现隐性性状的亲本因此为杂合子。
先由已生后代和上一代的性状反推亲本基因型，再列配子组合；每次受精彼此_____，前胎不改变下一胎概率。

答案：纯合隐性；隐性；独立

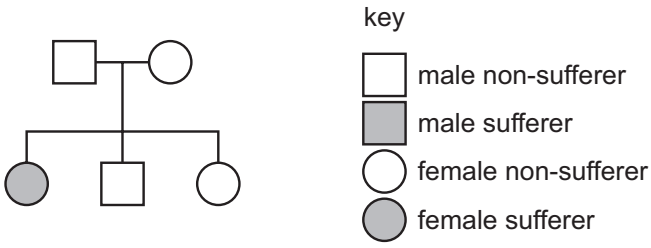
怎么认 题目出现家系图并求下一胎的性状概率时，先由已生后代和上一代反推亲本基因型。

例题 1

Cystic fibrosis is a genetic condition.

The allele for cystic fibrosis is recessive.

The diagram shows inheritance of cystic fibrosis in a family.



What is the chance of the next child having cystic fibrosis?

A 0% **B** 25% **C** 75% **D** 100%

（2024 Feb/Mar · 0654/22 · Question 11 · Extended）

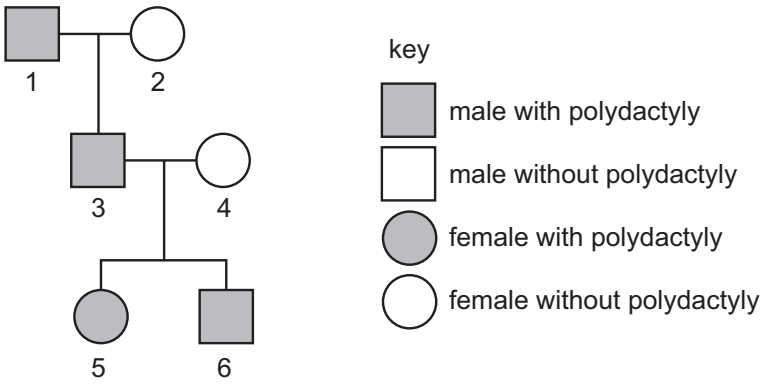
解：设正常等位基因为 A，囊性纤维化等位基因为 a。
患病女儿的基因型为 aa，说明父母双方都提供了 a。
父母均不患病，故父母的基因型均为 Aa。
子代的等可能基因型为 AA, Aa, Aa, aa。
4 种组合中仅 aa 患病，下一胎患病的概率为

$\frac{1}{4} = 25\%$
故选 B。

针对练习

1. Cats with polydactyly have an extra digit on their paw. The allele for polydactyly, P, is dominant to the allele for having five digits, p.

The pedigree diagram shows a family of cats where polydactyly is present.



What is the probability that the next kitten from the mating of 3 and 4 has five digits?

A 0.00 **B** 0.25 **C** 0.50 **D** 0.75

（2023 Oct/Nov · 0654/21 · Question 11 · Extended）

第 17 章 变异与自然选择

17.1 变异与自然选择

题型 1：在人为选择中挑亲本并安排世代（考频★★★☆☆）

知识点 人工选择（artificial selection）是人按照生产需要，选择具有目标性状的个体作亲本并繁殖后代的过程。

选择育种（selective breeding）中，选择主体是_____，亲本通过_____产生有遗传差异的后代。

从后代中再次选择具有目标性状的个体作亲本，并在许多代中反复进行，具有目标性状的个体比例可逐代提高。

自然选择由环境条件产生选择作用，不由人按生产目标挑选亲本。

答案：人；有性生殖

怎么认 题目出现人挑选目标性状亲本、繁殖后代并重复多代时，先判为人工选择。

一. 辨认选择主体和繁殖方式

例题 1

A list of the stages of a process is shown.

1 Choose animals with the desired characteristics.

2 Breed the animals together.

3 Choose the offspring with the desired characteristics and breed the offspring.

4 Repeat over many generations.

What is this process called?

A asexual reproduction

B artificial selection

C mutation

D natural selection

（2025 Oct/Nov · 0654/11 · Question 13 · Core）

解：题干中人先选择具有目标性状的动物作亲本，再从后代中继续选择并繁殖，且重复许多代。

这种由人按目标性状挑选亲本的过程是人工选择。

故选 B。

针对练习

1. Selective breeding is used to improve crop plants.

What does selective breeding involve?

A artificial selection

B asexual reproduction

C immunodeficiency

D natural selection

（2026 May/Jun · 0654/13 · Question 11 · Core）

2. A student writes down the statement shown.

> ‘Selective breeding by natural selection is carried out over many generations to improve crop plants and domesticated animals.’

The statement is **not** correct.

Which change makes the statement correct?

A Change crop plants to flowering plants.

B Change domesticated to wild.

C Change generations to offspring.

D Change natural to artificial.

（2023 May/Jun · 0654/23 · Question 11 · Extended）

3. Selection in chickens has produced individuals that lay more eggs per week.

What is required for this to occur?

	reproduction	selection
A	asexual	human
B	asexual	natural
C	sexual	human
D	sexual	natural

（2022 May/Jun · 0654/12 · Question 11 · Core；同题：2022 May/Jun · 0654/22 · Question 11 · Extended；同题：2022 May/Jun · 0654/13 · Question 11 · Core）

4. Which process is correctly described?

	process	**human intervention**	**example**
A	artificial selection	no	giraffe with long necks
B	artificial selection	yes	cows that produce an increased yield of milk
C	natural selection	no	wheat plants that produce a reduced yield
D	natural selection	yes	cheetahs that can run fast

（2026 May/Jun · 0654/11 · Question 11 · Core）

二. 排序亲本选择、交配和后代选择

知识点 人为选择是人类选择具有_____的个体作为亲本，使其繁殖，并从后代中继续选择该性状的过程。

人为选择的条件是种群中存在_____，且目标性状能够遗传。

基本次序为选择亲本、亲本_____产生后代、选择目标后代；选出的后代成熟后可进入下一轮繁殖。

答案：目标性状；可遗传的变异；交配

怎么认 题目出现人为选择的步骤框或编号并要求排序时，先按选择亲本、交配、选择后代、后代再交配的因果次序排列。

例题 2

Three stages involved in the selective breeding of wheat to increase the size of the seeds are shown.

1 crossing wheat plants to produce the next generation

2 selection by humans of wheat with large seeds

3 selection of wheat offspring with large seeds

What is the correct sequence of these stages?

A $1 \rightarrow 2 \rightarrow 3$ **B** $2 \rightarrow 1 \rightarrow 3$ **C** $2 \rightarrow 3 \rightarrow 1$ **D** $3 \rightarrow 1 \rightarrow 2$

（2025 Oct/Nov · 0654/12 · Question 12 · Core；同题：2025 Oct/Nov · 0654/13 · Question 12 · Core）

解：要增加小麦种子的大小，先由人类选出种子大的小麦作亲本，故先进行 2。
亲本交配产生下一代，故接着进行 1；下一代出现后，再选择种子大的后代，故最后进行 3。
正确次序为 2, 1, 3，故选 B。

针对练习

5. The boxes show the steps involved in artificial selection of an animal species.

1	2	3	4
identify offspring with desirable features	mate a male and a female with desirable features	mate male and female offspring with desirable features	humans select animals with desirable features

Which sequence of steps is correct?

A $2 \rightarrow 1 \rightarrow 4 \rightarrow 3$

B $2 \rightarrow 4 \rightarrow 3 \rightarrow 1$

C $4 \rightarrow 3 \rightarrow 2 \rightarrow 1$

D $4 \rightarrow 2 \rightarrow 1 \rightarrow 3$

（2024 Oct/Nov · 0654/23 · Question 11 · Extended）

三. 按性别和两个目标性状选择亲本

知识点 人工选择是人根据育种目标，选择具有_____的个体作亲本并让其繁殖。

绵羊配种需选择_____，不能选择两只同性个体。

育种目标含多个性状时，应_____比较各性状，在可配对个体中选择组合最好的亲本。

每一代再从后代中选择符合目标的个体繁殖，目标性状便会逐代增多。

答案：符合育种目标的性状；一只公羊和一只母羊；同时

怎么认 题目出现亲本的性别及多个目标性状时，先按一公一母分组，再比较各项目标性状。

例题 3

A farmer wants sheep with a high yield of fleece that will give fine-quality wool.

The table shows six of the sheep available for breeding.

sheep number	sex of sheep	fleece yield	wool quality
1	female	medium	fine
2	female	medium	coarse
3	female	high	fine
4	male	low	fine
5	male	low	coarse
6	male	medium	fine

Which sheep should the farmer select to breed together?

A 1 and 3 **B** 1 and 4 **C** 3 and 4 **D** 3 and 6

（2026 May/Jun · 0654/12 · Question 11 · Core）

解：绵羊配种需选择一只母羊和一只公羊。
母羊中，3 号羊的羊毛产量高且羊毛细，最符合目标；公羊中，6 号羊的羊毛产量中等且羊毛细，最符合目标。
因此选择 3 号羊和 6 号羊配种，故选 D。

题型 2：按有无中间值区分连续与不连续变异（考频★★★☆☆）

知识点 连续变异是表型在两个极端之间形成一个_____，并有中间值；身高、体重等测量性状通常属于连续变异。
不连续变异的表型分成若干彼此分开的_____，类别之间没有中间值；血型、指纹形状等属于不连续变异。
连续数据按题图所标单位记录，不连续类别本身没有_____；分布图中前者覆盖连续区间，后者各类别彼此分开。

答案：范围；类别；单位

怎么认 题目出现表型范围、类别或分布图时，先判断两极之间是否有中间值。

例题 1

The size of tomatoes is an inherited characteristic with a range of phenotypes between two extremes.

What best describes this?

A continuous variation

B discontinuous variation

C natural selection

D selective breeding

（2022 Oct/Nov · 0654/12 · Question 11 · Core）

解：番茄大小的表型在两个极端之间形成一个范围，存在中间值，属于连续变异。故选 A。

针对练习

1. Which characteristic is an example of discontinuous variation?

A body height

B body mass

C blood group

D hand span

（2025 May/Jun · 0654/23 · Question 10 · Extended）

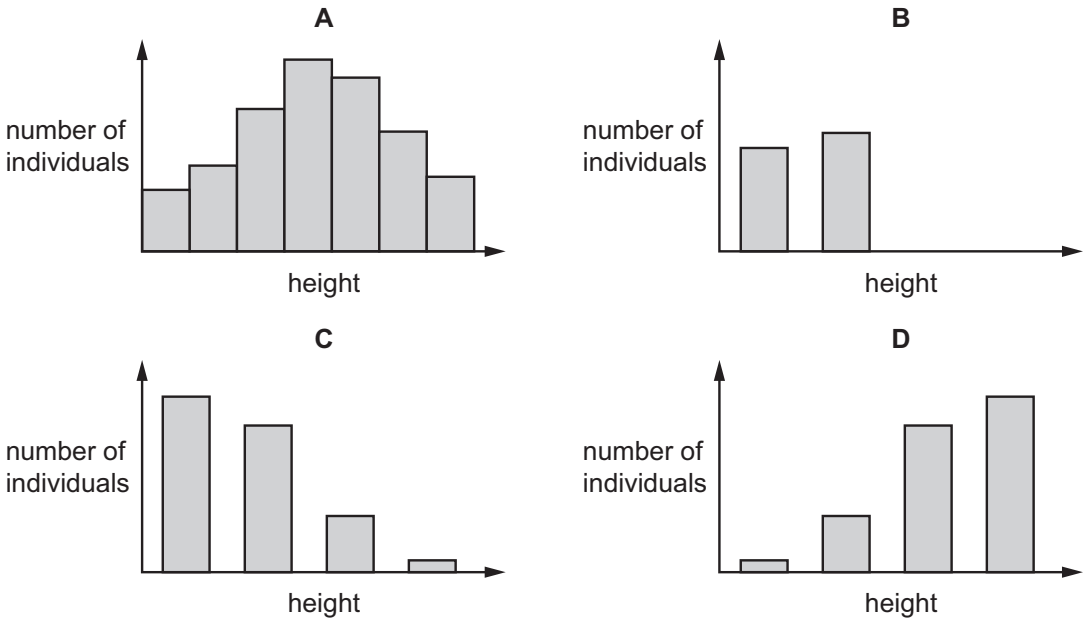
2. Continuous variation is defined as a 1 of phenotypes 2 .

Which words correctly complete gaps 1 and 2?

	1	2
A	limited number	between two extremes
B	limited number	with no intermediates
C	range	between two extremes
D	range	with no intermediates

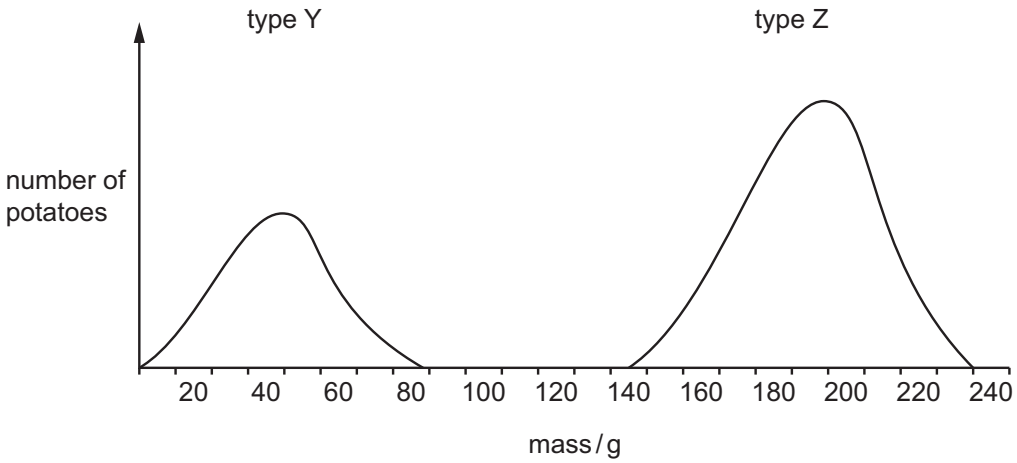
（2023 Oct/Nov · 0654/11 · Question 11 · Core）

3. Which graph represents variation in the height of humans?



（2025 May/Jun · 0654/11 · Question 12 · Core）

4. The graph shows the masses of samples of two different types of potato, Y and Z.



What is shown by the graph?

A Genes do not affect the mass of potatoes.

B Type Y potatoes show continuous variation.

C Type Z potatoes are smaller than type Y.

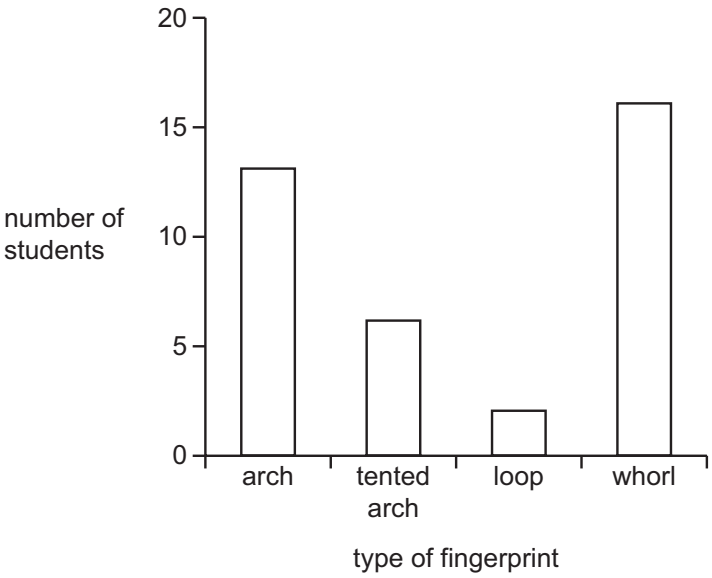
D Type Z potatoes show discontinuous variation.

(2024 May/Jun · 0654/11 · Question 11 · Core)

5. Fingerprints are classified by their shape.

A class of students identified the type of fingerprint they have on the thumb of their left hand.

The chart shows the results.



Which statement about the data in the chart is correct?

A Fingerprints are an example of continuous variation because the data shows a range of phenotypes.

B Fingerprints are an example of continuous variation because the data shows no intermediates.

C Fingerprints are an example of discontinuous variation because the data shows a range of phenotypes.

D Fingerprints are an example of discontinuous variation because the data shows no intermediates.

（2023 May/Jun · 0654/12 · Question 11 · Core；同题：2023 May/Jun · 0654/13 · Question 11 · Core）

题型 3：辨认同物种个体差异的名称（考频★☆☆☆☆）

知识点 同一物种的不同个体之间在特征上的差异称为_____（variation）。

判断这一概念的条件是所比较的个体属于_____；变异是现象名称，没有单位。

答案：变异；同一物种

怎么认 题目出现同一物种不同个体间的差异时，先对应变异的定义。

例题 1

Which term describes differences between individuals of the same species?

A competition

B generation

C selection

D variation

（2023 Oct/Nov · 0654/12 · Question 11 · Core）

解：由变异的定义，同一物种不同个体之间的差异称为变异（variation）。
题干描述的正是这种个体差异。
故选 D。

题型 4：区分变异产生与自然选择筛选（考频★★☆☆☆）

知识点 突变能产生新的_____；自然选择不产生环境所需的性状，而是筛选种群中已经存在的变异。
当种群存在可遗传变异且环境形成选择压力时，具有有利性状的个体较易存活并繁殖，使相应性状在后代中更常见。
抗生素环境下，非耐药菌被杀死，耐药菌获得相对的生存和繁殖优势，这属于_____；由人选择亲本繁殖才属于_____。

答案：遗传变异；自然选择；人工选择

怎么认 题目出现抗生素、污染变化与某类个体比例改变时，先判断变异怎样产生，再判断由环境还是人完成筛选。

例题 1

Which process results in the development of strains of antibiotic-resistant bacteria?

A artificial selection

B discontinuous variation

C natural selection

D selective breeding

（2023 May/Jun · 0654/22 · Question 11 · Extended）

解：细菌种群中原有由突变产生的耐药变异。抗生素杀死非耐药菌，耐药菌较易存活并繁殖，使耐药性在后代中更常见。该过程由环境筛选，属于自然选择。故选 C。

针对练习

1. Which statement explains why the overuse of antibiotics increases the risk of resistant bacteria developing?

A Bacteria are more likely to become immune to antibiotics if antibiotics are used more often.

B Non-resistant bacteria are more likely to reproduce when antibiotics are used more often.

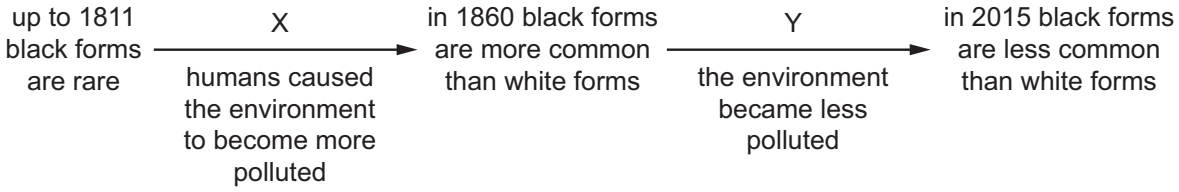
C Increased use of antibiotics causes bacteria to develop a mutation for resistance.

D Increased use of antibiotics kills non-resistant bacteria, reducing competition for resources for resistant bacteria.

（2026 May/Jun · 0654/22 · Question 11 · Extended）

2. In one area, two forms of peppered moth exist. One form is pale white with a black and grey pattern. The other form is completely black.

The diagram shows the changes in colour that have occurred in the peppered moth over a period of more than 200 years.



Which row shows what happened?

	caused the black forms to first appear	process X	process Y
A	adaptation	artificial selection	artificial selection
B	adaptation	natural selection	natural selection
C	mutation	artificial selection	artificial selection
D	mutation	natural selection	natural selection

（2023 Feb/Mar · 0654/22 · Question 11 · Extended）

题型 5：从年代数据求抗性出现间隔（考频★☆☆☆☆）

知识点 抗生素耐药性（antibiotic resistance）是细菌在相应抗生素作用下仍能存活并繁殖的特性。

由年代数据判断耐药性出现间隔时，用_____减去_____，所得时间间隔的单位为年。

当各抗生素的两类年份均已给出时，分别计算间隔，再比较_____；首次报告年份较晚不一定表示间隔较长。

答案：耐药性首次报告年份；抗生素引入年份；各时间间隔的长短

怎么认 题目出现抗生素引入年份和耐药性首次报告年份时，先逐种作差求间隔。

例题 1 The table shows the dates that different antibiotics were introduced and the dates that antibiotic-resistant bacteria were first reported.

antibiotic	date introduced	date resistance first reported
penicillin	1943	1946
tetracycline	1948	1953
erythromycin	1952	1988
ampicillin	1961	1973

Which statements about the development of antibiotic resistance are supported by the data?

1 Tetracycline was the last antibiotic to be introduced.

2 Erythromycin took the longest time for bacteria to become resistant.

3 Penicillin had the shortest time between introduction and the first report of resistance.

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

（2025 May/Jun · 0654/21 · Question 13 · Extended）

解：由耐药性首次报告年份减去抗生素引入年份得
青霉素：$1946-1943=3$ 年；
四环素：$1953-1948=5$ 年；
红霉素：$1988-1952=36$ 年；
氨苄青霉素：$1973-1961=12$ 年。
引入年份最晚的是氨苄青霉素，陈述 1 不成立；36 年最长，陈述 2 成立；3 年最短，陈述 3 成立。
故选 D。

题型 6：区分耐药散点图的相关与因果结论（考频★☆☆☆☆）

知识点 散点图表示成对数据的分布；当横坐标增大时，纵坐标总体增大，称为_____。

相关关系表示两个变量共同变化，但不能据此确定_____；得出因果结论还需控制其他变量并有实验等证据。

本题横坐标为每个国家每年服用抗生素的平均天数，单位为天；纵坐标为耐药菌感染者百分比，单位为 %。判断多数时，符合条件的国家数应超过总数的一半。

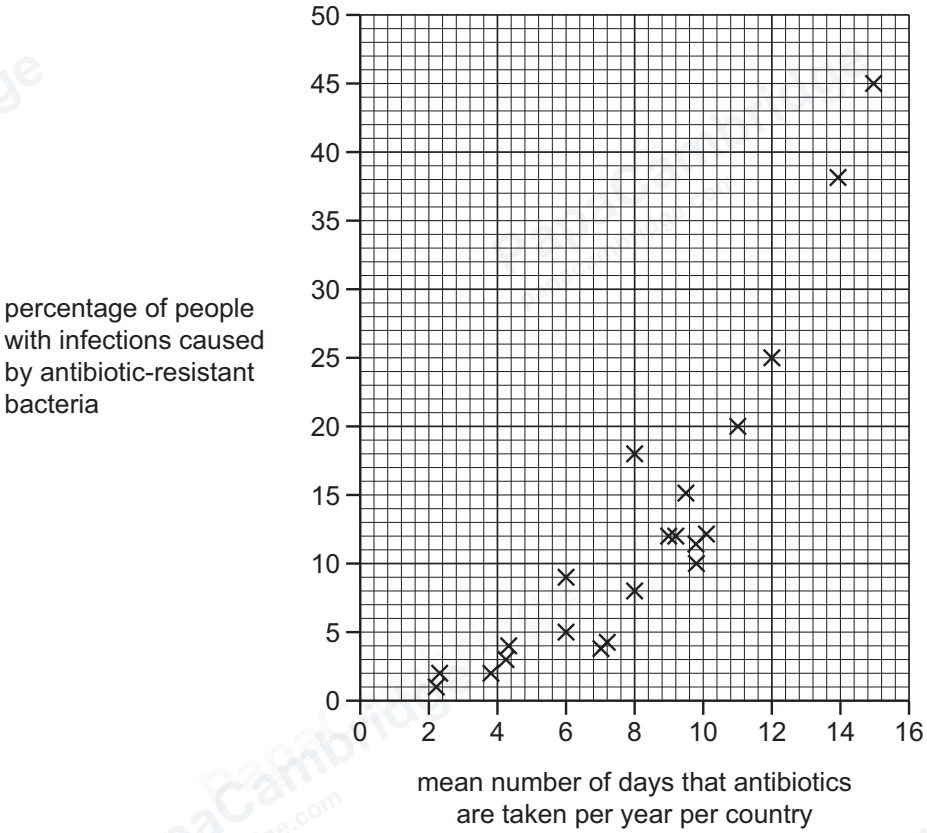
答案：正相关；因果关系

怎么认 题目出现两变量散点图和若干结论时，先数指定范围内的点，再读总体趋势并排除图中没有的数据和因果判断。

例题 1

The graph shows the relationship in different countries between the mean number of days that antibiotics are taken per year and the percentage of people with infections caused by antibiotic-resistant bacteria.

Each point represents a different country.



Which conclusions can be made from the data in the graph?

1 In most countries, antibiotics are taken for fewer than 10 days per year.

2 Antibiotics increase the percentage of people with infections caused by antibiotic-resistant bacteria.

3 Fewer people take antibiotics in some countries than others.

4 As the mean number of days that antibiotics are taken per year increases, the percentage of people with infections caused by antibiotic-resistant bacteria increases.

A 1, 2 and 3 **B** 1 and 4 **C** 2, 3 and 4 **D** 3 and 4 only

（2026 May/Jun · 0654/23 · Question 11 · Extended）

解：每个点代表一个国家，横坐标小于 10 天的点超过总点数的一半，故结论 1 成立。
散点总体由左下向右上分布，表明平均服药天数与耐药菌感染者百分比呈正相关，故结论 4 成立。
散点图不能证明抗生素造成耐药菌感染者百分比增加，故结论 2 不成立；横轴表示平均服药天数，并非服药人数，故结论 3 不成立。
故选 B。

[Biology] 第 18 章 食物网、能量流与碳循环

18.1 食物网、能量流与碳循环

题型 1：从单条食物链确定生态角色与营养级（考频★★★★☆）

知识点 生产者是能通过_____制造有机物的生物；绿色植物和藻类通常是生产者，太阳提供能量，但不是生产者。

消费者必须以其他生物为食；草食动物、肉食动物和寄生动物都属于_____。

营养级是生物在食物链中的_____；生产者为第一营养级，初级消费者为第二营养级，次级消费者为第三营养级。

食物链的箭头由食物指向取食者，表示食物和能量传递的方向。

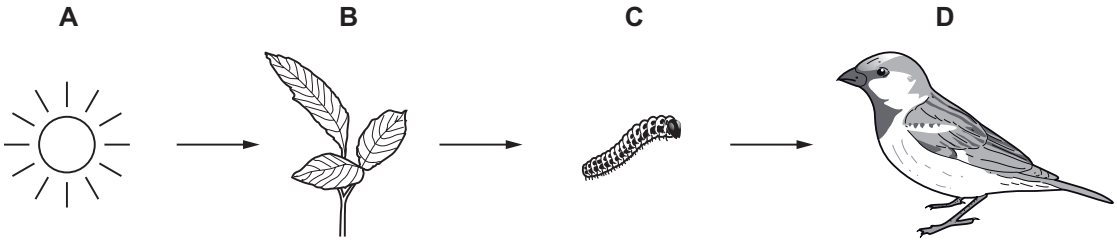
答案：光合作用；消费者；位置

怎么认 题目出现单条食物链、生态角色或营养级时，先找能进行光合作用的生物，再沿箭头确定各营养级。

例题 1

The diagram shows a food chain.

Which is the producer?



（2023 May/Jun · 0654/12 · Question 12 · Core；同题：2023 May/Jun · 0654/13 · Question 12 · Core）

解：A 是太阳，为食物链提供能量，但不是生物；B 是植物，能通过光合作用制造有机物，是生产者。故选 B。

针对练习

1. The diagram shows a food chain.

mahogany tree → caterpillar → songbird → hawk

What is the mahogany tree in this food chain?

A carnivore

B consumer

C herbivore

D producer

（2023 Oct/Nov · 0654/13 · Question 12 · Core）

2. What is a description of a trophic level?

A the ability of an organism to make its own food through photosynthesis

B the death of organisms due to increased availability of nitrates

C the interaction of an organism with its environment

D the position of an organism in a food chain

（2024 Oct/Nov · 0654/22 · Question 12 · Extended）

3. The diagram shows a food chain.

dandelion plant → slug → blackbird → fox

Which organisms are consumers?

A dandelion plant only

B fox only

C blackbird and slug only

D slug, blackbird and fox

（2022 May/Jun · 0654/12 · Question 12 · Core；同题：2022 May/Jun · 0654/13 · Question 12 · Core）

4. Rabbits are herbivores.

Which trophic levels can the rabbit occupy?

A 1 only **B** 2 and 3 **C** 2 only **D** 3 and 4

（2025 Oct/Nov · 0654/22 · Question 13 · Extended）

5. The diagram shows a food chain.

beech tree → insect → shrew → owl

Which statement is correct?

A The beech tree is a consumer.

B The insect is a producer.

C The owl is a carnivore.

D The shrew is a herbivore.

（2022 Feb/Mar · 0654/12 · Question 12 · Core）

6. Which organism is a secondary consumer in the food chain shown?

A	B	C	D
plant →	herbivore →	carnivore →	carnivore

（2026 May/Jun · 0654/13 · Question 12 · Core）

7. The diagram shows a food chain.

grass → rabbit → fox → flea

Which statement is correct?

A The grass is a primary consumer.

B The rabbit is a secondary consumer.

C The fox is a tertiary consumer.

D The flea is a tertiary consumer.

(2023 Feb/Mar · 0654/12 · Question 12 · Core)

8. The diagram shows a food chain.

phytoplankton → char → capelin → harbour seal → orca

Which statement about the food chain is correct?

A The capelin is a carnivore.

B The harbour seal is a herbivore.

C The orca is a tertiary consumer.

D The phytoplankton is a primary consumer.

(2026 May/Jun · 0654/12 · Question 12 · Core)

9. A food chain is shown.

tree → insect → mouse → owl

Which statement about this food chain is correct?

A The insect is a carnivore.

B The mouse is a herbivore.

C The owl is a secondary consumer.

D The tree is a producer.

(2025 May/Jun · 0654/11 · Question 13 · Core)

10. Which organisms can be described as producers and herbivores in the food chain shown?

diatoms → copepods → amphipods

	producers	herbivores
A	amphipods	copepods
B	amphipods	diatoms
C	diatoms	amphipods
D	diatoms	copepods

(2022 May/Jun · 0654/11 · Question 12 · Core)

11. A food chain is shown.

plant → insect → songbird → hawk

Which statements are correct?

1 The hawk is a consumer.

2 The insect is a carnivore.

3 The songbird is a herbivore.

4 The plant is a producer.

A 1 and 2 **B** 1 and 4 **C** 2 and 3 **D** 2 and 4

(2024 May/Jun · 0654/11 · Question 12 · Core)

12. What is the correct order for the food chain from the information given?

- beetles are herbivores
- mice eat the beetles
- owls are the tertiary consumers
- the leaves of a plant are the producer

A beetles → mice → owl → leaves

B leaves → beetles → mice → owl

C leaves → beetles → owl → mice

D owl → mice → beetles → leaves

(2024 Oct/Nov · 0654/11 · Question 12 · Core)

13. Information about a lake is shown.

- Aquatic plants grow in the lake.
- Aquatic plants are eaten by small fish.
- Small fish are eaten by large fish.
- Small fish are eaten by frogs.

Which statement is correct?

A The frogs are primary consumers.

B The large fish are secondary consumers.

C The small fish are at trophic level 1.

D The aquatic plants are herbivores.

(2025 May/Jun · 0654/22 · Question 13 · Extended)

14. A food chain is shown.

plant → insect → mouse → snake → eagle

Which statements are correct for this food chain?

1 The eagle is a tertiary consumer.

2 The insect is at trophic level 1.

3 The mouse is a secondary consumer.

4 The plant is a producer.

A 1 and 2 **B** 2 and 3 **C** 2 and 4 **D** 3 and 4

（2025 May/Jun · 0654/23 · Question 11 · Extended）

题型 2：由获能方式区分生产者、消费者和分解者（考频★★★★☆）

知识点 生产者利用_____制造有机物，处于第一营养级；消费者通过取食其他生物获得能量。
草食动物只以植物为食，肉食动物以动物为食，二者都属于_____。
分解者通过分解死生物遗体或废弃有机物获得能量；生态角色由获能方式决定。

答案：光能；消费者

怎么认 题目出现阳光、自制有机物、吃植物、吃动物或分解死物时，先按获能方式判定生态角色。

例题 1

Which type of organism gets its energy from the remains of dead organisms or other organic waste?

A a carnivore

B a decomposer

C a herbivore

D a producer

（2022 Oct/Nov · 0654/11 · Question 12 · Core；同题：2022 Oct/Nov · 0654/21 · Question 12 · Extended）

解：分解者通过分解死生物遗体或废弃有机物获得能量。
题干所述获能方式对应分解者，故选 B。

针对练习

1. Which type of organism gets its energy from breaking down dead or waste organic matter?

A carnivore

B consumer

C decomposer

D producer

（2023 Oct/Nov · 0654/12 · Question 12 · Core）

2. Which type of organism obtains energy by feeding only on plants?

A herbivore

B carnivore

C producer

D secondary consumer

（2024 Feb/Mar · 0654/22 · Question 12 · Extended）

3. Which statement about all food chains is correct?

A All the carnivores are producers.

B All the consumers are carnivores.

C All the herbivores are consumers.

D All the producers are herbivores.

（2024 Oct/Nov · 0654/23 · Question 12 · Extended）

4. Which row shows the primary source of energy for an organism?

	organism	source of energy
A	carnivores	dead plants
B	decomposers	living plants
C	green plants	sunlight
D	herbivores	animals

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（2026 Feb/Mar · 0654/12 · Question 12 · Core）

5. In a food chain, what do all living organisms get from their food?

A a supply of water

B oxygen for respiration

C protection from disease

D the energy they need

（2023 Oct/Nov · 0654/11 · Question 12 · Core）

6. How do herbivores get their energy?

A by eating animals and plants

B by eating animals only

C by eating plants only

D directly from sunlight

（2023 May/Jun · 0654/11 · Question 12 · Core）

7. Which definition is correctly matched to a type of organism?

	organism	definition
A	producer	an organism that gets its energy by feeding on other organisms
B	consumer	an organism that gets its energy from dead or waste organic matter
C	decomposer	an animal that gets its energy by eating other animals
D	herbivore	an animal that gets its energy by eating plants

（2024 Oct/Nov · 0654/12 · Question 12 · Core；同题：2024 Oct/Nov · 0654/13 · Question 12 · Core）

8. What is a carnivore?

A an organism that gets its energy by eating animals

B an organism that gets its energy by eating plants

C an organism that gets its energy from dead matter

D an organism that makes its own organic matter

（2022 Oct/Nov · 0654/13 · Question 12 · Core；同题：2022 Oct/Nov · 0654/23 · Question 12 · Extended）

9. What is a producer in a food web?

A an organism that gets its energy by digesting plants

B an organism that makes its own food using light energy

C an organism that obtains energy from digested animals

D an organism that gets its energy from dead or waste organic matter

（2022 Oct/Nov · 0654/12 · Question 12 · Core；同题：2022 Oct/Nov · 0654/22 · Question 12 · Extended）

10. Which statement about organisms in a food chain is correct?

A A carnivore is an organism that gets its energy by eating plants.

B A consumer is an organism that gets its energy by eating other organisms.

C A herbivore is an organism that gets its energy by eating animals.

D A producer is an organism that gets its energy from dead or waste matter.

（2024 May/Jun · 0654/12 · Question 12 · Core；同题：2024 May/Jun · 0654/13 · Question 12 · Core）

11. Which statement describes a producer?

A an organism that obtains its energy from dead or waste organic matter

B an organism that makes its own organic nutrients using energy from sunlight

C an organism that obtains its energy from feeding on other organisms

D an animal that obtains its energy from eating plants

（2025 May/Jun · 0654/12 · Question 13 · Core；同题：2025 May/Jun · 0654/13 · Question 13 · Core）

12. How does an organism in the first trophic level gain energy?

A by absorbing energy from sunlight

B by breaking down dead or waste organic matter

C by eating organisms in the second trophic level

D by eating plants

（2024 May/Jun · 0654/21 · Question 12 · Extended）

题型 3：追踪碳在空气与有机物之间的移动（考频★★★★☆）

知识点 碳循环是碳在空气、生物体、土壤和化石燃料等碳库之间的转移；光合作用把空气中的二氧化碳转入有机物，呼吸、分解和燃烧把有机物中的碳以二氧化碳形式释放回空气。

在其他条件不变时，光合作用使空气中二氧化碳浓度_____，呼吸、分解和燃烧使其_____。

化石化把生物遗体中的碳长期储存在化石燃料中；蒸腾作用主要转移水，不属于碳循环。

大气二氧化碳浓度常用 ppm 表示；题目采用任意单位时，只比较图中数值的增减。

答案：降低；升高

怎么认 题目出现碳循环过程与空气二氧化碳增减时，先判断该过程吸收还是释放二氧化碳。

一. 由过程判断空气二氧化碳增减

例题 1

The concentration of carbon dioxide in the atmosphere has increased during the last 200 years.

What has contributed to this increase?

A burning large areas of forest

B increasing use of pesticides

C planting more crops

D using fewer fossil fuels

（2023 Oct/Nov · 0654/12 · Question 13 · Core；同题：2023 Oct/Nov · 0654/22 · Question 13 · Extended）

解：燃烧大片森林时，植物体内的有机碳经燃烧转化为二氧化碳并释放到空气中，且森林减少使光合作用吸收的二氧化碳减少。
因此空气中二氧化碳浓度升高。
故选 A。

针对练习

1.

Which process is **not** part of the carbon cycle?

A combustion

B fossilisation

C transpiration

D photosynthesis

（2024 Feb/Mar · 0654/12 · Question 13 · Core）

2.

Which processes change the amount of carbon dioxide in the air?

	process causing increase in carbon dioxide	process causing decrease in carbon dioxide
A	burning fossil fuels	photosynthesis in plants
B	photosynthesis in plants	respiration in animals
C	respiration in animals	respiration in plants
D	respiration in plants	burning fossil fuels

（2024 Oct/Nov · 0654/21 · Question 13 · Extended）

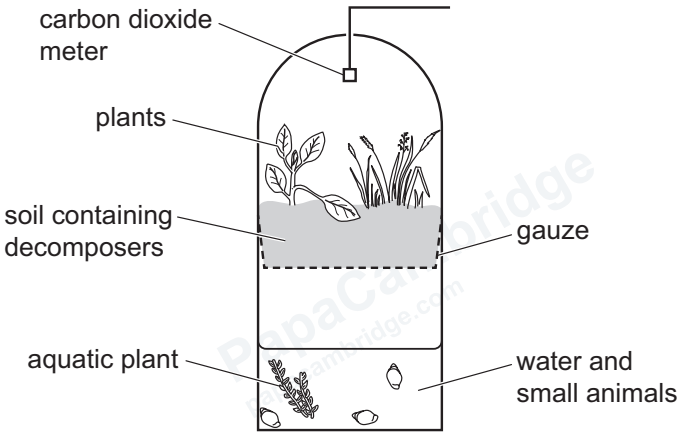
3.

Which row about a process in the carbon cycle is correct?

	process	effect on level of atmospheric carbon dioxide
A	combustion	decreases
B	decomposition	increases
C	fossilisation	increases
D	respiration	decreases

（2024 Oct/Nov · 0654/12 · Question 13 · Core；同题：2024 Oct/Nov · 0654/13 · Question 13 · Core）

4. Some students investigate the carbon cycle using a sealed bottle garden. The bottle garden contains a meter to measure carbon dioxide gas.



After two weeks, the carbon dioxide concentration in the bottle garden increases.

What causes this increase in carbon dioxide concentration?

1 decomposition

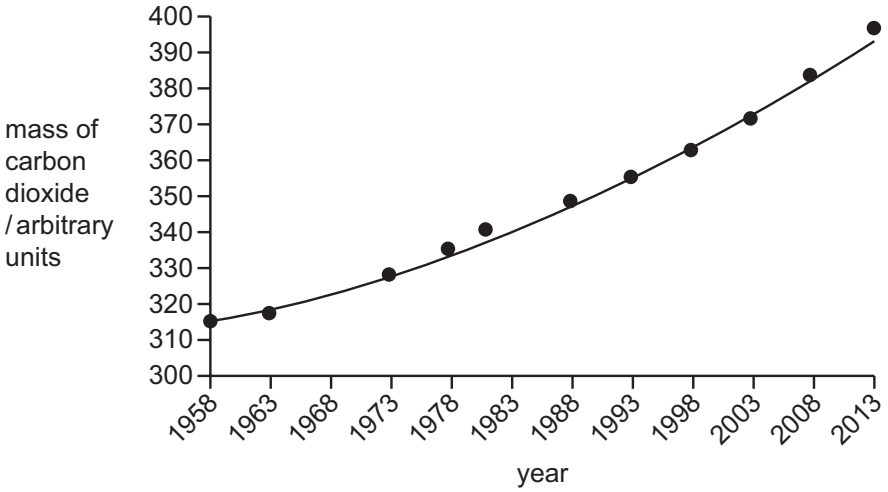
2 photosynthesis

3 respiration

A 1 and 2 **B** 1 and 3 **C** 2 and 3 **D** 3 only

(2026 May/Jun · 0654/22 · Question 12 · Extended)

5. The graph shows the change in atmospheric carbon dioxide levels over time.



A reduction of which process could cause the change in carbon dioxide shown?

A combustion

B decomposition

C photosynthesis

D respiration

(2023 May/Jun · 0654/11 · Question 13 · Core)

二. 由箭头起终点辨认碳转移过程

知识点 碳循环图中的箭头表示碳从_____转移到箭头终点，判断前提是图中两端均表示含碳物质或储存碳的对象。

大气中的二氧化碳指向植物表示_____；植物或动物指向大气表示呼吸作用。

化石燃料指向大气表示_____；植物指向动物表示取食。

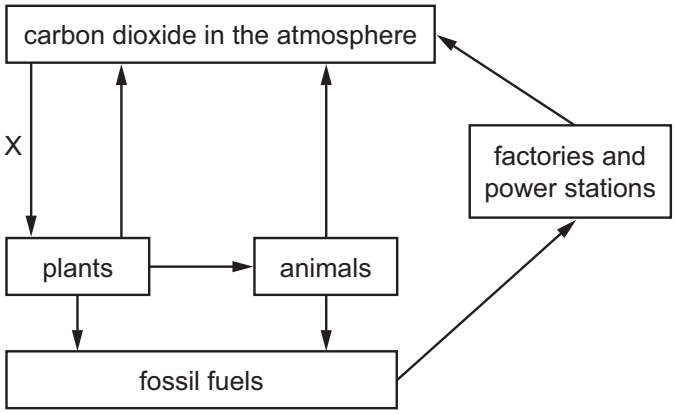
各过程表示碳的转移方向，不涉及数值计算和单位。

答案：箭头起点；光合作用；燃烧

怎么认 题目出现碳循环图及带字母的箭头时，先读箭头起点和终点，再判定碳的转移过程。

例题 2

The diagram shows part of the carbon cycle.



Which process does X represent?

A combustion

B decomposition

C photosynthesis

D respiration

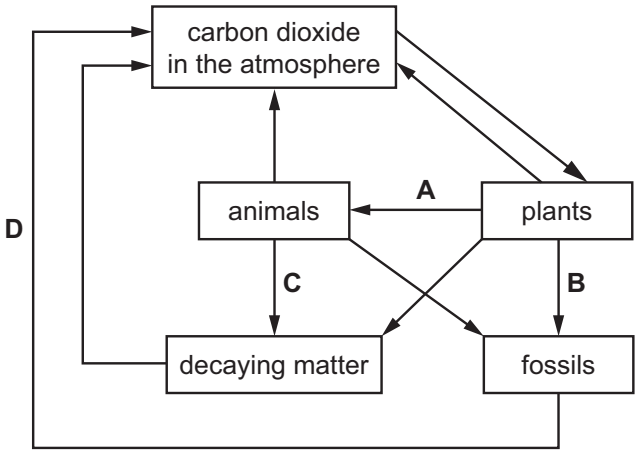
（2024 Oct/Nov · 0654/11 · Question 13 · Core）

解：箭头 X 从大气中的二氧化碳指向植物，表示植物吸收二氧化碳形成含碳有机物，这一过程是光合作用。故选 C。

针对练习

6. The diagram shows part of the carbon cycle.

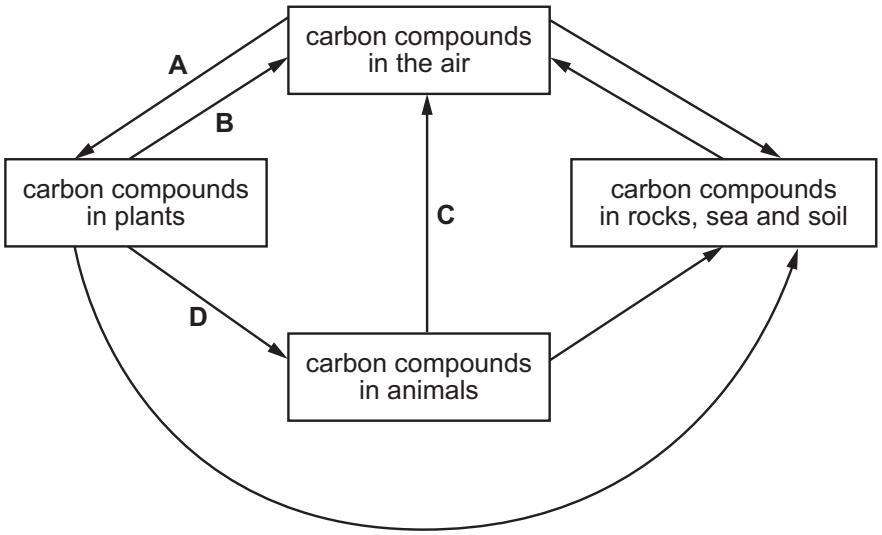
Which process, due to human activities, has increased the concentration of carbon dioxide in the atmosphere?



（2024 May/Jun · 0654/23 · Question 13 · Extended）

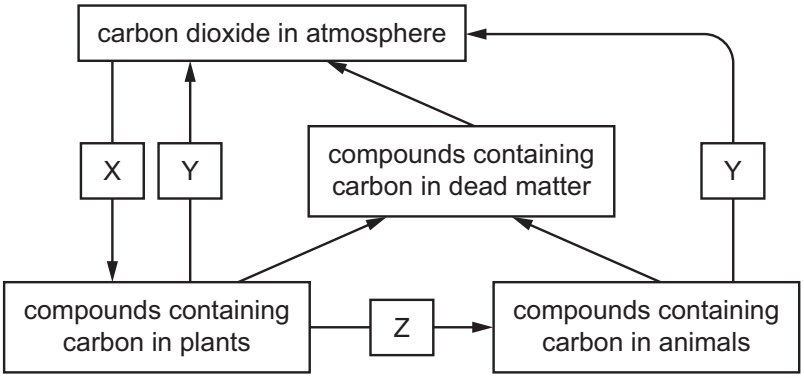
7. The diagram shows part of the carbon cycle.

Which arrow represents plant respiration?



（2022 May/Jun · 0654/11 · Question 13 · Core；同题：2022 May/Jun · 0654/12 · Question 13 · Core、2022 May/Jun · 0654/13 · Question 13 · Core）

8. The diagram shows part of the carbon cycle.

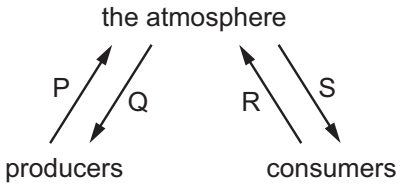


What are processes X, Y and Z?

	X	Y	Z
A	decomposition	respiration	feeding
B	photosynthesis	respiration	feeding
C	photosynthesis	decomposition	respiration
D	decomposition	photosynthesis	respiration

（2022 Feb/Mar · 0654/12 · Question 13 · Core）

9. The diagram shows gas exchange by two groups of organisms during the hours of darkness.



Which letters represent gases that are part of the carbon cycle?

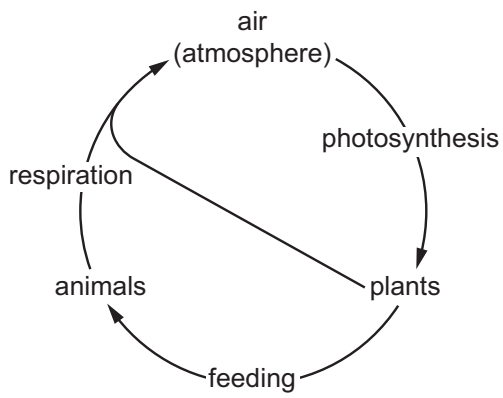
A P and Q **B** P and R **C** P and S **D** Q and S

（2024 May/Jun · 0654/12 · Question 13 · Core；同题：2024 May/Jun · 0654/13 · Question 13 · Core）

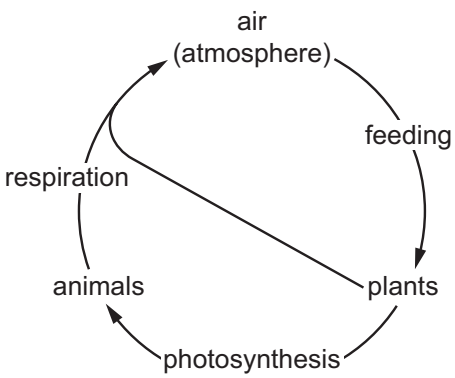
10. A student draws four different attempts at part of the carbon cycle.

Which diagram is correct?

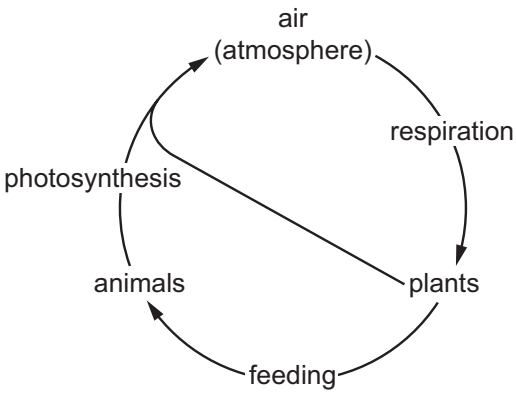
A



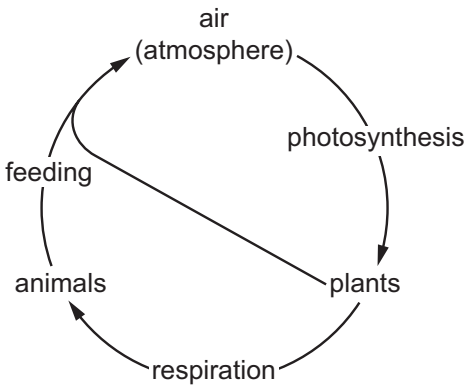
B



C



D



（2023 Feb/Mar · 0654/12 · Question 13 · Core）

题型 4：区分生态系统与食物网或单个种群（考频★★☆☆☆）

知识点 生态系统是一定区域内全部生物及其_____相互作用所形成的整体。判定生态系统时，生物成分、非生物环境及二者的相互作用须同时存在。多条食物链相互连接形成_____，它表示生物之间的取食关系，不等同于生态系统。一定栖息地内同一物种的全部个体组成_____；单一物种、单独的巢穴或食物链均不是完整的生态系统。

答案：环境；食物网；种群

怎么认 题目出现生态系统的定义或实例时，先判断是否同时包含生物、环境及二者的相互作用。

例题 1

What is an ecosystem?

A a network of interconnected food chains in a given area

B all the members of one species in a given habitat

C all the organisms and their environment interacting together in a given area

D all the transfer of energy in a given habitat

（2023 Oct/Nov · 0654/23 · Question 12 · Extended）

解：生态系统由一定区域内全部生物及其环境共同组成，二者之间存在相互作用。
选项 C 同时包含生物、环境和相互作用，符合生态系统的定义。故选 C。

针对练习

1. What is an example of an ecosystem?

A a decomposing log and the organisms in it

B a food chain

C the network of burrows in which some rabbits live

D the oak trees in a forest

（2024 Oct/Nov · 0654/21 · Question 12 · Extended）

2. What is an ecosystem?

A a chart showing the flow of energy from one organism to another

B a diagram giving the energy level of an organism in its environment

C a network of interconnected food chains

D a unit containing all of the organisms and their environment

（2024 May/Jun · 0654/22 · Question 12 · Extended）

题型 5：沿食物网不同路径判断消费者等级（考频★★★☆☆）

知识点 食物网中的箭头由_____指向取食者，表示能量传递的方向。

取食生产者的动物是初级消费者；取食初级消费者时，该动物在这条食物链中是_____消费者，随后依次为三级、四级消费者。

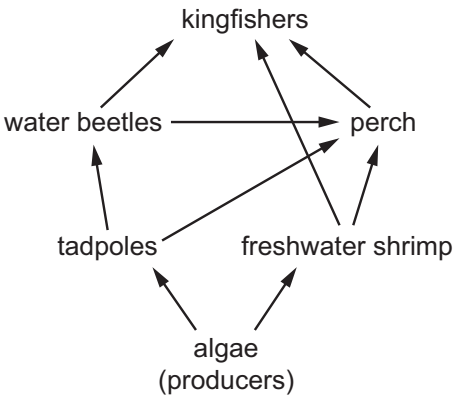
同一动物可沿不同食物链处于不同等级；肉食动物所吃的食物中含_____。消费者等级没有计量单位。

答案：食物；次级；动物

怎么认 题目出现食物网及肉食动物或消费者等级的设问时，先逆着指向候选者的箭头逐一追查其食物。

例题 1

The diagram shows a food web.



Which animals are carnivores?

A kingfishers, perch and water beetles

B kingfishers only

C perch and water beetles only

D tadpoles and freshwater shrimp

（2024 Feb/Mar · 0654/12 · Question 12 · Core）

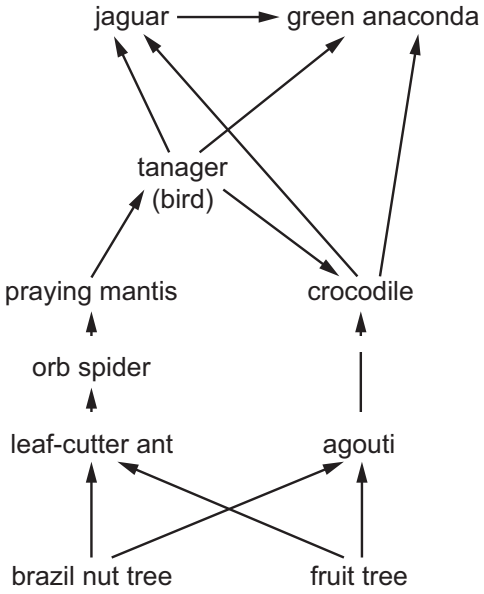
解：图中箭头由食物指向取食者。

water beetles 取食 tadpoles；perch 取食 water beetles、tadpoles 和 freshwater shrimp；kingfishers 取食 water beetles、perch 和 freshwater shrimp。

三者所吃的食物中均有动物，所以三者均为肉食动物。故选 A。

针对练习

1. The diagram shows part of a food web in a rainforest.



Which animals are feeding as quaternary consumers?

A crocodile and green anaconda

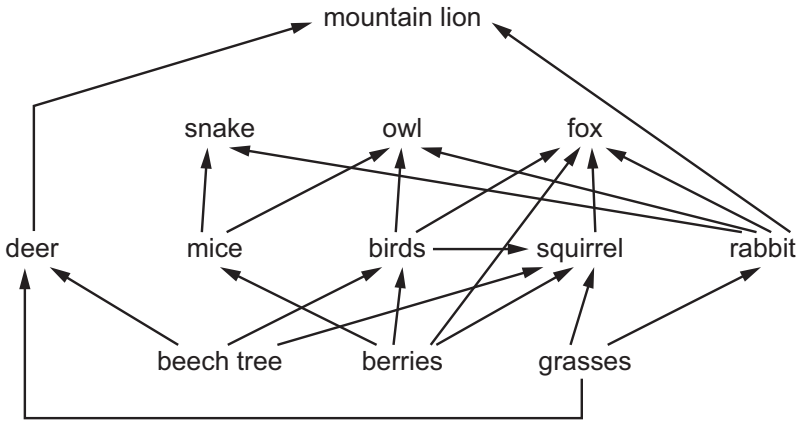
B crocodile and jaguar

C green anaconda and tanager

D jaguar and tanager

（2024 May/Jun · 0654/23 · Question 12 · Extended）

2. The diagram shows a North American food web.



Which organism is both a primary and secondary consumer?

A birds

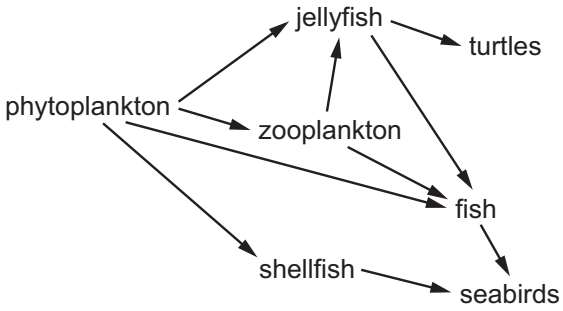
B owl

C snake

D squirrel

(2023 Oct/Nov · 0654/22 · Question 12 · Extended)

3. The diagram shows a food web.



Which groups of organisms are both primary **and** secondary consumers?

A fish and jellyfish

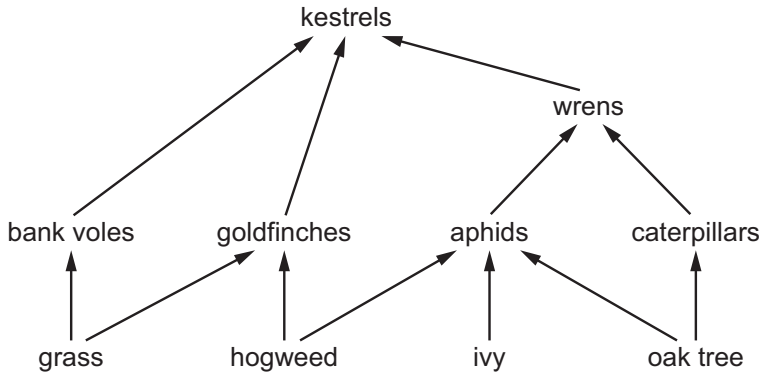
B fish and shellfish

C seabirds and turtles

D shellfish and zooplankton

(2023 May/Jun · 0654/22 · Question 12 · Extended)

4. The diagram shows a food web.

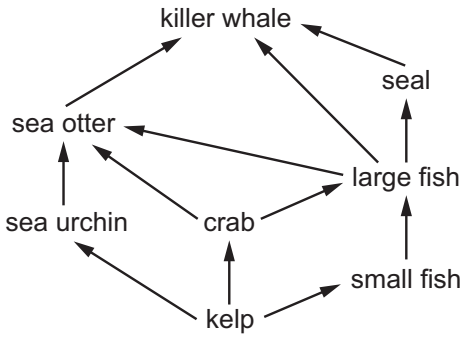


How many primary consumers, secondary consumers, tertiary consumers and quaternary consumers are present?

	primary	secondary	tertiary	quaternary
A	1	1	4	4
B	2	4	2	0
C	4	2	1	0
D	4	4	1	1

(2023 May/Jun · 0654/21 · Question 12 · Extended)

5. The diagram shows a marine food web around a kelp (seaweed) forest.



Which organisms are secondary consumers and which organisms are tertiary consumers?

	secondary consumers	tertiary consumers
A	seal	killer whale
B	sea otter, large fish	killer whale, seal, large fish
C	sea otter, large fish	sea otter, killer whale, seal
D	sea urchin, small fish, crab	sea otter, large fish

(2023 May/Jun · 0654/23 · Question 12 · Extended)

题型 6：由能量递减解释食物链长度与饮食效率（考频★★☆☆☆）

知识点 营养级间能量传递效率表示上一营养级的能量传到下一营养级的比例。

能量传递效率 $=\frac{\text{传到下一营养级的能量}}{\text{上一营养级的能量}}\times 100\%$，适用于比较相邻营养级；能量常用 kJ，效率用百分数表示。

每次传递都有能量因呼吸作用、运动、散热、排遗及未被摄食而损失，传递效率越_____，食物链通常越短。

人类取食_____时，中间传递次数最少，能量效率最高。

答案：低；生产者

怎么认 题目出现营养级数量、食物链长度或最节能食物时，先判断营养级间的能量递减。

例题 1

What is the main factor which determines the number of trophic levels in food chains?

A competition between organisms

B efficiency of energy transfer between trophic levels

C removal of a member of a food chain

D unstable ecosystem due to changing environment

（2022 Feb/Mar · 0654/22 · Question 12 · Extended）

解： 食物链每向上一个营养级传递，只有部分能量进入下一营养级。

营养级间的能量传递效率决定较高营养级可获得的能量，因而决定食物链能维持的营养级数。

故选 B。

针对练习

1. What is the most energy efficient resource for humans to eat?

A herbivores

B primary consumers

C producers

D secondary consumers

（2025 Oct/Nov · 0654/23 · Question 13 · Extended）

2. Which statement explains why food chains usually have fewer than five trophic levels?

A All the carnivores consume herbivores.

B The energy passed on decreases from one trophic level to the next.

C There is less protein in each individual higher up the chain.

D There is only one producer in each chain.

（2025 Oct/Nov · 0654/21 · Question 13 · Extended）

题型 7：由各级死物去向辨认分解者（考频★☆☆☆☆）

知识点 营养级表示生物在食物链中的取食位置；生产者和各级消费者都可能形成死体并排出废物。

_____分解这些有机物并获取能量，因此可从_____营养级获得能量。

答案：分解者；每个

怎么认 题目出现各营养级的死体、废物或多条能量箭头共同指向某类生物时，先判断其是否接收各级有机物。

例题 1

Which organisms obtain energy directly from every trophic level?

A carnivores

B decomposers

C herbivores

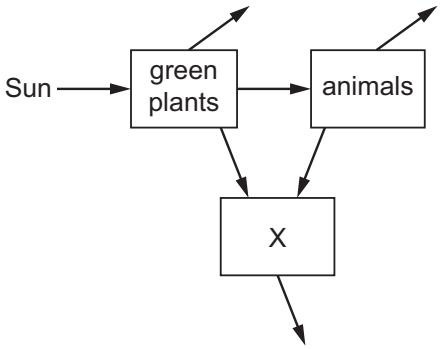
D producers

（2022 May/Jun · 0654/21 · Question 12 · Extended；同题：2022 May/Jun · 0654/23 · Question 12 · Extended；同题：2022 May/Jun · 0654/22 · Question 12 · Extended）

解：各营养级中的生物都会留下死体和废物，分解者分解其中的有机物并获取能量。
因此，分解者可从每个营养级获得能量。故选 B。

针对练习

1. The diagram shows the energy flow in part of an ecosystem.



Which group of organisms is X?

A carnivores

B decomposers

C herbivores

D producers

（2023 Feb/Mar · 0654/22 · Question 12 · Extended）

题型 8：按营养级传递比例连续计算能量（考频★☆☆☆☆）

知识点 食物链中，相邻营养级之间按一定比例传递能量；传递效率为 p 时，每经过一次传递，后一营养级获得的能量等于前一营养级能量乘_____。
目标生物与起始生物相隔 n 次传递时，$E_n = E_0 p^n$，其中 E_0 为起始能量；能量单位与题干保持一致，如 J 或 kJ。
当 $p = 10\%$ 时，每传递一次，能量变为原来的_____；计算前应先确定目标生物经过的_____。

答案：p；10%；传递次数

怎么认 题目出现食物链、营养级传递百分比及起始能量时，先数目标生物经过的传递次数。

例题 1

The diagram shows a food chain.

grass → grasshopper → frog → snake → eagle

The grass receives 14 000 J of energy.

There is a 10% transfer of energy between each organism in the food chain.

Which statement is correct?

A The eagle receives 14 J of energy.

B The frog receives 1400 J of energy.

C The grasshopper receives 140 J of energy.

D The snake receives 14 J of energy.

（2026 May/Jun · 0654/11 · Question 12 · Core）

解：草到蛇经过三次能量传递，每次传递效率为 10%，依次得

$E_{蚱蜢} = 14000\ \text{J} \times 0.10 = 1400\ \text{J}$

$E_{青蛙} = 1400\ \text{J} \times 0.10 = 140\ \text{J}$

$E_{蛇} = 140\ \text{J} \times 0.10 = 14\ \text{J}$

蛇获得 14 J 的能量，故选 D。

针对练习

1. In the food chain shown, 10% of the energy is transferred between each trophic level.

grass → grasshopper → frog → snake → buzzard

How much energy is transferred to the tertiary consumer for every 100 kJ of energy in the herbivore?

A 0.1 kJ **B** 1 kJ **C** 10 kJ **D** 100 kJ

（2025 May/Jun · 0654/21 · Question 12 · Extended）

题型 9：区分种群分布改变的原因与监测结果（考频★☆☆☆☆）

知识点 种群分布改变是种群占据的地理范围发生变化。

原分布区食物减少可能促使个体迁出；新区域气候更适宜，有利于迁入个体存活和繁殖，二者都属于_____。

监测增加只能提高发现和记录分布变化的机会，属于_____，不是促使生物迁移的条件。

答案：生态原因；观测因素

怎么认 题目出现生物分布范围改变及若干陈述时，先区分迁移条件与观测因素。

例题 1

Little egrets are a type of bird originally found in Southern Europe, Africa, Asia and Australia.

Since the 1990s, little egrets have spread to Northern Europe.

The statements give possible reasons for this spread north.

1 Monitoring of the population of little egrets in Southern Europe has increased.

2 The food source for little egrets has decreased in Southern Europe.

3 Climate change has made the northern climate warmer.

Which statements could explain the spread of little egrets?

A 1, 2 and 3 **B** 1 and 2 only **C** 1 only **D** 2 and 3 only

（2026 May/Jun · 0654/12 · Question 13 · Core）

解：监测增加会提高记录到种群变化的机会，但不会促使小白鹭向北迁移，故 1 不能解释扩散。
南欧食物来源减少，小白鹭可能迁离原分布区，故 2 能解释扩散。
北方气候变暖，有利于小白鹭在北方生存，故 3 能解释扩散。
因此能解释扩散的是 2 和 3，故选 D。

题型 10：核对细胞活动及废物造成的能量损失（考频★☆☆☆☆）

知识点 能量从一个营养级传向下一个营养级时，只有保存在能被摄食的_____中的化学能可继续传递。
呼吸为肌肉收缩、细胞分裂及维持恒定体温供能，部分化学能最终以_____散失。
排泄使含有化学能的物质随废物离开，也会减少下一营养级可得能量；能量常用单位为 J 或 kJ。

答案：生物量；热能

怎么认 题目出现哺乳动物的多种生命活动并问下一营养级可得能量时，先逐项判断是否引起热散失或废物排出。

例题 1

Four processes that occur in mammals are listed.

1 muscle contraction

2 cell division

3 excretion

4 maintenance of a constant body temperature

Which processes reduce the amount of energy available to the next trophic level?

A 1, 2, 3 and 4

B 1 and 2 only

C 1, 3 and 4 only

D 4 only

（2023 Oct/Nov · 0654/21 · Question 12 · Extended）

解：肌肉收缩和维持恒定体温都需呼吸供能，部分能量以热能散失。
细胞分裂虽形成新的生物量，但分裂过程也需呼吸供能，仍有部分能量以热能散失。
排泄使含有化学能的物质随废物离开，因此过程 1、2、3、4 均减少传给下一营养级的能量。
故选 A。

[Biology] 第 19 章 栖息地、污染与保护

19.1 栖息地、污染与保护

题型 1：由树木减少判断毁林的环境后果（考频★★★★☆）

知识点 毁林是大面积砍伐或焚烧森林，使树木数量和森林覆盖面积减少。

树木减少时，光合作用吸收的二氧化碳减少、释放的氧气减少；焚烧还会释放二氧化碳，因此大气中二氧化碳浓度_____，氧气浓度_____。

植被和根系减少时，雨水截留和土壤固定作用减弱，地表径流增多，因此洪水风险和土壤侵蚀增大。

栖息地被破坏时，生物多样性和物种数减少，物种灭绝风险增大；气体浓度可用百分比表示，其他环境变量通常判断变化方向。

答案：升高；降低

怎么认 题目出现毁林、砍伐或焚烧森林，并询问气体、洪水、土壤或物种变化时，先判断树木和根系减少造成的变化方向。

一. 直接判断环境变量变化方向

例题 1

Forests are cut down and burnt in deforestation programmes.

As a result of this, which gas in the atmosphere increases in concentration?

A carbon dioxide

B hydrogen

C nitrogen

D oxygen

（2023 Oct/Nov · 0654/11 · Question 13 · Core；同题：2023 Oct/Nov · 0654/21 · Question 13 · Extended）

解：由树木减少得，光合作用吸收的二氧化碳减少；由森林焚烧得，燃烧释放二氧化碳。

大气中二氧化碳浓度升高，故选 A。

针对练习

1. What is an undesirable effect of deforestation?

A It increases the oxygen concentration of the atmosphere.

B It leads to erosion and loss of soil.

C It makes land available for agriculture.

D It pollutes the air with methane.

（2022 Oct/Nov · 0654/11 · Question 13 · Core；同题：2022 Oct/Nov · 0654/12 · Question 13 · Core、2022 Oct/Nov · 0654/13 · Question 13 · Core、2022 Oct/Nov · 0654/21 · Question 13 · Extended、2022 Oct/Nov · 0654/22 · Question 13 · Extended、2022 Oct/Nov · 0654/23 · Question 13 · Extended）

2. How does deforestation change the concentrations of carbon dioxide and oxygen in the atmosphere?

	carbon dioxide	oxygen
A	rise	fall
B	rise	rise
C	fall	rise
D	fall	fall

（2022 May/Jun · 0654/23 · Question 13 · Extended）

3. Which row shows undesirable effects of deforestation?

	flooding	**number of species**
A	decrease	decrease
B	decrease	increase
C	increase	decrease
D	increase	increase

（2026 Feb/Mar · 0654/12 · Question 13 · Core）

4. Which row describes the effects of deforestation?

	level of carbon dioxide in the air	risk of flooding
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

（2023 Oct/Nov · 0654/13 · Question 13 · Core；同题：2023 Oct/Nov · 0654/23 · Question 13 · Extended）

5. Which row shows undesirable effects of deforestation?

	flooding	**biodiversity**
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

（2026 May/Jun · 0654/13 · Question 13 · Core）

6. Which row about the effects of deforestation is correct?

	risk of flooding	amount of carbon dioxide in atmosphere
A	decreased	decreased
B	decreased	increased
C	increased	decreased
D	increased	increased

（2023 May/Jun · 0654/12 · Question 13 · Core；同题：2023 May/Jun · 0654/13 · Question 13 · Core）

7. What are undesirable effects of deforestation?

1 increase of carbon dioxide in the atmosphere

2 extinction of species

3 flooding

4 increased number of habitats

A 1, 2, 3 and 4

B 1, 2 and 3 only

C 1, 2 and 4 only

D 3 and 4 only

（2026 May/Jun · 0654/21 · Question 13 · Extended）

8. What are undesirable effects of deforestation?

A habitat creation and decreased carbon dioxide in the atmosphere

B habitat creation and increased carbon dioxide in the atmosphere

C habitat destruction and decreased carbon dioxide in the atmosphere

D habitat destruction and increased carbon dioxide in the atmosphere

（2025 Oct/Nov · 0654/12 · Question 13 · Core；同题：2025 Oct/Nov · 0654/13 · Question 13 · Core）

二. 核对原因与结果的因果链

知识点 毁林是大面积清除森林，使树木、树根、叶片和栖息地减少。

树木减少时，光合作用减弱，吸收的二氧化碳_____，释放的氧气_____；树根减少使地表径流、洪水和土壤侵蚀增加。

在其他条件相同时，栖息地减少使物种灭绝风险_____。气体浓度可用百分数表示，本题只判断增减。

答案：减少；减少；升高

怎么认 题目出现毁林及根、叶或栖息地减少与环境后果时，先核对原因能否引起所述结果。

例题 2

Which row shows a cause and an effect that results from deforestation?

	cause	effect
A	fewer tree roots	decrease in flooding
B	fewer tree leaves respire	increase in carbon dioxide
C	fewer tree roots	decrease in soil erosion
D	fewer habitats	increase in extinctions

（2025 May/Jun · 0654/23 · Question 12 · Extended）

解：毁林使森林中的栖息地减少，依赖这些栖息地的生物失去生存和繁殖场所。
因此物种灭绝数量增加。故选 D。

针对练习

9. What could be a result of deforestation?

A a decrease in flooding because there are fewer tree roots

B an increase in carbon dioxide because there are fewer tree leaves respiring

C a decrease in soil loss because there are fewer tree roots

D an increase in extinction because there are fewer habitats

（2025 Feb/Mar · 0654/22 · Question 13 · Extended）

10. Deforestation changes the concentration of carbon dioxide and oxygen in the atmosphere.

Which statement is correct?

A There is less carbon dioxide and more oxygen because there are fewer trees photosynthesising.

B There is less carbon dioxide and less oxygen because there are fewer trees respiring.

C There is more carbon dioxide and less oxygen because there are fewer trees photosynthesising.

D There is more carbon dioxide and more oxygen because there are fewer trees respiring.

（2024 Feb/Mar · 0654/22 · Question 13 · Extended）

题型 2：从肥料进入追踪富营养化和缺氧（考频★★★☆☆）

知识点 富营养化是水体中_____过多，使藻类等生产者大量生长的现象。
含氮肥料使用过量时，硝酸盐可经淋溶进入河流或湖泊，引起富营养化。
藻类死亡后，_____的有氧呼吸增强，消耗水中的溶解氧。
溶解氧浓度下降可使鱼类等水生动物因_____而死亡。

答案：营养物质；分解者；缺氧

怎么认 题目出现肥料进入水体、藻类数量变化或溶解氧曲线时，先追踪营养物、分解者和溶解氧的变化。

一. 辨认过量营养物与缺氧机制

例题 1

What causes eutrophication?

A combustion of fossil fuels

B cutting down of forests

C discarded plastic rubbish

D overuse of nitrogen-containing fertiliser

（2023 May/Jun · 0654/21 · Question 13 · Extended）

解：含氮肥料使用过量时，硝酸盐经淋溶进入水体，使水中营养物质过多，引起富营养化。
故选 D。

针对练习

1. What decreases as a result of eutrophication?

A aerobic respiration by decomposers

B decomposition of dead producers

C dissolved oxygen in the water

D growth of producers

（2023 May/Jun · 0654/23 · Question 13 · Extended）

2. Which row shows an effect of a human activity on the environment?

	activity	effect
A	cutting down forests	acid rain
B	cutting down forests	eutrophication
C	overuse of fertilisers	acid rain
D	overuse of fertilisers	eutrophication

（2022 Feb/Mar · 0654/22 · Question 13 · Extended）

3. The release of fertiliser into rivers and lakes causes eutrophication which can lead to the death of fish.

What causes the fish to die?

A Decreased photosynthesis by producers reduces the carbon dioxide.

B Increased photosynthesis by producers reduces the oxygen.

C Increased decomposition reduces the carbon dioxide.

D Increased decomposition reduces the oxygen.

（2024 Oct/Nov · 0654/23 · Question 13 · Extended）

4. The flow diagram shows the consequence of the overuse of fertilisers on farm land.

leaching fertiliser → fast growth of algae → death of algae → fast growth of **X** → death of fish

Which group of organisms is represented by **X**?

A decomposers

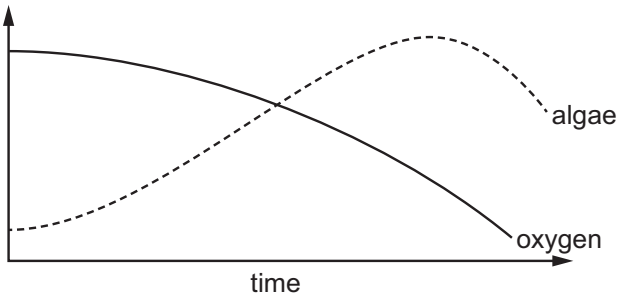
B fish

C invertebrates

D plants

（2023 May/Jun · 0654/22 · Question 13 · Extended）

5. When fertiliser is washed into lakes, it leads to changes in the oxygen concentration and the population of algae.



Which statement explains the change in oxygen over time?

A The algae use up the oxygen for photosynthesis.

B Decomposer bacteria use up the oxygen for respiration.

C Nitrates react with the oxygen.

D The algae use up the oxygen for respiration.

（2022 May/Jun · 0654/22 · Question 13 · Extended）

二. 排列藻类生长、死亡、分解和缺氧

知识点 富营养化是水体中硝酸盐等无机营养盐过多，使生产者过度生长并导致溶解氧降低的过程。

当肥料进入湖泊时，藻类等_____迅速生长；藻层遮光使水生植物因光合作用减弱而死亡。

死亡的植物使_____作用增强；分解者的_____增强并消耗氧，动物可因缺氧死亡。

答案：生产者；分解；有氧呼吸

怎么认 题目出现肥料或硝酸盐进入水体及事件排序或流程图时，先按营养增、藻增、植物死、分解增、耗氧、动物死排序。

例题 2

The list shows changes that occur in a lake which is polluted by fertiliser.

1 Decomposers feed on aquatic plants.

2 Growth of algae increases.

3 Oxygen levels decrease in the lake.

4 Aquatic plants die.

In which order do these changes occur?

A $2 \rightarrow 4 \rightarrow 1 \rightarrow 3$

B $2 \rightarrow 3 \rightarrow 4 \rightarrow 1$

C $3 \rightarrow 4 \rightarrow 2 \rightarrow 1$

D $3 \rightarrow 4 \rightarrow 1 \rightarrow 2$

（2024 May/Jun · 0654/21 · Question 13 · Extended）

解：肥料使水中无机营养盐增加，藻类生长加快，故先发生 2。
藻层遮挡光线，水生植物因光合作用减弱而死亡，故 4 在 2 后。
分解者以死亡的水生植物为食，进行有氧呼吸并消耗氧，故依次发生 1、3。
顺序为 $2, 4, 1, 3$。故选 A。

针对练习

6. What is the correct sequence of events that occur during eutrophication following an increase of nitrate ions in water?

1 increased aerobic respiration by decomposers

2 death of producers

3 rapid growth of producer organisms

4 death of animals due to lack of oxygen

A $4 \rightarrow 2 \rightarrow 3 \rightarrow 1$

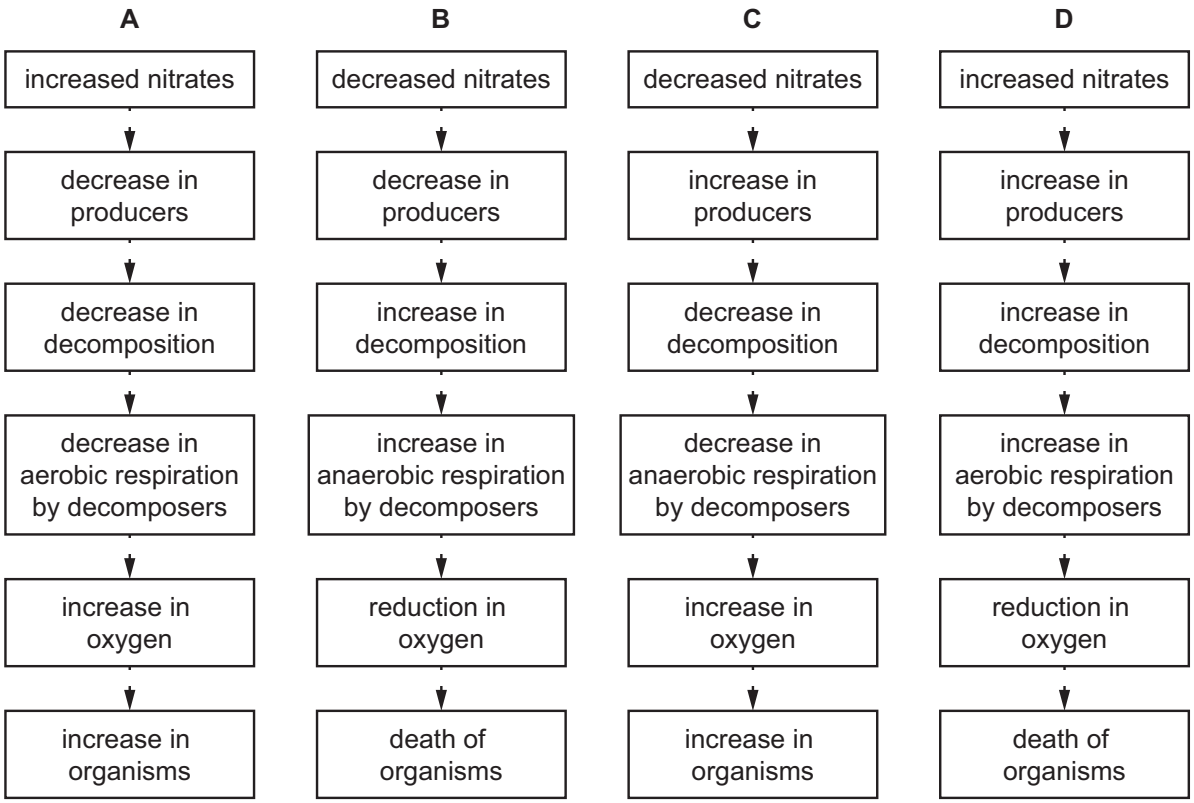
B $3 \rightarrow 2 \rightarrow 1 \rightarrow 4$

C $3 \rightarrow 1 \rightarrow 2 \rightarrow 4$

D $4 \rightarrow 2 \rightarrow 1 \rightarrow 3$

（2023 Feb/Mar · 0654/22 · Question 13 · Extended）

7. Which flowchart correctly shows the stages of eutrophication?



（2022 May/Jun · 0654/21 · Question 13 · Extended）

题型 3：同时核对濒危动物保育措施（考频★☆☆☆☆）

知识点 濒危动物的保育是采取措施维持其种群，降低灭绝风险。

圈养繁育计划在受控条件下繁殖濒危动物，以_____。

公众教育可提高保护意识，减少_____。

保护栖息地可保留食物、庇护所和繁殖场所，使动物能够_____。

答案：增加个体数量；捕杀和非法交易；生存和繁殖

怎么认 题目出现濒危动物及三措施表时，先确认三项均为保育方法，再选全为勾号的一行。

例题 1

The photograph shows an endangered animal called a Sunda pangolin.



Which row shows methods to help conserve the Sunda pangolin?

	captive breeding programmes	education of people	protecting the habitat
A	✓	✓	✓
B	✓	✓	✗
C	✓	✗	✓
D	✗	✓	✓

（2026 May/Jun · 0654/22 · Question 13 · Extended）

解： 圈养繁育可增加濒危动物的个体数量，公众教育可减少捕杀和非法交易，保护栖息地可维持其生存和繁殖条件。
三项均能帮助保育巽他穿山甲，表中三项均为勾号的是 A 行。
故选 A。

题型 4：对照时空曲线判断富营养化（考频★☆☆☆☆）

知识点 富营养化是水体中硝酸盐等无机盐过量，导致藻类大量繁殖的过程。

藻类死亡后，分解者进行有氧呼吸，消耗水中_____，使其浓度下降。

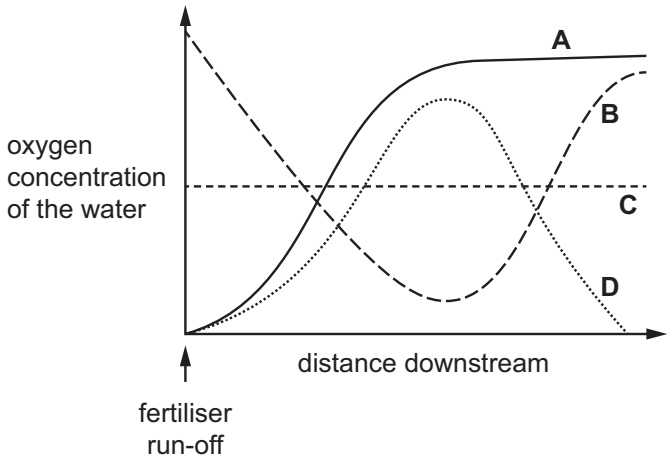
在肥料进入流动水体且下游逐渐远离污染源时，溶解氧浓度通常_____；常用单位为 mg/L。

答案：氧气；先下降后回升

怎么认 题目出现肥料污染后的下游或时间曲线时，先找营养盐增多后分解者增加、氧气下降的关系。

例题 1

Which line shows how the oxygen concentration of the water changes after excess fertiliser has entered a stream?

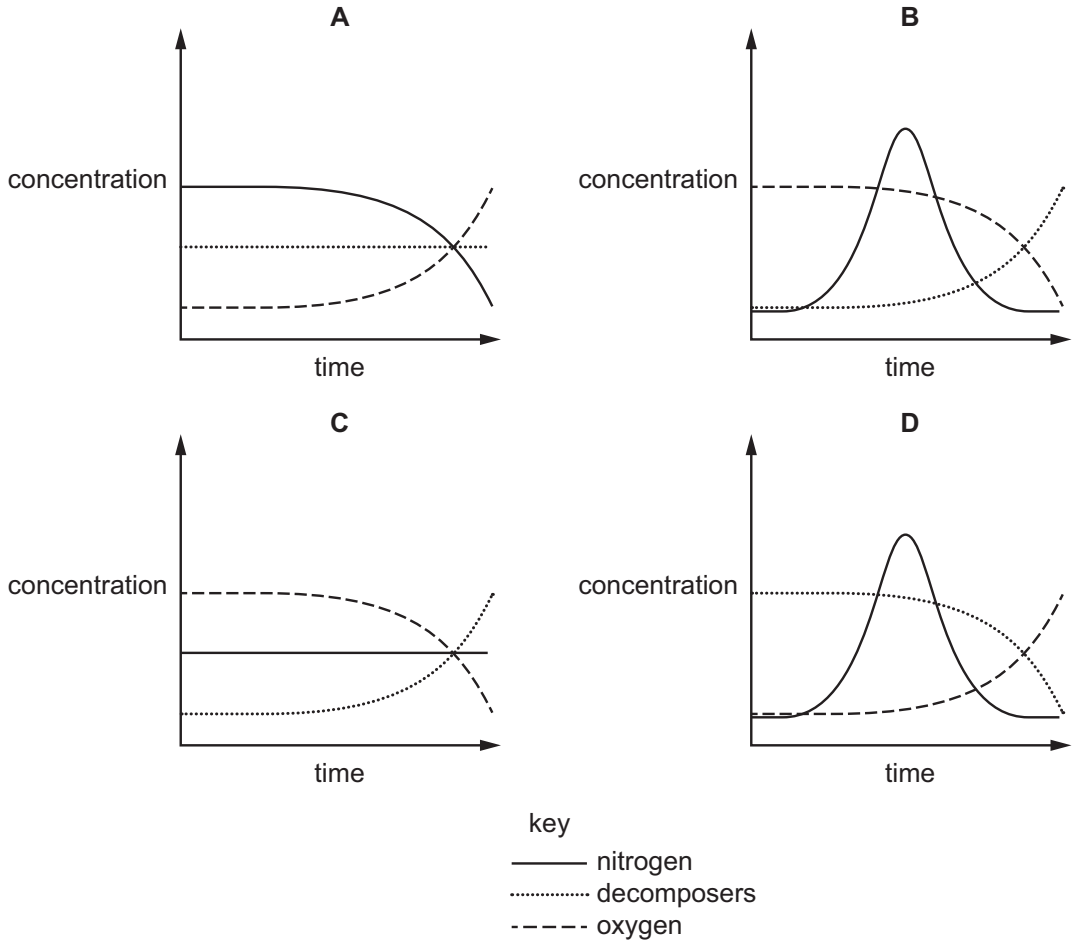


（2024 May/Jun · 0654/22 · Question 13 · Extended）

解：过量肥料进入溪流，藻类大量繁殖后死亡，分解者有氧呼吸消耗水中氧气，故下游氧浓度下降。离污染源较远后，含氧水汇入且水面与空气交换气体，氧浓度逐渐恢复，对应曲线 B。
故选 B。

针对练习

1. Which graph represents a pollution incident in a lake causing eutrophication?



（2024 Oct/Nov · 0654/22 · Question 13 · Extended）

题型 5：从逐年柱图核对毁林损失的趋势（考频★☆☆☆☆）

知识点 逐年柱图中，每根柱表示一年内损失的面积；各柱时间间隔相同，柱高越大，年损失速率越_____。

本图面积单位为km^2；按一年计时，年损失速率单位可写为$\frac{\mathrm{km}^2}{\mathrm{year}}$。

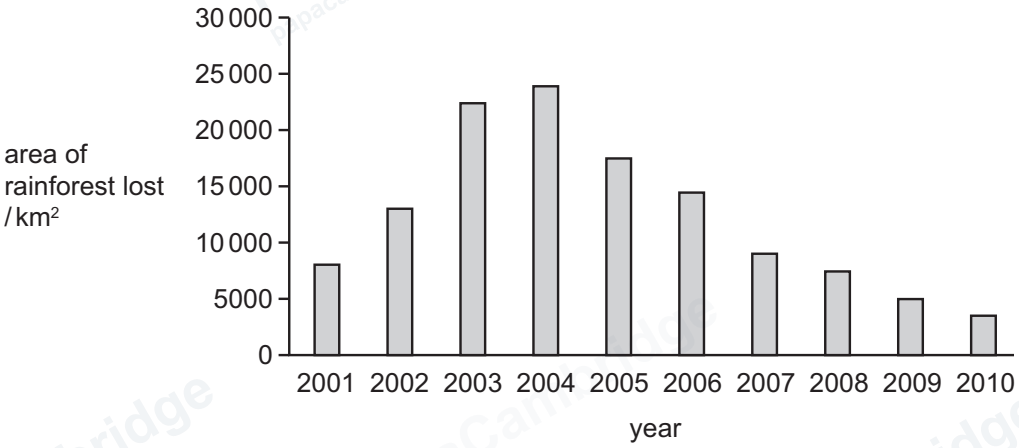
判断逐年递减，要按年份依次比较_____柱高；某年的损失面积不能用多年总损失代替。

答案：高；相邻

怎么认 题目出现逐年柱图和多条趋势陈述时，先找最高柱，再逐年比较相邻柱，并比较指定年份。

例题 1

The graph shows the area of Brazilian rainforest lost each year between 2001 and 2010.



Which statements are correct?

1 The year that had the highest rate of rainforest loss was 2004.

2 The area of forest lost every year after 2004 decreased each year.

3 There was a higher rate of rainforest loss in 2009 than in 2001.

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

（2026 May/Jun · 0654/11 · Question 13 · Core）

解：由柱高比较，2004 年的年损失面积最大，故陈述 1 正确。

2004 年后，2005 至 2010 年的柱高逐年降低，故陈述 2 正确。

由图得

$5000\mathrm{km}^2 < 8000\mathrm{km}^2$，

即 2009 年的年损失面积小于 2001 年，故陈述 3 错误。正确的是 1 和 2，故选 B。