学生手册 2026–2028

CIE IGCSE Physics 全基础题型

0625 · Core & Extended · 运动、力与能量

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[1] 专题 1 运动、力与能量

1.1 物理量与测量方法

题型 1：量具题先找刻度和读数点（考频★★★★☆）

知识点 直尺用于测量长度；正方体的边长为 a 时，体积为 $V=a^3$。

量筒用于测量液体体积；长度单位常用 m、cm、mm，体积单位常用 m^3、cm^3。

量具的量程应覆盖待测值；量程合适时，最小分度越_____，测量通常越精确。

读量筒时视线与液面相平，水形成凹液面，应读_____；夹球测直径时量两挡块内侧间距。

答案：小；凹液面最低点的刻度

怎么认 题目出现量具刻度、液面或测量方案时，先确认待测物理量、量程、最小分度和读数点。

一. 按量程精度选量具

例题 1 Which single apparatus is used to find the volume of a solid cube and which single apparatus is used to find the volume of a quantity of liquid?

	volume of solid cube	volume of liquid
A	balance	balance
B	balance	measuring cylinder
C	ruler	balance
D	ruler	measuring cylinder

（2023 夏季 0625/12 第1题）

解： 正方体的边长用直尺测量，由 $V=a^3$ 得到体积。

液体体积用量筒测量。

故选 D。

针对练习

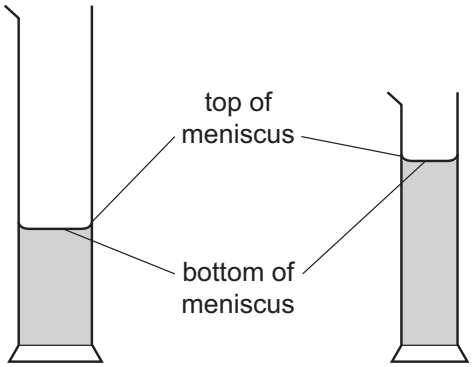
1. A student uses a metre ruler to measure the length of a sheet of paper.

Which measurement is shown to the nearest millimetre?

A 0.2932 m　　**B** 0.293 m　　**C** 0.29 m　　**D** 0.3 m

（2024 冬季 0625/21 第1题）

2. A student wishes to measure accurately the volume of approximately 40 cm^3 of water. She has two measuring cylinders, a larger one that can hold 100 cm^3, and a smaller one that can hold 50 cm^3. The water forms a meniscus where it touches the glass.



Which cylinder and which water level does the student use to ensure an accurate result?

	cylinder	water level
A	larger one	bottom of meniscus
B	larger one	top of meniscus
C	smaller one	bottom of meniscus
D	smaller one	top of meniscus

（2024 夏季 0625/22 第1题）

二. 末读数减初读数

知识点 用带刻度的量具测量一段长度时，若起点不在零刻度，长度等于_____减去_____。

用量筒求倒出的液体体积时，倒出体积等于倒出前读数减去倒出后读数。

读数差的单位与量具的刻度单位相同，长度常用 mm 或 cm，体积常用 cm^3 或 mL。

答案：末读数；初读数

怎么认　题目出现物体不从零刻度起量，或给出液体倒出前后读数时，先用较大读数减去较小读数。

例题 2　A student investigates the balancing of a metre ruler.

Fig. 1.1 shows the set-up.

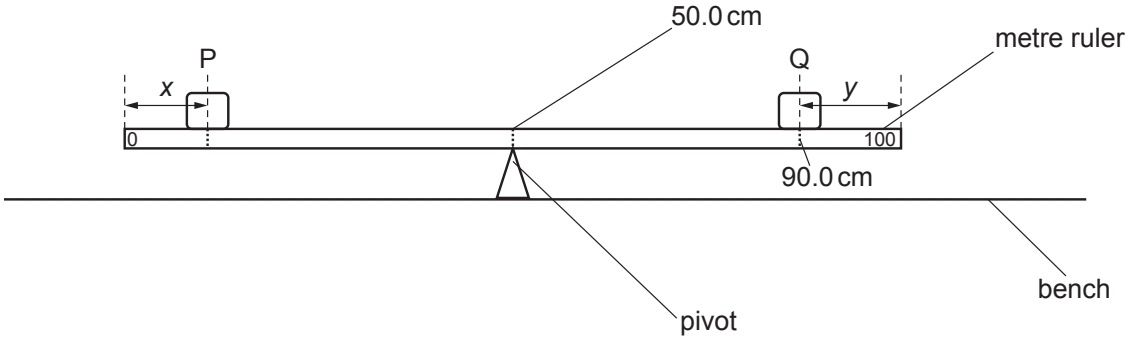


Fig. 1.1

(a) The student places the metre ruler on the pivot at the 50.0 cm mark with the scale of the ruler facing upwards.
He places an object Q with its centre on the metre ruler at the 90.0 cm mark.

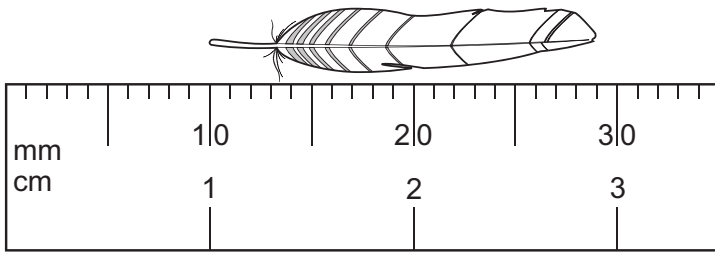
Calculate the distance *y* from the centre of Q to the 100.0 cm end of the ruler.

（2023 夏季 0625/61 第1题(a)）

解：物体 Q 的中心在 90.0 cm 刻度处，米尺末端在 100.0 cm 刻度处，
由长度等于末读数减初读数，得
$y = 100.0\ \text{cm} - 90.0\ \text{cm}$
$y = 10.0\ \text{cm}$。
答：距离 y 为 10.0 cm。

针对练习

3. The diagram shows an enlarged drawing of the end of a metre ruler. It is being used to measure the length of a small feather.



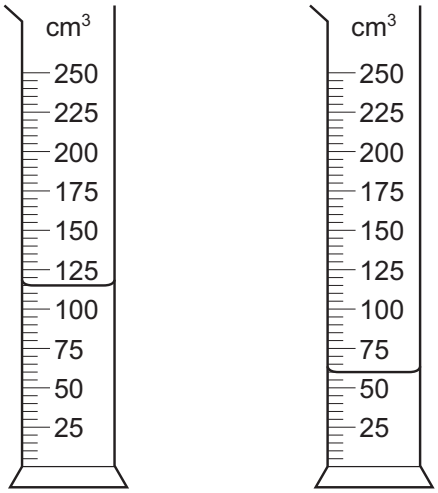
What is the length of the feather?

A 19 mm　**B** 29 mm　**C** 19 cm　**D** 29 cm

（2024 夏季 0625/11 第1题）

4. A measuring cylinder contains water.

The diagrams show the measuring cylinder before and after some of the water is poured into a beaker.

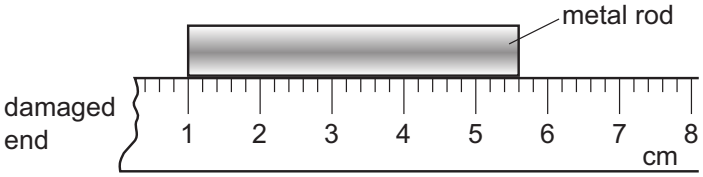


How much water has been poured into the beaker?

A 51 cm^3 **B** 52 cm^3 **C** 55 cm^3 **D** 63 cm^3

（2023 春季 0625/12 第1题）

5. A girl uses a ruler to measure the length of a metal rod. The end of the ruler is damaged, so she places one end of the rod at the 1 cm mark, as shown.



How long is the metal rod?

A 43 mm **B** 46 mm **C** 53 mm **D** 56 mm

（2025 冬季 0625/13 第1题）

三. 量三边求规则体积

知识点 用直尺测量长度时，物体长度等于_____；若一端位于零刻度，长度就是另一端的读数。

长方体或近似长方体的长、宽、高必须_____，体积为_____。

若三边单位均为 cm，体积单位为 cm^3；薄片面积为 $S = l \times w$，单位为 cm^2。

要求精确到最近的毫米时，以 cm 记录测量值应保留一位小数。

答案：末刻度读数减去初刻度读数；互相垂直；$V = l \times w \times h$

怎么认 题目出现直尺、规则物体的三条互相垂直边及所求体积时，先读出长、宽、高。

例题 3 In this experiment, you will determine the volume of a block of modelling clay by two methods. Do **not** change the shape of the block of modelling clay or remove the thread from it.

Method 1

Refer to Fig. 1.1.

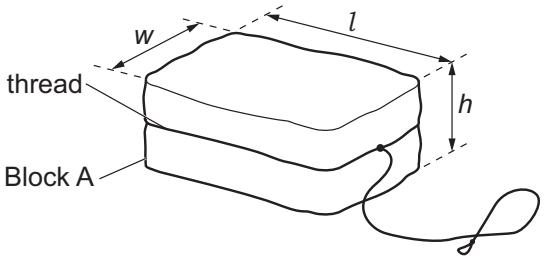


Fig. 1.1

(a) (i) Measure the length l, width w and height h of Block A. Record your values in centimetres to the nearest millimetre.

(ii) Calculate a value V_A for the volume of Block A. Use your measurements from **(a)(i)** and the equation:

$$V_A = l \times w \times h$$

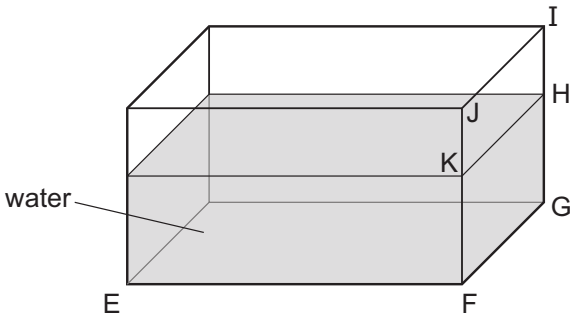
（2025 冬季 0625/53 第1题(a)）

解：按图量得 $l = 2.5\ \text{cm}$，$w = 1.1\ \text{cm}$，$h = 1.0\ \text{cm}$。
由长方体的体积公式得
$V_A = l \times w \times h$
$V_A = 2.5 \times 1.1 \times 1.0 = 2.75\text{cm}^3 \approx 2.8\text{cm}^3$。
答：$V_A \approx 2.8\text{cm}^3$。

针对练习

6. A student uses a ruler to find the volume of water in a tank.

She measures the lengths EF and FG.



What other length does she need to measure?

A FJ **B** FK **C** HI **D** IJ

（2024 冬季 0625/13 第1题）

7. A student determines the volume of a block of modelling clay by two methods.

Method 1

He measures the block of modelling clay shown full size in Fig. 1.1.

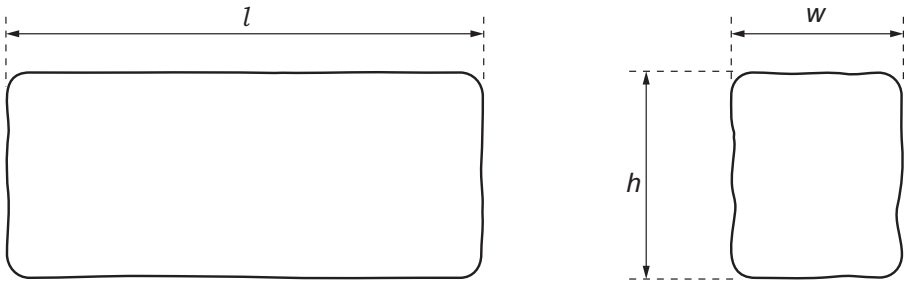


Fig. 1.1

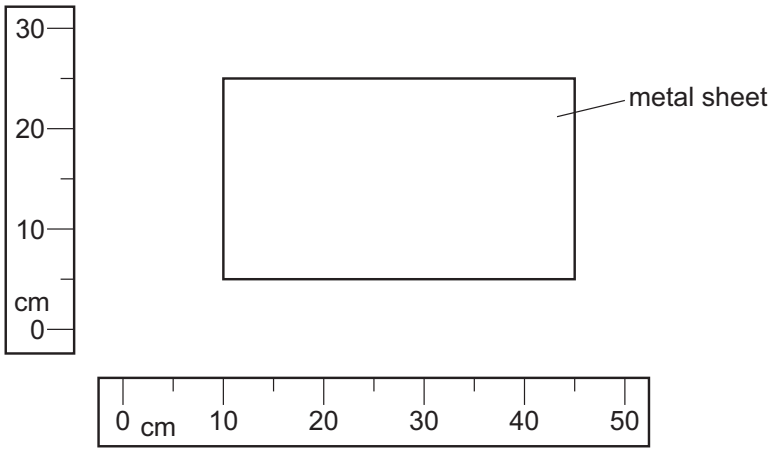
(a) (i) Measure the length l, width w and height h of the block of modelling clay on Fig. 1.1. Record your values in centimetres to the nearest millimetre.

(ii) Calculate a value V_A for the volume of the block. Use your measurements from **(a)(i)** and the equation:

$$V_A = l \times w \times h.$$

（2025 冬季 0625/63 第1题(a)）

8. The diagram shows a rectangular metal sheet close to two rulers.



What is the area of the metal sheet?

A 700 cm^2 **B** 875 cm^2 **C** 900 cm^2 **D** 1125 cm^2

（2024 冬季 0625/11 第1题）

9. In this experiment, you will determine the density of modelling clay by two methods.

Refer to Fig. 1.1.

Method 1

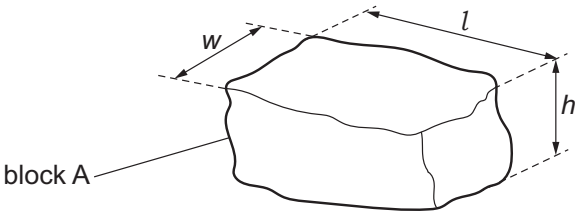


Fig. 1.1

(a) **(i)** Measure the length l, width w and height h of block A. Record your values in centimetres to the nearest millimetre.

(ii) Calculate the volume V_A of block A. Use your measurements from **(a)(i)** and the equation $V_A = l \times w \times h$.

（2024 夏季 0625/53 第1题(a)）

题型 2：小量题先累积再平均（考频★★★★☆）

知识点 测量单个微小物体的尺寸时，可将 n 个相同物体紧密排列，测得总长度 L，则平均尺寸为 _____。

若刻度尺的起点读数为 x_1、末端读数为 x_2，则总长度 $L =$ _____。

物体之间应无空隙，所得平均尺寸的单位与总长度的单位相同。

答案：$\frac{L}{n}$；$x_2 - x_1$

怎么认 题目出现多个相同小物体紧密排列及总长度时，先用末读数减初读数，再除以物体个数。

一. 总长度除以个数

例题 1 Fig. 1.1 shows two strips of staples.

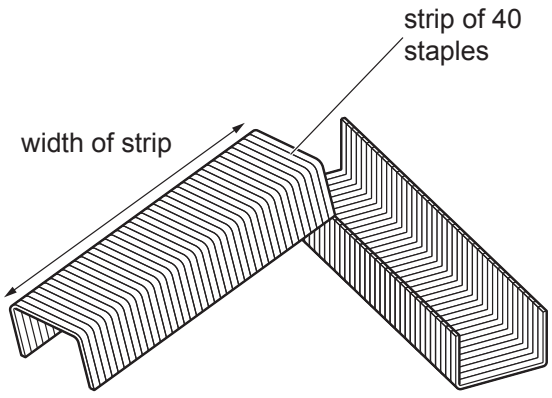


Fig. 1.1 NOT to scale

(a) The width of one strip is 56 mm. There are 40 staples in the strip.

Calculate the average width of **one** staple.

（2023 春季 0625/32 第1题(a)）

解：40 枚订书钉的总宽度为 56 mm，由平均值定义得

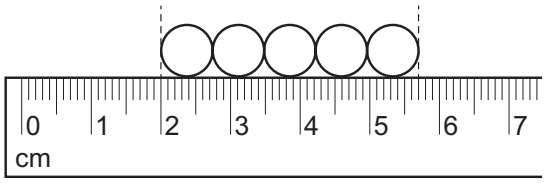
$w = \frac{L}{n}$

$w = \frac{56}{40}\ \text{mm} = 1.4\ \text{mm}$

答：一枚订书钉的平均宽度为 1.4 mm。

针对练习

1. The diagram shows a ruler being used to measure the length of a line of ball-bearings.



Which expression gives the average diameter of a ball-bearing?

A $\frac{(5.7 + 2.0)}{5}$

B $\frac{(5.7 - 2.0)}{5}$

C $(5.7 + 2.0) \times 5$

D $(5.7 - 2.0) \times 5$

（2025 冬季 0625/12 第2题）

2. A student places six 100 g masses in a stack, as shown in Fig. 2.1.

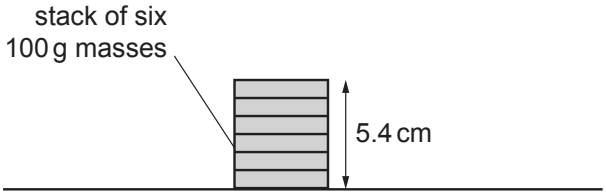


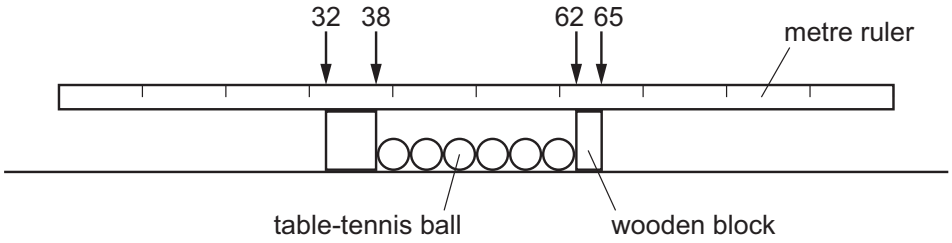
Fig. 2.1 (not to scale)

(a) The height of the stack of masses is 5.4 cm.

Calculate the average thickness of **one** mass.

（2024 夏季 0625/31 第2题(a)）

3. A student uses a metre ruler to measure the length of six identical table-tennis balls placed between two wooden blocks.



What is the diameter of one ball?

A 4 cm **B** 5 cm **C** 6 cm **D** 8 cm

（2023 冬季 0625/13 第1题）

二. 多周期总时除次数

知识点 摆完成一次往返并回到相同运动状态所用的时间称为周期，用 T 表示。

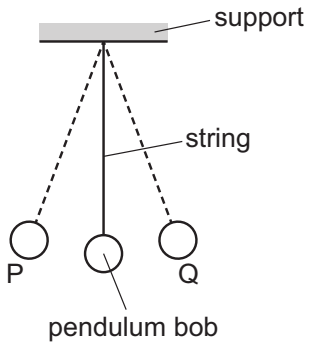
测量 N 个完整周期的总时间 t，再求平均，$T=\frac{t}{N}$；计时的开始和结束应处于_____。

总时间和周期的国际单位均为_____；增大 N 可减小反应时间误差对周期结果的百分比影响。

答案：相同运动状态；秒（s）

怎么认 题目出现多个完整振动的总时间，或同方向多次经过标记点时，先用总时间除以周期数。

例题 2 The diagram shows a pendulum that oscillates between P and Q.



Which method is used to find the average period of oscillation for the pendulum?

A Measure the time it takes to swing from P to Q.

B Measure the time it takes to swing from P to Q to P 10 times and divide that time by 10.

C Measure the time it takes to swing from P to Q to P 10 times and multiply that time by 10.

D Measure the time it takes to swing from Q to P.

（2024 春季 0625/12 第1题）

解： 摆从 P 经 Q 再回到 P，回到相同运动状态，完成一次振动。

设 10 次完整振动的总时间为 t，则平均周期为

$T=\frac{t}{10}$

故选 B。

针对练习

4. A student uses a stop-watch to measure the time for one complete oscillation of a pendulum.

Fig. 2.1 shows his measurement.



Fig. 2.1

(b) Another student uses a different pendulum and measures the time for 15 complete oscillations. The time for 15 complete oscillations is 11.7 s.

Calculate the average time for **one** complete oscillation.

（2025 夏季 0625/31 第2题(b)）

5. In this experiment, you will investigate the period of a pendulum.

Complete the following instructions, referring to Fig. 1.1 and Fig. 1.2.

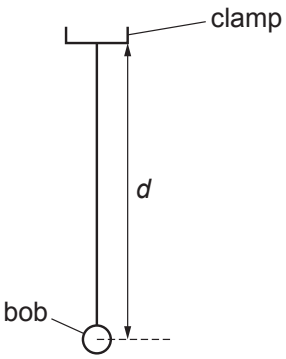


Fig. 1.1

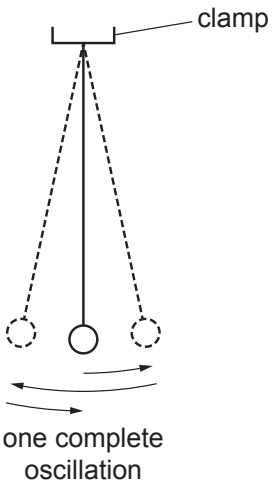


Fig. 1.2

A pendulum has been set up for you as shown in Fig. 1.1.

(e) Explain why timing 10 oscillations gives a more accurate result for the period *T* than timing one oscillation.

（2023 冬季 0625/52 第1题(e)）

6. When a pendulum passes a marker, a timer displays 1 minute 30 seconds.

The pendulum passes the marker 12 more times from the same direction.

On the final pass, the timer displays a time of 2 minutes 18 seconds.

What is the time period of oscillation of the pendulum?

A 4.0 s **B** 4.4 s **C** 7.5 s **D** 12 s

（2025 冬季 0625/23 第1题）

7. A student investigates the period of a pendulum.

Fig. 1.1 shows the set-up.

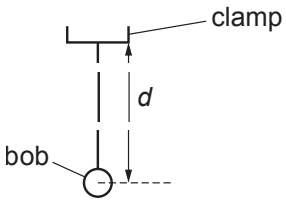


Fig. 1.1

(a) The distance *d* is measured from the bottom of the clamp to the centre of the bob.

The student adjusts the length of the pendulum until *d* = 50.0 cm.

He displaces the bob slightly and releases it so that it swings.

He uses a stop-watch to measure the time *t* for 10 complete oscillations.



Fig. 1.2

(i) Fig. 1.2 shows the reading on the stop-watch.

Record, in Table 1.1, the time *t* for 10 complete oscillations.

(ii) Calculate and record in Table 1.1, the period *T* of the pendulum. The period is the ti for one complete oscillation.

(iii) Calculate T^2 and record your value in Table 1.1.

(iv) Write the units in the column headings.

Table 1.1

d/	t/	T/	T^2/
50.0			
100.0	20.20	2.02	4.08

（2023 冬季 0625/62 第1题(a)）

三. 统一时间单位再处理

知识点 同一过程重复测量 n 次时，平均时间为 $t_{平均}=\frac{t_1+t_2+...+t_n}{n}$，各次测量条件应相同。

计时器显示累计读数时，时间间隔等于_____；读数含分和秒时，应先统一单位。

1 min = _____ s，时间间隔与所用时间单位一致。

答案：停止读数减去开始读数；60

怎么认 题目出现多次测量或计时器的起止读数时，先统一时间单位，再作差或取算术平均。

例题 3 Four students are instructed to find the time it takes for a ball bearing to fall through a vertical height of 1.0 m.

Each student uses a different procedure.

Which student follows the correct procedure?

A The student measures the time taken for the ball to fall 1.0 m five times. He then adds the times taken together and divides by five.

B The student measures the time taken for the ball to fall 1.0 m five times. He then multiplies the times taken together and divides by five.

C The student measures the time taken for the ball to fall 2.0 m. He then divides the time taken by two.

D The student measures the time taken for the ball to fall 2.0 m five times. He then adds the times taken together and divides by ten.

（2025 春季 0625/12 第3题）

解： 设五次测得的时间分别为 t_1、t_2、t_3、t_4、t_5。

同一高度下重复测量，取算术平均值，

$t_{平均}=\frac{t_1+t_2+t_3+t_4+t_5}{5}$

A 中的做法符合上述关系，故选 A。

针对练习

8. A digital stop-clock measures time in minutes and seconds.

The stop-clock reads 00:50 when it is started (i.e. 00 minutes 50 seconds).

It reads 02:10 when it is stopped.

What is the shortest possible time that has passed between starting and stopping the stop-clock?

A 1 minute 06 seconds

B 1 minute 20 seconds

C 2 minutes 10 seconds

D 3 minutes 00 seconds

（2025 春季 0625/12 第2题）

9. An athlete runs around a circular track.

Readings on the stop-watch used to time the athlete are shown.

after one lap



after two laps



after three laps



How long did it take the athlete to run the third lap?

A 1 min 19 s **B** 1 min 22 s **C** 1 min 37 s **D** 1 min 59 s

（2025 冬季 0625/12 第1题）

题型 3：不规则体积先用排水法（考频★★★☆☆）

知识点 不能由规则几何公式确定体积的小物体，可用_____和水通过排水法测量体积。
先读水的初体积 V_1，再将物体完全浸没并读出总体积 V_2，物体体积 $V=$ _____。
物体须不溶于水且不吸水；量筒应量程合适、分度值尽量小。
体积常用单位为 cm^3 或 mL，且 $1\ \mathrm{mL}=1\mathrm{cm}^3$。

答案：量筒；V_2-V_1

怎么认 题目出现小物体体积、量筒和水时，先选量筒，用浸没前后读数之差求体积。

一. 先选量筒和水

例题 1 A student has a measuring cylinder containing water and also has a balance.

Which of these could she use to find the volume of a small metal sphere?

She has no other apparatus.

A either the measuring cylinder containing water or the balance

B the measuring cylinder containing water only

C the balance only

D neither the measuring cylinder nor the balance

（2024 春季 0625/22 第1题）

解：将小金属球完全浸入量筒中的水，浸没前后读数之差等于小球的体积。
天平测量质量，未给金属的密度，不能单独求出小球的体积。
故选 B。

针对练习

1. Which instrument is most suitable to determine the volume of a small irregularly shaped stone?

A 30 cm ruler

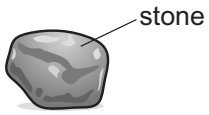
B digital timer

C measuring cylinder

D tape measure

（2025 夏季 0625/22 第1题）

2. A student wishes to find the volume of a small, irregularly shaped stone.



A ruler and a measuring cylinder containing some water are available.

Which apparatus is needed?

A neither the ruler nor the measuring cylinder

B the measuring cylinder only

C the ruler and the measuring cylinder

D the ruler only

（2024 夏季 0625/13 第1题）

二. 浸没前后体积作差

知识点 排水法可测量不规则固体的体积：记录水的初体积 V_1，再记录固体完全浸没后的读数 V_2。固体排开水的体积等于固体体积，因此 $V=$ _____；固体须完全浸没，且表面不得附着气泡。读数时视线与弯月面最低点同高，并垂直于量筒刻度；体积单位常用 _____。

答案：V_2-V_1；cm^3

怎么认 题目出现量筒浸没前后两次读数并求固体体积时，先写 $V=V_2-V_1$。

例题 2

(a) A student determines the volume of a piece of metal. The student pours 30 cm^3 of water into a measuring cylinder. The piece of metal is submerged in the water and the new volume reading on the measuring cylinder is 42 cm^3.

Calculate the volume of the piece of metal.

（2024 春季 0625/32 第2题(a)）

解： 由排水法，金属块的体积等于量筒读数的增加量，

$V=V_2-V_1$

$=42-30$

$=12\mathrm{cm}^3$

答：金属块的体积为 $12\mathrm{cm}^3$。

针对练习

3. Which piece of apparatus is used to determine the volume of an irregularly shaped solid?

A balance

B measuring cylinder

C ruler

D thermometer

（2025 夏季 0625/12 第2题）

4. A student measures the volume of a small, irregularly shaped stone.

Which apparatus must be used?

A a ruler and a measuring cylinder containing water

B a measuring cylinder containing water only

C a ruler and an empty measuring cylinder

D a ruler only

（2024 夏季 0625/23 第1题）

5. A student determines the volume of a block of modelling clay by two methods.

Method 1

He measures the block of modelling clay shown full size in Fig. 1.1.

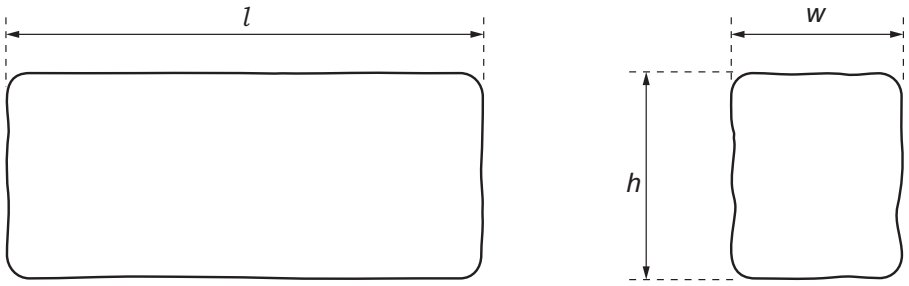


Fig. 1.1

Method 2

(d) (i) The student pours water into a measuring cylinder.

Record the volume V_1 of the water in the measuring cylinder shown in Fig. 1.2.

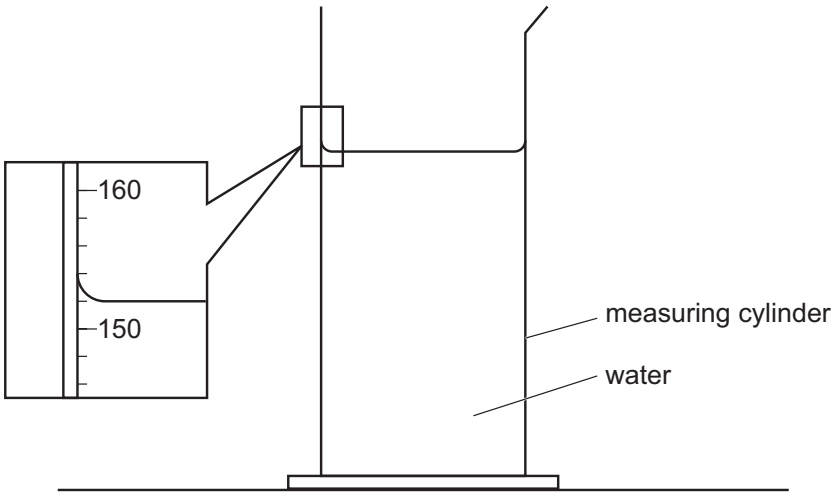


Fig. 1.2

(ii) Describe briefly how a measuring cylinder is read to obtain an accurate value for the volume of water.

(e) The student lowers the modelling clay into the water using a loop of thread, as shown in Fig. 1.3.

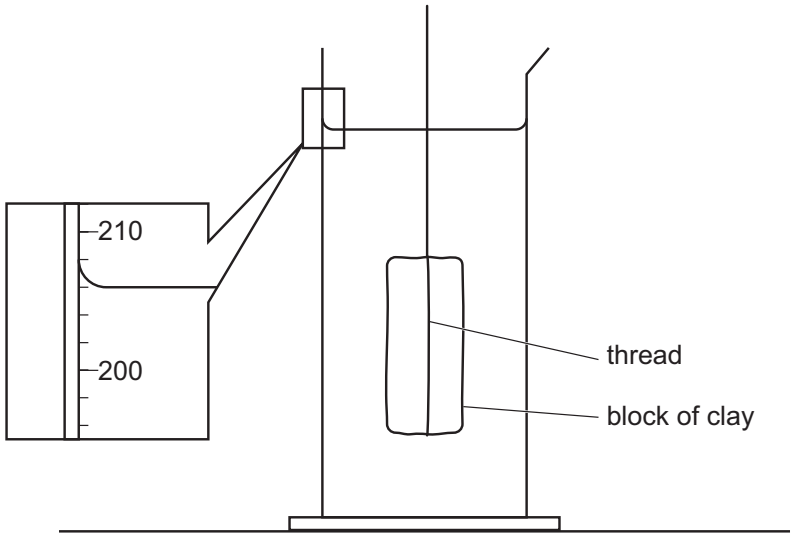


Fig. 1.3

Record the new reading V_2 shown on the measuring cylinder scale in Fig.1.3.

Calculate another value V_B for the volume of the block.

Use your measurements from **(d)(i)** and **(e)** and the equation: $V_B = (V_2 - V_1)$.

（2025 冬季 0625/63 第1题(e)）

题型 4：标矢量先看有没有方向（考频★★★☆☆）

知识点 标量只有_____，矢量同时具有_____和方向。

距离、速率、时间、质量、能量和温度是标量；力、重量、加速度、速度、动量、电场强度和重力场强度是矢量。

不同物理量的单位各不相同，标量与矢量的分类不由单位决定。

答案：大小；大小

怎么认 题目出现标量、矢量或按方向性分类时，先判断各物理量是否具有方向。

一. 按方向性分类

例题 1

(b) Speed is a scalar quantity and velocity is a vector quantity.

State the names of **one** other scalar quantity and **one** other vector quantity.

（2023 春季 0625/42 第1题(b)）

解：质量只有大小，没有方向，故质量是标量；力既有大小又有方向，故力是矢量。
答：标量为质量，矢量为力。

针对练习

1. **(a)** Circle the vector quantities in the list.

acceleration **mass** **speed** **time** **velocity**

（2025 夏季 0625/41 第1题(a)）

2. Which list contains only vector quantities?

A acceleration, distance, speed

B electric field strength, momentum, weight

C energy, mass, temperature

D force, time, velocity

（2024 冬季 0625/23 第1题）

3. In which row are quantities correctly categorised into scalar quantities and vector quantities?

	scalar quantities	vector quantities
A	mass and energy	weight and acceleration
B	gravitational field strength and time	force and electric field strength
C	speed and momentum	distance and force
D	distance and energy	velocity and temperature

（2024 夏季 0625/21 第1题）

4. **(a)** **(i)** State the difference between a scalar quantity and a vector quantity.

.....

..... [1]

(ii) Define momentum.

.....

..... [1]

（2024 冬季 0625/43 第1题(a)）

二. 分方向作矢量合成

知识点 矢量既有大小又有_____；同类矢量的合矢量等于各矢量的矢量和。

同一直线上的同向分量相加，反向分量相减，再分别得到水平、竖直方向的合分量。

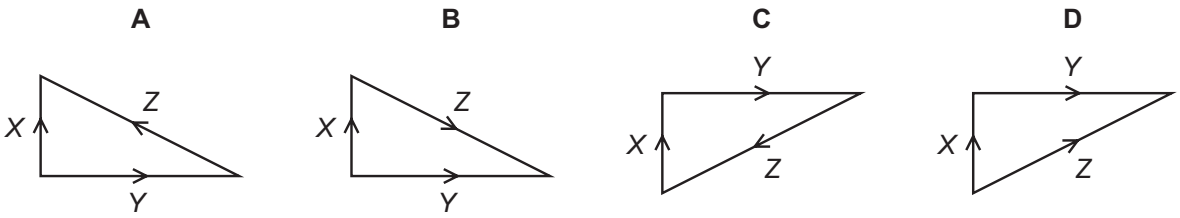
互相垂直的两个分量大小为 a、b 时，合量大小为_____，方向由 $\tan\theta=\frac{b}{a}$ 确定；合量与分量单位相同，θ 用度表示。

作图时将矢量首尾相接，合矢量从第一个矢量的起点指向最后一个矢量的_____。

答案：方向；$\sqrt{a^2+b^2}$；末端

怎么认 题目出现互相垂直的力或速度并求合量时，先分别求水平、竖直方向的合分量。

例题 2 Which vector diagram correctly shows the force *Z* as the resultant of forces *X* and *Y*?

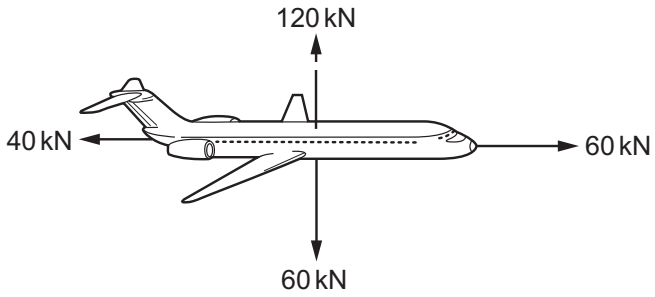


（2023 夏季 0625/21 第1题）

解：由矢量首尾相接法，先沿 X 的方向，再沿 Y 的方向，合力 Z 应从 X 的起点指向 Y 的终点。图 D 中，X 与 Y 首尾相接，Z 由左下指向右上。故选 D。

针对练习

5. The diagram shows the four forces acting on an aircraft in flight.



Which arrow shows the direction of the resultant of the four forces?



（2025 夏季 0625/21 第2题）

6. **(a)** A boat crosses a river. The boat points at right angles to the river bank and it travels at a speed of 3.5 m/s relative to the water.

A river current acts at right angles to the direction the boat points. The river current has a speed of 2.5 m/s.

By drawing a scale diagram or by calculation, determine the speed and direction of the boat relative to the river bank.

（2023 春季 0625/42 第1题(a)）

7. Fig. 1.1 shows a straight section of a river where the water is flowing from right to left at a speed of 0.54 m/s.

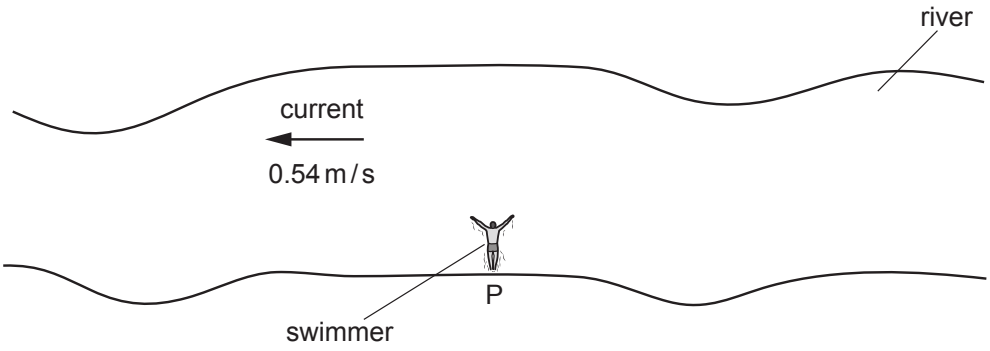


Fig. 1.1 (not to scale)

A swimmer starts at point P and swims at a constant speed of 0.72 m/s relative to the water and at right angles to the current.

(a) **(i)** Determine, relative to the river bank, both the magnitude and direction of the swimmer's velocity.

(ii) After 1.5 minutes, the swimmer reaches point Q.

Calculate the distance between P and Q.

（2023 夏季 0625/41 第1题(a)）

1.2 运动

题型 1：先分清速率、速度和加速度（考频★★★★☆）

知识点 速率表示单位时间内通过的_____，$v=\frac{s}{t}$；其中 s 为路程，t 为时间，常用单位为 $\mathrm{m/s}$。
速率是标量，只有_____；速度是某一给定方向上的速率，是既有大小又有方向的矢量。
加速度表示速度随时间的变化率，常用单位为 $\mathrm{m\ s^{-2}}$；速度的大小或方向发生变化时，物体有加速度。
若两个速度分量互相垂直，合速度的大小满足 $v=\sqrt{v_1^2+v_2^2}$。

答案：路程；大小

怎么认 题目出现方向描述或互相垂直的运动分量时，先判定所求是速率大小还是带方向的速度，再画分量。

一. 看方向辨速率与速度

例题 1 Which row defines speed and velocity?

	speed	velocity
A	distance travelled in a given direction	speed per unit time
B	distance travelled per unit time	speed in a given direction
C	distance travelled in a given direction	speed in a given direction
D	distance travelled per unit time	speed per unit time

（2025 春季 0625/22 第2题）

解：速率表示单位时间内通过的路程，速度是某一给定方向上的速率。
表中同时符合两项定义的是 B 行。
故选 B。

针对练习

1. Which statement is correct?

A speed = distance travelled × time taken

B speed = velocity in a given direction

C velocity = $\frac{\text{time taken}}{\text{distance travelled}}$

D velocity = speed in a given direction

（2024 冬季 0625/13 第2题）

2. A train travels with a constant velocity of 56 m/s on a horizontal track. The mass of the train is 440 000 kg.

(a) State the difference between the velocity of the train and its speed.

（2025 冬季 0625/41 第1题(a)）

3. Fig. 1.1 shows the speed–time graph for a car.

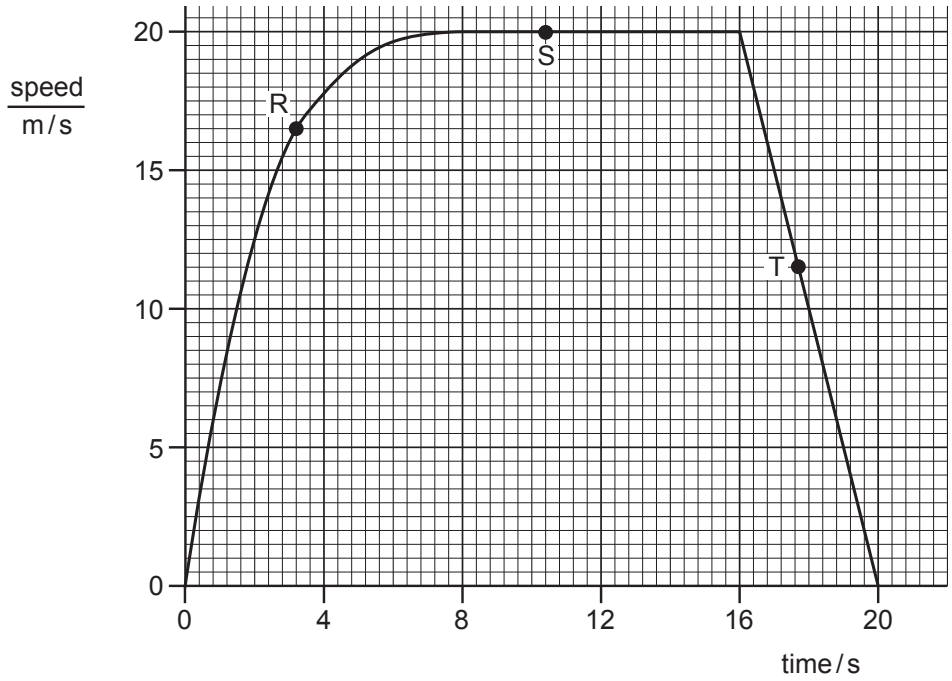


Fig. 1.1

(b) Define the term velocity.

（2024 夏季 0625/31 第1题(b)）

4. An aircraft is moving at 60 m/s in a northerly direction when a cross-wind from the east starts to blow. The speed of the wind is 13 m/s.

What is the magnitude of the aircraft's velocity when the wind is blowing?

A 47 m/s **B** 59 m/s **C** 61 m/s **D** 73 m/s

（2023 夏季 0625/23 第3题）

二. 速度变化量除以时间

知识点 速度是有方向的速率；加速度表示速度随时间的变化快慢。

加速度是单位时间内速度的_____，$a=\frac{v-u}{t}$，其中 u 为初速度，v 为末速度。

加速度恒定时，$v=u+at$；由静止出发时，$u=$_____。

计算前应统一速度和时间单位；加速度的单位是_____，各量按同一正方向取正负。

答案：变化量；0 m/s；m s^{-2}

怎么认 题目出现初速度、加速度、时间并求末速度时，先统一单位，再用 $a=\frac{v-u}{t}$。

例题 2 Fig. 1.1 shows a balloon filled with helium gas.

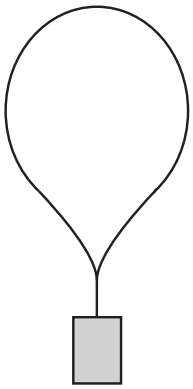


Fig. 1.1

The mass of the balloon is 120 kg.

(c) The balloon accelerates upwards from rest at 0.45 m/s^2 for 8.0 s.

Calculate the velocity of the balloon after 8.0 s.

（2023 夏季 0625/43 第1题(c)）

解：取竖直向上为正，气球由静止出发，$u=0$。

由 $a=\frac{v-u}{t}$ 得

$v=u+at$

$=0+0.45\times 8.0$

$=3.6$ m/s。

答：气球在 8.0 s 后的速度为竖直向上 3.6 m/s。

5. A racing car is fitted with an on-board computer. Every time the car passes the starting line, the computer records the distance travelled in the following two seconds.

Which set of data shows that the car is increasing in speed during the two seconds?

A

time / s	distance travelled / m
0	0
1	100
2	200

B

time / s	distance travelled / m
0	0
1	90
2	180

C

time / s	distance travelled / m
0	0
1	80
2	190

D

time / s	distance travelled / m
0	0
1	100
2	180

（2024 夏季 0625/12 第2题）

6. Fig. 2.1 shows a motorcyclist accelerating along a straight horizontal section of track.

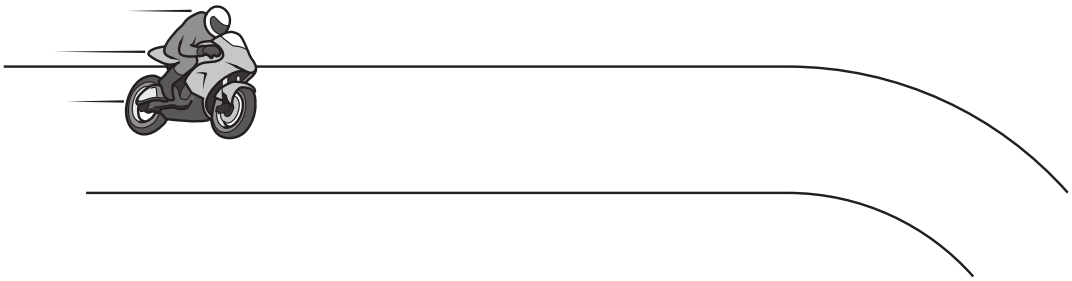


Fig. 2.1

The motorcyclist and motorcycle have a combined mass of 240 kg.

(a) On the straight horizontal section of the track, the motorcyclist accelerates from rest at $7.2\,m/s^2$.

(i) The motorcyclist reaches the end of the straight section of track in 5.3 s.

Calculate the speed of the motorcyclist at the end of the straight section.

(ii) Calculate the resultant force on the motorcyclist and motorcycle on the straight section of track.

（2023 夏季 0625/41 第2题(a)）

7. A train has a maximum speed of 200 km/h. It accelerates from rest with constant acceleration of 0.70 m/s^2.

(a) (i) Define acceleration.

(ii) Show that the maximum speed of the train is approximately 56 m/s.

(iii) Calculate the time taken for the train to reach its maximum speed.

（2025 春季 0625/42 第4题(a)）

三. 先比较重力与阻力

知识点 重力加速度是物体只受重力时的加速度，单位为 _____。

在同一天体表面附近，若空气阻力可忽略，重力加速度 g 近似_____，不随下落时间、速率或几米的高度变化而改变。

有空气阻力时，空气阻力随下落速率增大，向下的合力和加速度均减小。

当空气阻力等于重力时，合力和加速度均为零，物体以_____下落，此速率称为终端速率。

答案：m s^{-2}；恒定；恒定速率

怎么认 题目出现自由下落及空气阻力条件时，先比较重力与空气阻力的大小。

例题 3 A ball is dropped in a vacuum from a height of 4.0 m above the surface of Mars. The acceleration of the ball at a height of 2.0 m is 3.8 m/s^2.

What is the acceleration of the ball at a height of 1.0 m above the surface of Mars?

A 1.9 m/s^2 **B** 3.8 m/s^2 **C** 5.7 m/s^2 **D** 7.6 m/s^2

（2023 春季 0625/12 第3题）

解： 真空中无空气阻力，且两处均在火星表面附近，重力加速度近似不变。

$a_{1.0\ \mathrm{m}} = a_{2.0\ \mathrm{m}}$

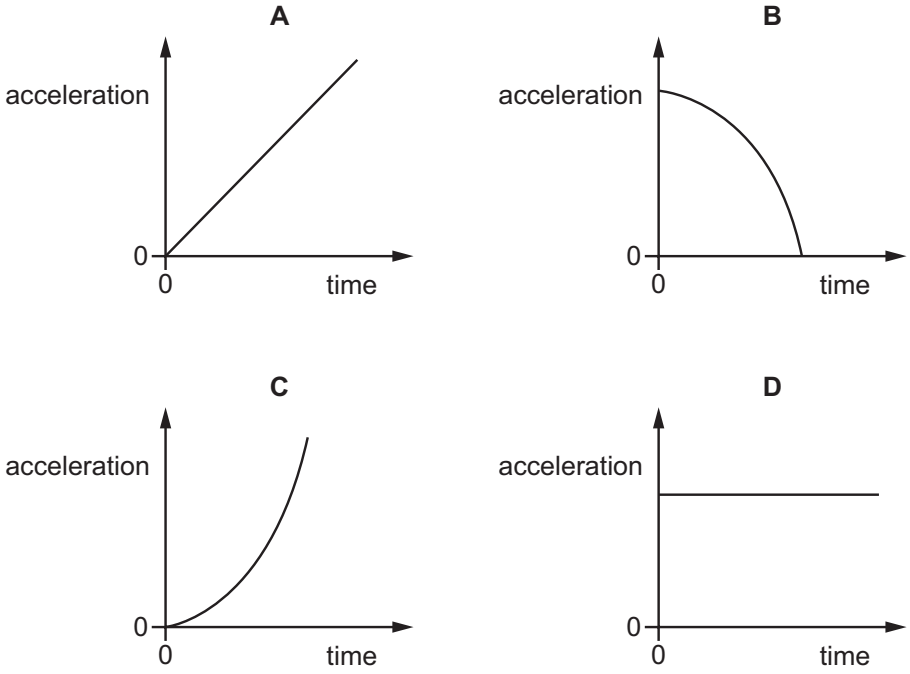
$a_{1.0\ \mathrm{m}} = 3.8\mathrm{m\ s^{-2}}$

故选 B。

针对练习

8. A stone falls freely from the top of a cliff. Air resistance may be ignored.

Which graph shows how the acceleration of the stone varies with time as it falls?



（2024 冬季 0625/13 第3题）

9. An object begins to fall close to the Earth's surface. Air resistance can be ignored.

Which statement about the object's acceleration is correct?

A The acceleration is constant.

B The acceleration decreases as the body falls.

C The acceleration increases as the body falls.

D The acceleration is zero.

（2024 冬季 0625/11 第3题）

10. A steel ball is dropped from the top floor of a building. Air resistance can be ignored.

Which statement describes the motion of the ball?

A The ball falls with constant acceleration.

B The ball falls with constant speed.

C The ball falls with decreasing speed.

D The ball falls with increasing acceleration.

（2025 夏季 0625/22 第2题）

11. A ball of mass 130 g is launched from the ground at an initial velocity of 14 m / s vertically upwards. It decelerates until it is at rest momentarily at a height *h* above the ground.

(d) The ball is dropped from the top of a tall building.

Describe and explain the motion of the ball as it falls. Consider the effect of air resistance in your answer.

（2024 夏季 0625/43 第1题(d)）

题型 2：路程时间题先写速率公式（考频★★★☆☆）

知识点 速率表示物体单位时间内通过的路程，计算式为 $v=$ _____。

单程运动中，路程、速率和时间满足 $s=vt$，故 $t=$ _____；各量必须采用相互对应的单位。

路程用 m、时间用 s 时，速率单位为 m/s；真空或空气中的光速近似取 3.0×10^{8} m/s。

答案：$\frac{s}{t}$；$\frac{s}{v}$

怎么认 题目出现单程路程、速率、时间三者中已知两个并求另一个时，先统一单位，再写 $v=\frac{s}{t}$。

一. 单程用路程除时间

例题 1

(c) Jupiter is 780 000 000 000 m (7.8×10^{11} m) from the Sun.

The speed of light is 300 000 000 m/s (3.0×10^{8} m/s) .

Calculate the time for light to travel from the Sun to Jupiter.

（2023 春季 0625/32 第12题(c)）

解：由 $v=\frac{s}{t}$ 得

$t=\frac{s}{v}$

$=\frac{7.8\times10^{11}\ \text{m}}{3.0\times10^{8}\ \text{m/s}}$

$=2.6\times10^{3}\ \text{s}=2600\ \text{s}$

答：光从太阳传播到木星所需时间为 2.6×10^{3} s。

针对练习

1. Student X fires a starting pistol which produces smoke and sound. Student Y is standing 100 m away and sees the smoke the instant it is produced. The speed of sound in air is 340 m/s.

What is the time delay between student Y seeing the smoke and hearing the sound?

A 0.29 s **B** 0.59 s **C** 1.7 s **D** 3.4 s

（2023 夏季 0625/11 第22题）

2. A rocket travels with an average speed of 6 km/s for 2 minutes.

What is the distance travelled by the rocket?

A 12 km **B** 50 km **C** 720 km **D** 12 000 km

（2024 冬季 0625/21 第2题）

3. **(b)** The time taken for light to travel from the Moon to the Earth is 1.3 s.

Calculate the distance of the Moon from the Earth. Give your answer in m.

（2025 冬季 0625/42 第10题(b)）

4. **(b)** It takes light 490 s to travel from the Sun to the Earth.

Calculate the distance from the Sun to the Earth.

（2025 夏季 0625/43 第10题(b)）

二. 全程用总路程除总时间

知识点 速率表示单位时间内通过的路程，关系式为 $v=\frac{s}{t}$。

平均速率等于_____与_____之比；多段运动中，各段路程和各段用时分别相加。

路程与时间的单位须相互配套；常用速率单位为 m/s 和 km/h，平均速率不等于各段速率的简单平均。

答案：总路程；总时间

怎么认 题目出现运动路程、所用时间并求平均速率时，先写总路程除以总时间。

例题 2 A car moves through a measured distance s in a known time t.

What is the correct equation used to calculate the average speed v of the car?

A $v = \frac{s}{t}$ **B** $v = s \times t$ **C** $\frac{t}{s}$ **D** $v = s \times t^2$

（2024 春季 0625/12 第2题）

解：由平均速率定义得

$v = \frac{s}{t}$

故选 A。

针对练习

5. **(b)** On a different journey, the cyclist travels 560 m in 130 s.
Calculate the average speed of the cyclist.

（2025 冬季 0625/32 第1题(b)）

6. Fig. 1.1 shows the speed–time graph for a car travelling along a flat, straight road.
The graph has four sections, labelled JK, KL, LM and MN.

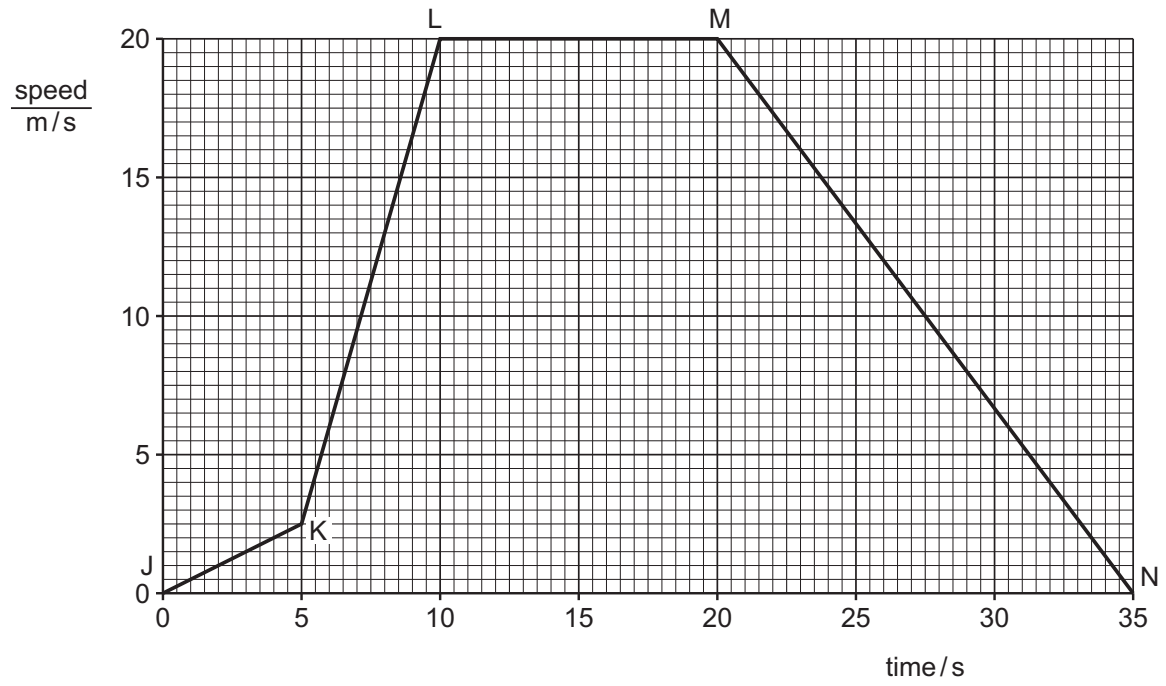


Fig. 1.1

(d) Another car travels a distance of 500 m in a time of 20 s.

Calculate the average speed of this car.

（2025 夏季 0625/31 第1题(d)）

7. An athlete runs 2.4 km in 12 minutes.

What is the average speed of the athlete?

A 0.20 m/s **B** 3.3 m/s **C** 29 m/s **D** 200 m/s

（2024 夏季 0625/23 第3题）

8. A boy takes 30 minutes to cycle a distance of 8.0 km. He then walks a further distance of 2.0 km in 15 minutes.

What is his average speed?

A 4.5 km/h **B** 5.6 km/h **C** 12 km/h **D** 13 km/h

（2024 冬季 0625/22 第2题）

题型 3：距离–时间图先看斜率（考频★★★★☆）

知识点 距离–时间图中，横轴表示_____，纵轴表示_____；图线上一点的坐标表示某一时刻对应的距离。
从指定点向两坐标轴投影可读出时刻和距离；若起、止时刻分别为 t_1 和 t_2，则 $\Delta t = t_2 - t_1$。
当纵轴表示离同一出发点的距离，且两地点位于同一路线上时，两地点间距离等于两个纵坐标之差。
图线水平表示距离不变，物体处于静止状态；距离和时长的单位分别取纵轴和横轴所标单位。

答案：时间；距离

怎么认 题目出现距离–时间图并求距离、时刻或某段时长时，先将端点向坐标轴投影读数。

一. 按坐标读路程和时长

例题 1 Fig. 1.1 shows the distance–time graph for a student. The student walks out of a classroom, stops to talk to some friends, and then walks to their next class.

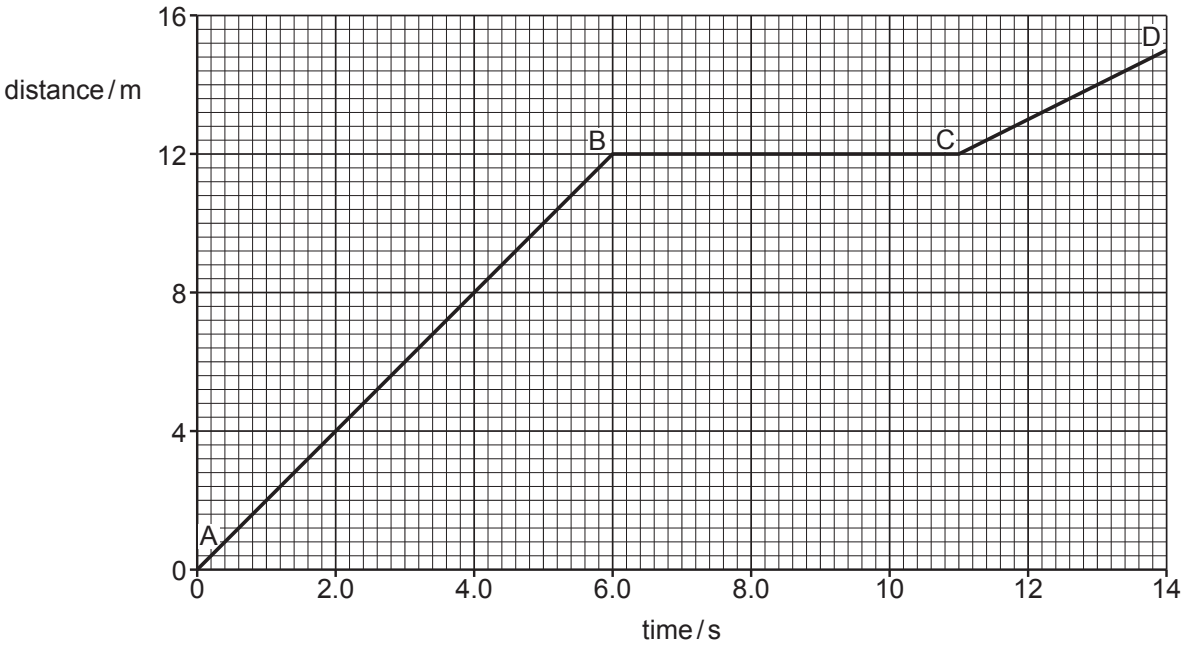


Fig. 1.1

(c) Determine the length of time for which the student stops walking.

（2024 春季 0625/32 第1题(c)）

解：图线 BC 水平，学生在这段时间停止行走。
由图得 $t_B = 6.0$ s，$t_C = 11.0$ s，
$\Delta t = t_C - t_B$
$= 11.0 - 6.0$
$= 5.0$ s。
答：学生停止行走的时长为 5.0 s。

针对练习

1. Fig. 1.1 shows the distance–time graph for a student's journey.

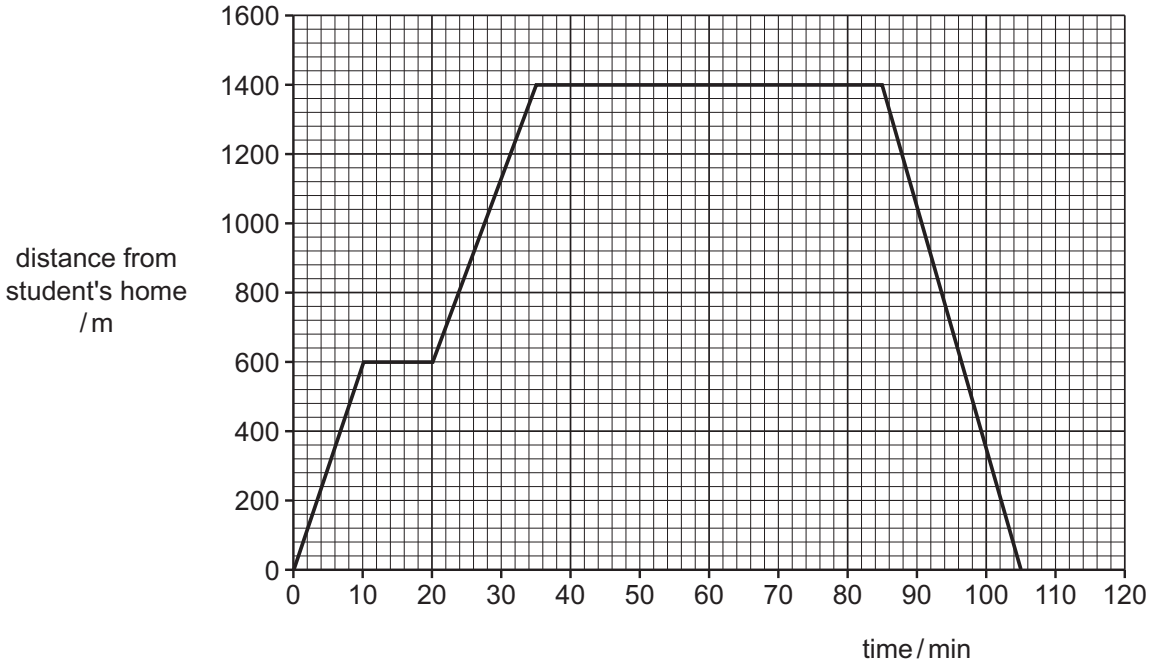


Fig. 1.1

The student walks from his home to a shop. He stops at the shop.
Then he walks to his friend's house and stops there for 50 minutes.
Then he walks back to his home without stopping.

(b) Calculate the total time for which the student is walking.

（2024 冬季 0625/32 第1题(b)）

2. Fig. 1.1 shows the distance–time graph for a student's journey.

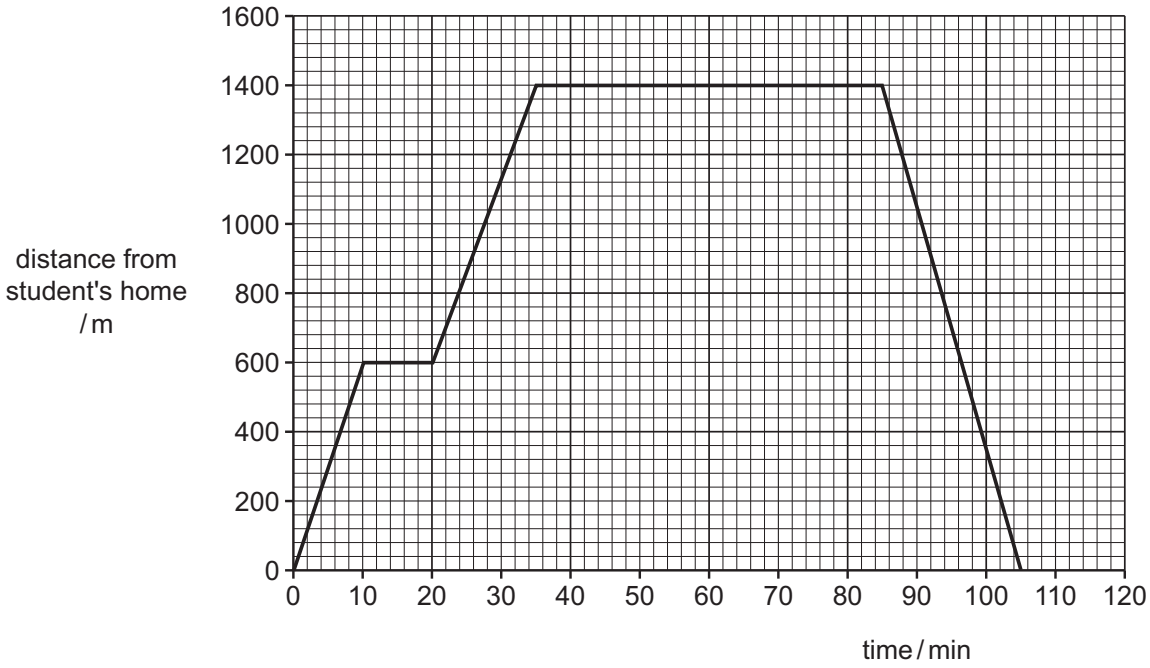


Fig. 1.1

The student walks from his home to a shop. He stops at the shop.
Then he walks to his friend's house and stops there for 50 minutes.
Then he walks back to his home without stopping.

(a) (i) Determine the distance between the student's home and his friend's house.

(ii) Calculate the distance between the shop and the friend's house.

（2024 冬季 0625/32 第1题(a)）

3. Fig. 1.1 shows the distance–time graph for an engineer's journey.
She drives from her home directly to her office and parks the car.
She then drives from her office to her friend's house and parks the car.

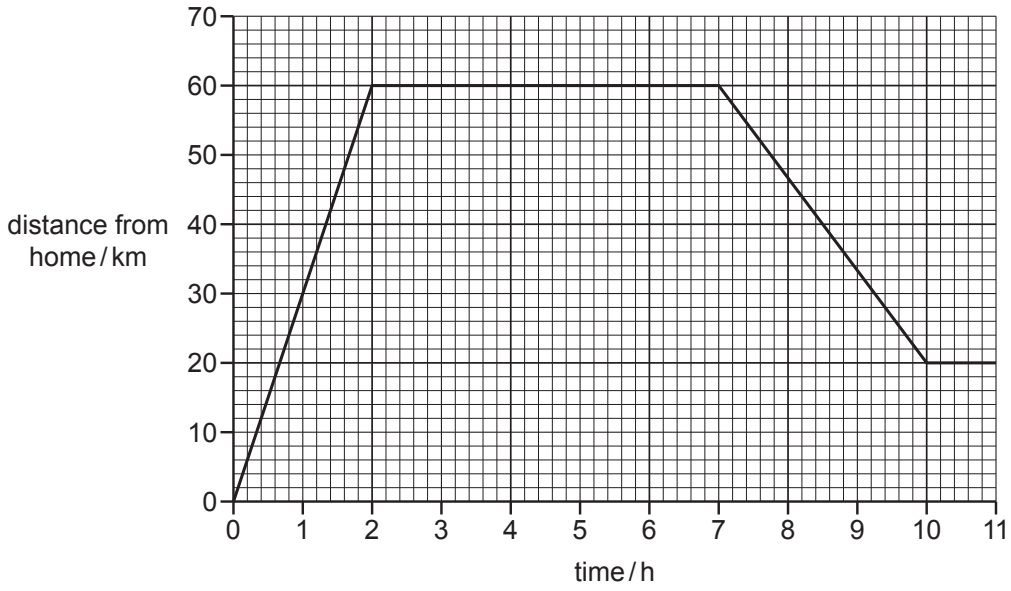


Fig. 1.1

(a) Determine the distance between:

(i) the engineer's home and her office

(ii) the engineer's office and her friend's house.

（2023 夏季 0625/33 第1题(a)）

4. Fig. 1.1 shows the distance–time graph for an engineer's journey.
She drives from her home directly to her office and parks the car.
She then drives from her office to her friend's house and parks the car.

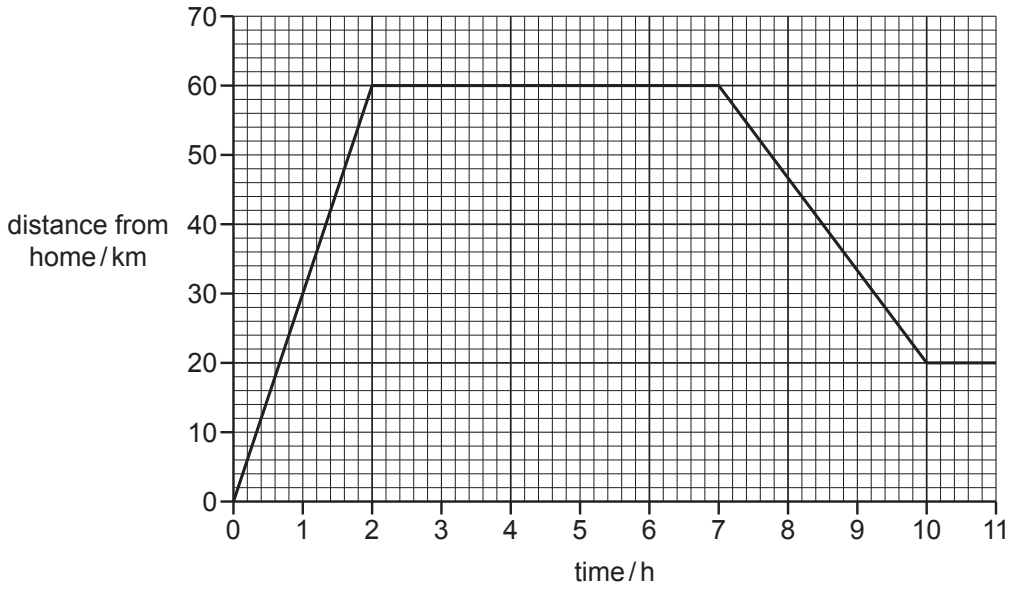


Fig. 1.1

(b) Determine the time taken to travel between:

(i) the engineer's home and her office

(ii) the engineer's office and her friend's house.

（2023 夏季 0625/33 第1题(b)）

二. 看斜率变化判运动

知识点 距离–时间图中，图线斜率的大小表示物体的_____；距离用 m、时间用 s 时，速率单位为 m/s。
图线斜率为零表示物体_____；斜率大小恒定表示物体做匀速运动。
图线斜率大小逐渐变大表示速率增大，逐渐变小表示速率减小。

答案：速率；静止

怎么认 题目出现距离–时间图并要求判断运动状态时，先比较图线斜率及其变化。

例题 2 Fig. 1.1 shows the distance–time graph for a student. The student walks out of a classroom, stops to talk to some friends, and then walks to their next class.

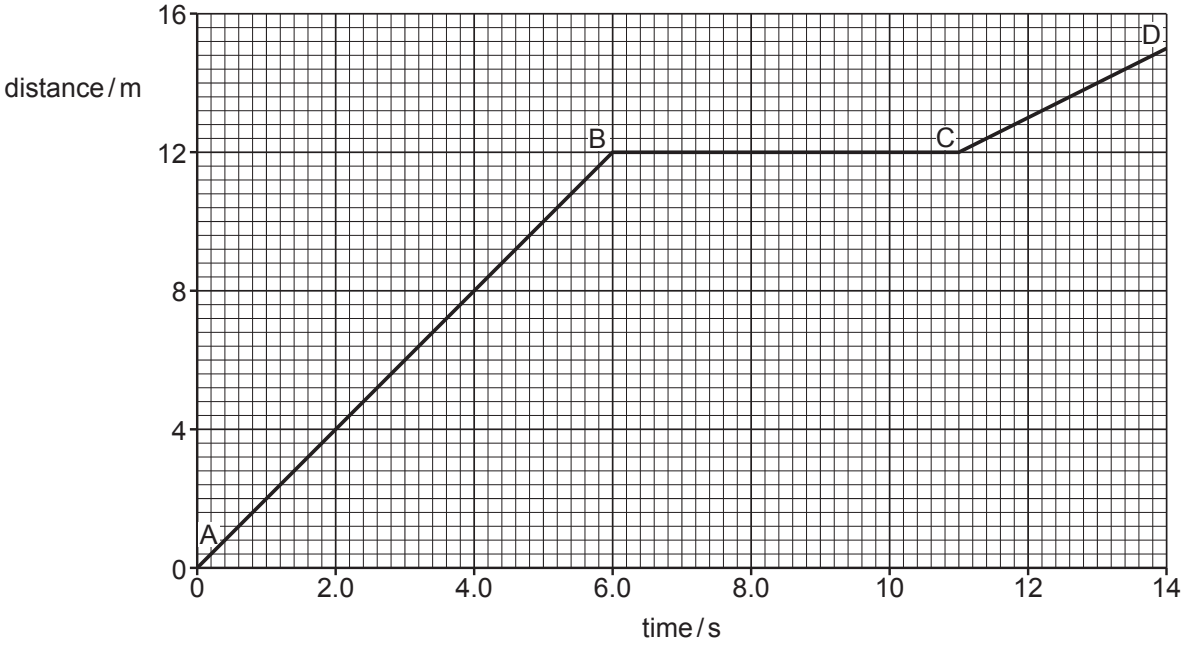


Fig. 1.1

(a) Describe the motion of the student between time = 0 and time = 6.0 s.

（2024 春季 0625/32 第1题(a)）

解： 由图得

$v = \frac{12-0}{6.0-0} = 2.0\ \mathrm{m/s}$。

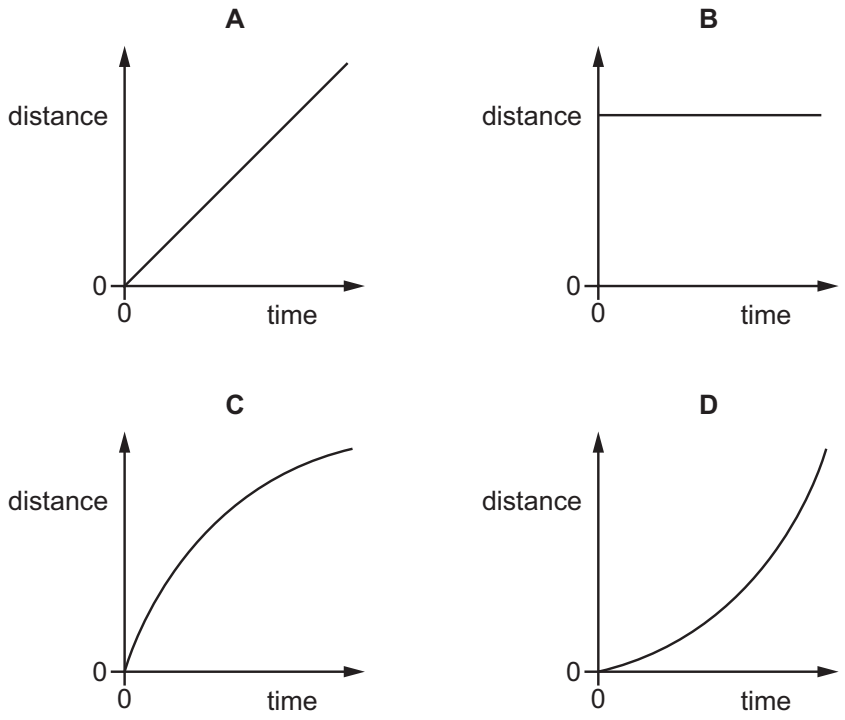
0 至 6.0 s 内图线斜率恒定，故学生做匀速运动。

答：学生以恒定速率行走。

针对练习

5. The diagrams show distance–time graphs for four objects.

Which object is moving with increasing speed?

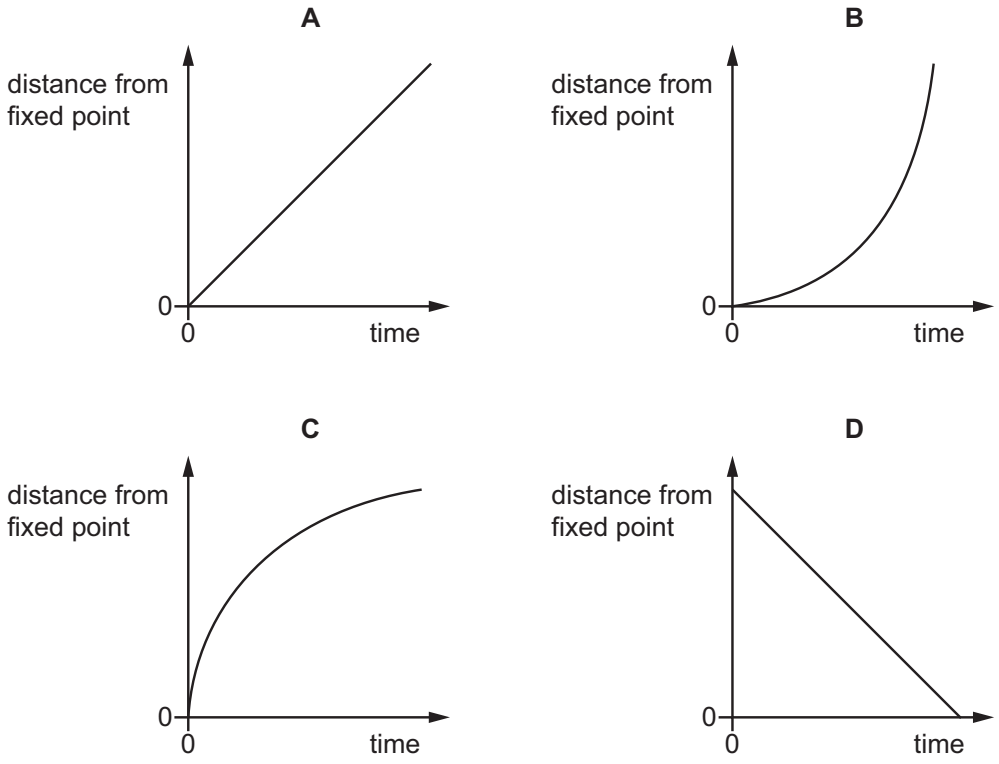


（2025 冬季 0625/11 第2题）

6. Four objects are moving along a straight line.

The distance of each object from a fixed point on the line is plotted against time.

Which object is decelerating?



（2024 夏季 0625/13 第3题）

三. 两点作差求斜率

知识点 速率是单位时间内通过的路程，$v=\frac{s}{t}$；路程用 m、时间用 s 时，速率单位为 m/s。
距离–时间图中，直线段的_____表示该段的速率；在线段上取相距较远的两点，$v=\frac{|\Delta s|}{\Delta}t$。
比较各直线段的速率时，应比较斜率的_____；横线的斜率为零，物体处于静止状态。

答案：斜率；绝对值

怎么认 题目出现距离–时间图并求某时段速率时，先读出两端点坐标，再用距离变化量的绝对值除以时间差。

例题 3 Fig. 1.1 shows the distance–time graph for a student. The student walks out of a classroom, stops to talk to some friends, and then walks to their next class.

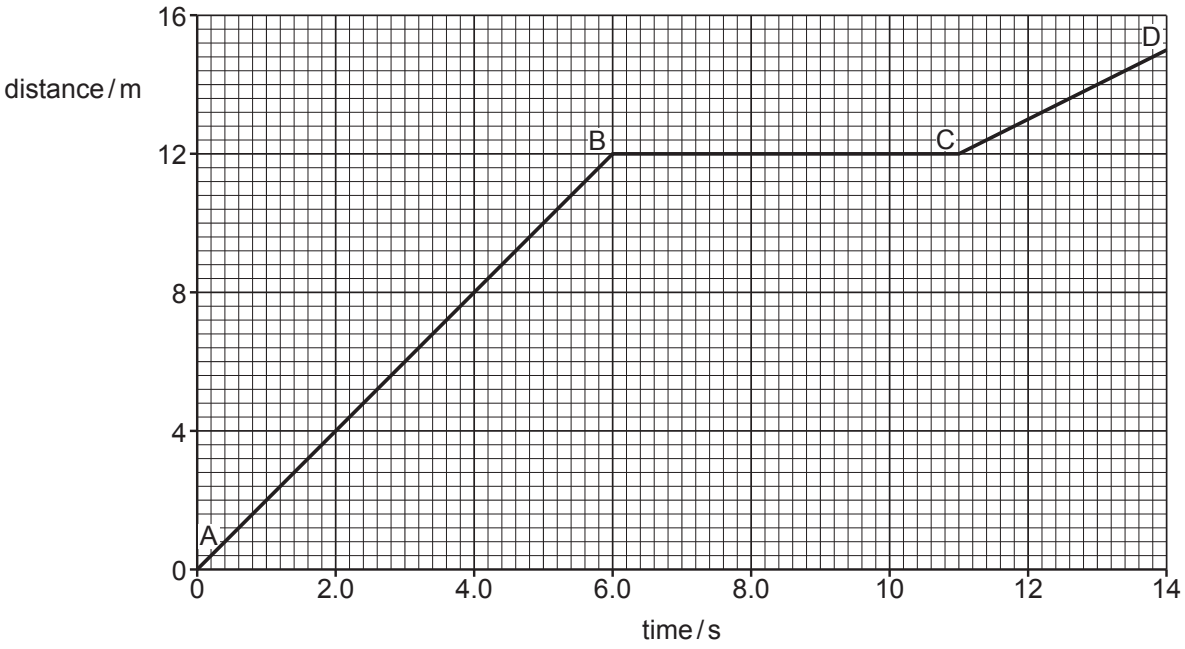


Fig. 1.1

(b) Calculate the speed of the student between time = 0 and time = 6.0 s.

（2024 春季 0625/32 第1题(b)）

解：由图得，$\Delta s=12-0=12$ m，$\Delta t=6.0-0=6.0$ s。
由距离–时间图的斜率表示速率，
$v=\Delta\frac{s}{\Delta}t=\frac{12}{6.0}=2.0$ m/s。
答：学生的速率为 2.0 m/s。

针对练习

7. Fig. 1.1 shows the distance-time graph for a cyclist travelling along a flat, straight road.

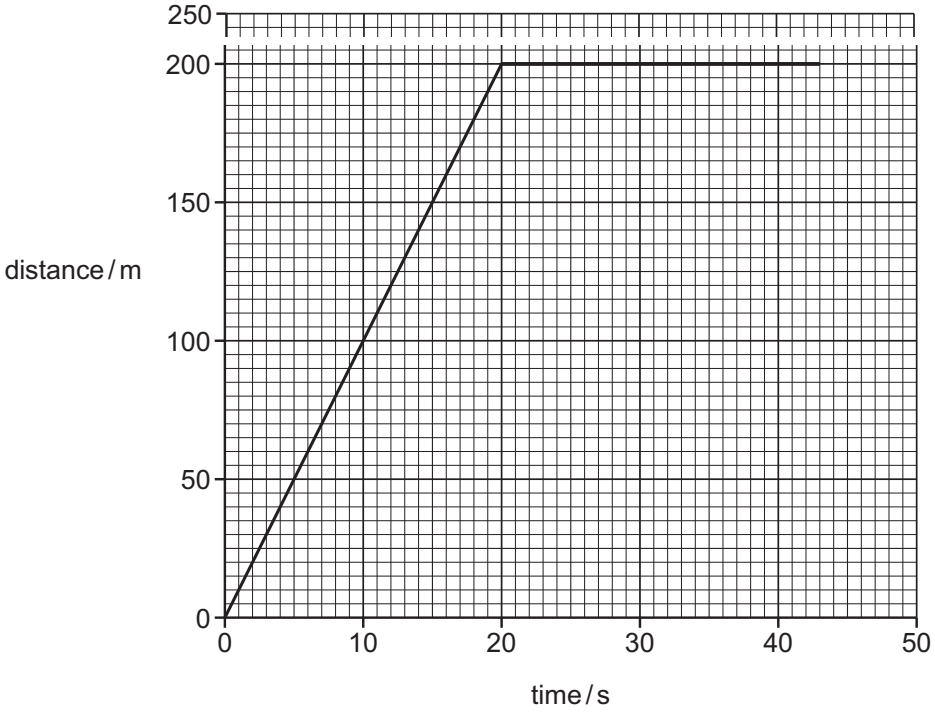


Fig. 1.1

(a) Calculate the speed of the cyclist between time = 0 and time = 10 s.

（2025 冬季 0625/31 第1题(a)）

8. Fig. 1.1 shows the distance–time graph for an engineer's journey.
She drives from her home directly to her office and parks the car.
She then drives from her office to her friend's house and parks the car.

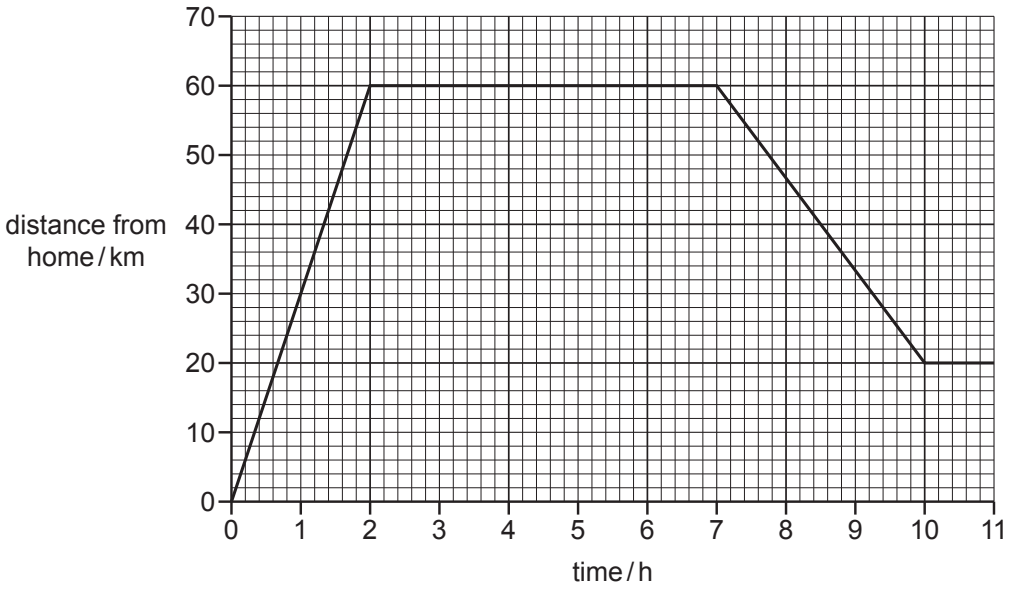


Fig. 1.1

(c) Calculate the speed of the car between time = 7 h and time = 10 h.

（2023 夏季 0625/33 第1题(c)）

9. Fig. 1.1 shows the distance–time graph for a student's journey.

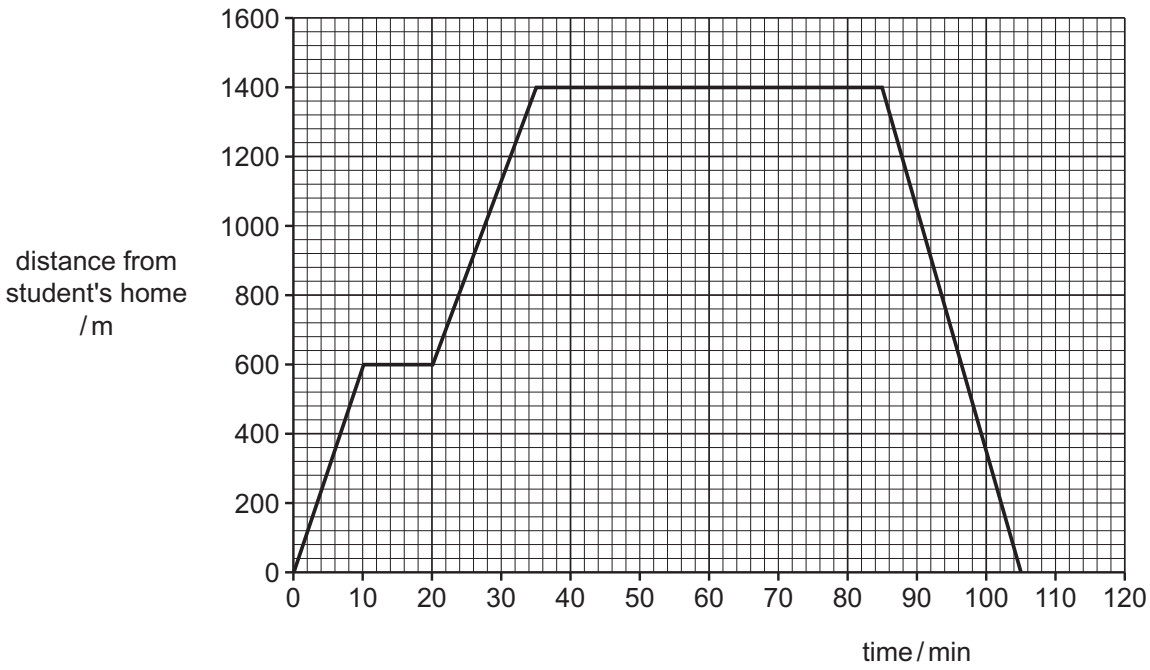


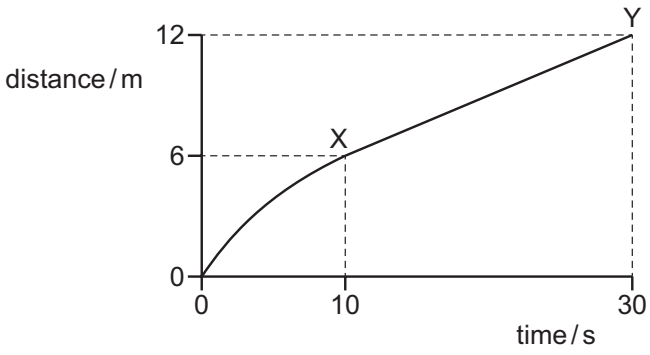
Fig. 1.1

The student walks from his home to a shop. He stops at the shop.
Then he walks to his friend's house and stops there for 50 minutes.
Then he walks back to his home without stopping.

(c) Calculate the average speed of the student when he walks back to his home.

（2024 冬季 0625/32 第1题(c)）

10. The diagram shows a distance–time graph for an object moving in a straight line.



What is the average speed between X and Y?

A 0.20 m / s **B** 0.30 m / s **C** 0.40 m / s **D** 0.60 m / s

（2023 夏季 0625/11 第3题）

题型 4：速率或速度–时间图先读纵轴（考频★★★★★）

知识点 速率–时间图的横轴表示_____，纵轴表示速率；图线上某点的纵坐标表示对应时刻的速率。
读取指定时刻的速率时，从横轴上的该时刻竖直到图线，再水平移向纵轴。
读数单位取自_____的单位标注，图中为 m/s。

答案：时间；纵轴

怎么认 题目出现速率–时间图并求指定时刻的速率时，先从该时刻竖直到图线，再水平移向纵轴。

一. 指定时刻读纵轴

例题 1 Fig. 1.1 shows the speed-time graph for a ball falling through the air.

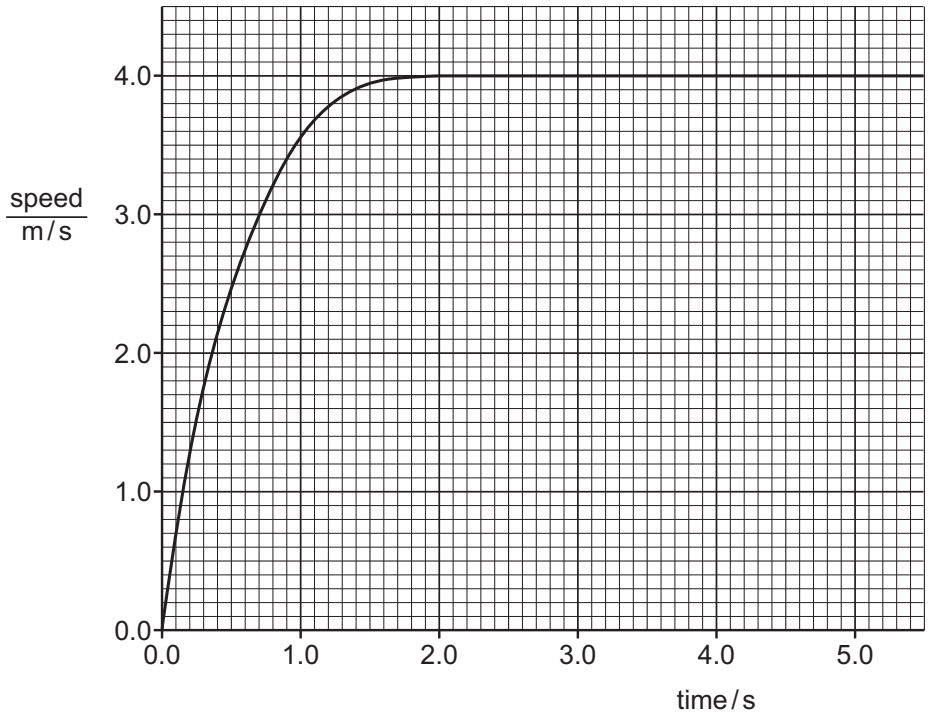


Fig. 1.1

(a) Determine the speed of the ball at time = 1.0 s.

（2025 春季 0625/32 第1题(a)）

解：在横轴上取 $t = 1.0$ s，竖直到图线，再水平移向纵轴。

$v = 3.55$ m/s

答：球的速率为 3.55 m/s。

针对练习

1. Fig. 1.1 shows the speed–time graph for a cyclist riding a bicycle.

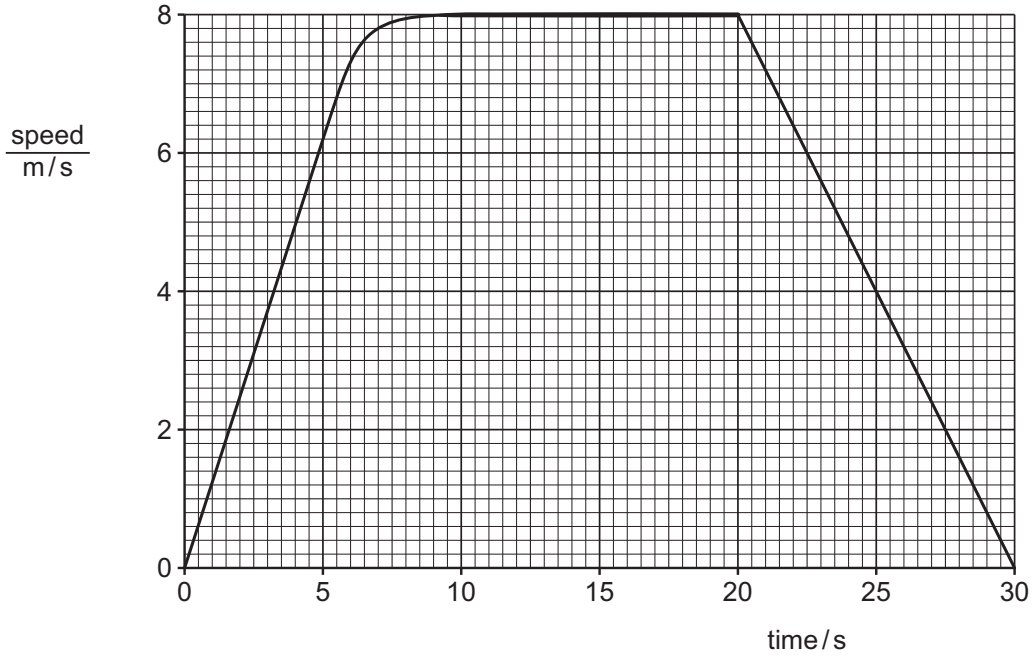


Fig. 1.1

(a) State the speed of the cyclist at time = 15 s.

（2024 冬季 0625/31 第1题(a)）

2. Fig. 1.1 shows the speed–time graph for a bus journey.

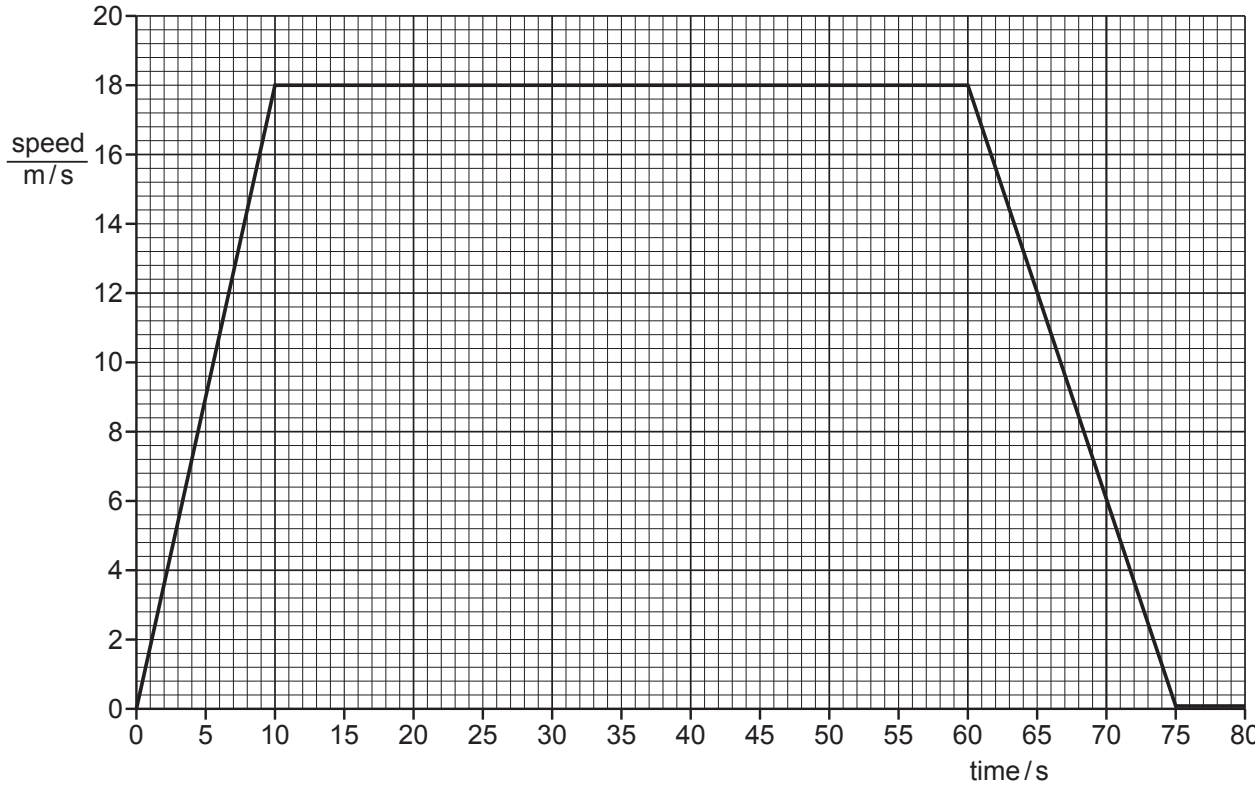


Fig. 1.1

(a) Using the information in Fig. 1.1, determine:

(i) the maximum speed of the bus during the journey

(ii) the speed of the bus at time = 65 s. On Fig. 1.1, show how you obtained this information.

（2023 冬季 0625/33 第1题(a)）

3. Fig. 1.1 shows the speed–time graph for a cyclist beginning a race. The motion of the cyclist changes at points A, B and C.

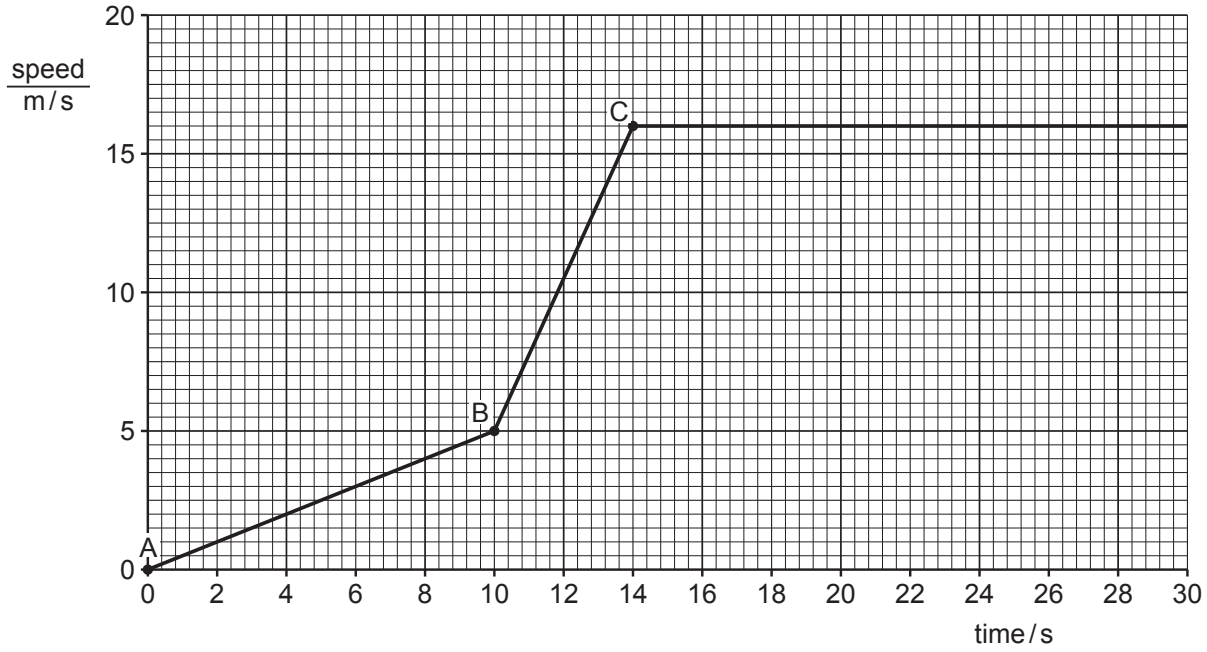


Fig. 1.1

(a) Using information from Fig. 1.1, determine:

(i) the speed of the cyclist at time = 6.0 s

(ii) the maximum speed of the cyclist.

（2023 冬季 0625/32 第1题(a)）

4. A car travels at a speed of 20 m/s. The driver applies the brakes when he sees a red traffic light.

Fig. 1.1 shows the speed–time graph for the car.

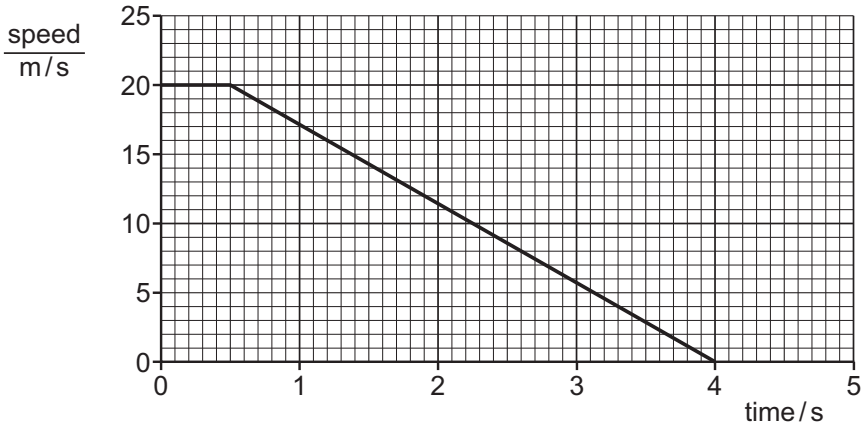


Fig. 1.1

(a) Determine the speed of the car at time = 2.0 s.

（2025 夏季 0625/43 第1题(a)）

二. 按线形分段判运动

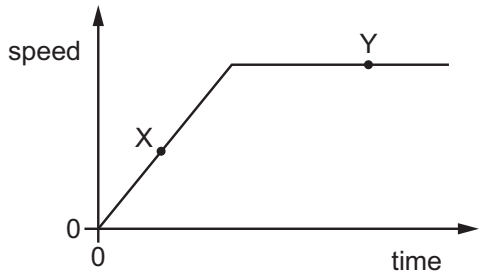
知识点 速率–时间图中，横轴表示时间，纵轴表示速率；图线上每一点的纵坐标表示相应时刻的速率。位于时间轴上方的水平线表示物体做_____；上升线段表示速率增大，物体_____；下降线段表示速率减小，物体减速。

图线落在时间轴上表示物体静止；速率常用单位为$\mathrm{m\ s^{-1}}$，时间常用单位为s。

答案：匀速运动；加速

怎么认 题目出现速率–时间图并要求描述运动时，先读纵轴，再按水平、上升、下降或贴轴判断。

例题 2 The diagram shows the speed–time graph for a car.



Which row describes the motion of the car at point X and at point Y?

	point X	point Y
A	at rest	moving with constant speed
B	moving with constant speed	at rest
C	moving with changing speed	at rest
D	moving with changing speed	moving with constant speed

（2023 春季 0625/12 第2题）

解：X点位于上升线段，纵坐标随时间增大，故汽车的速率在改变。

Y点位于时间轴上方的水平线，纵坐标不变，故汽车以恒定速率运动。

故选 D。

5. Fig. 1.1 is a speed–time graph for an ice skater.

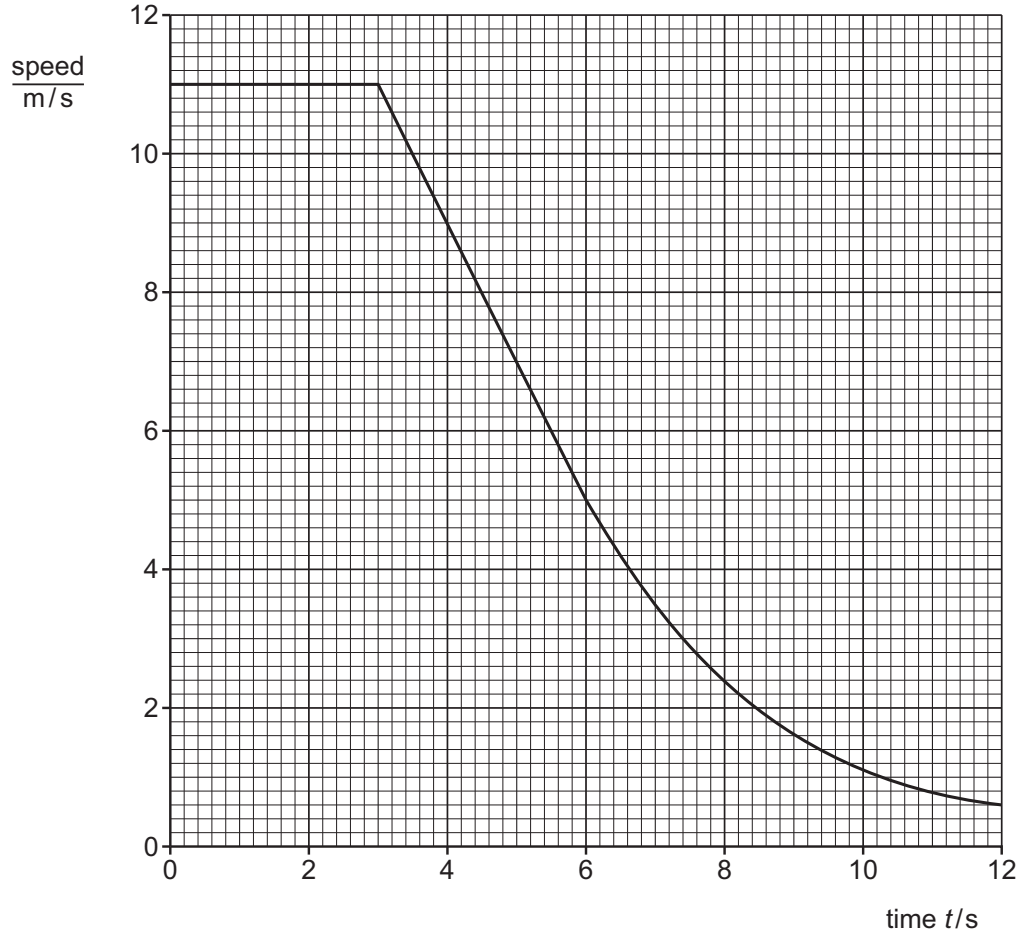


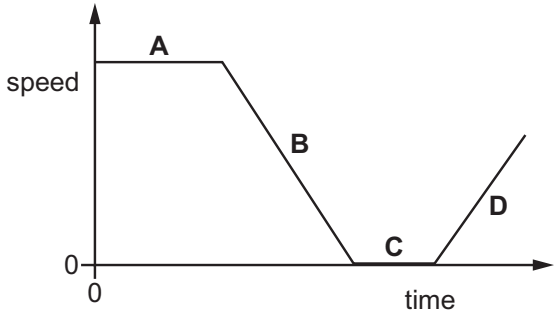
Fig. 1.1

(a) Describe the motion of the skater between $t = 0$ and $t = 3.0$ s.

（2025 夏季 0625/42 第1题(a)）

6. The graph shows the journey of a motorcyclist.

Which section of the graph shows the time when the motorcyclist is stationary at some traffic lights?



（2025 春季 0625/22 第3题）

7. Fig. 1.1 shows the speed–time graph for a cyclist riding a bicycle.

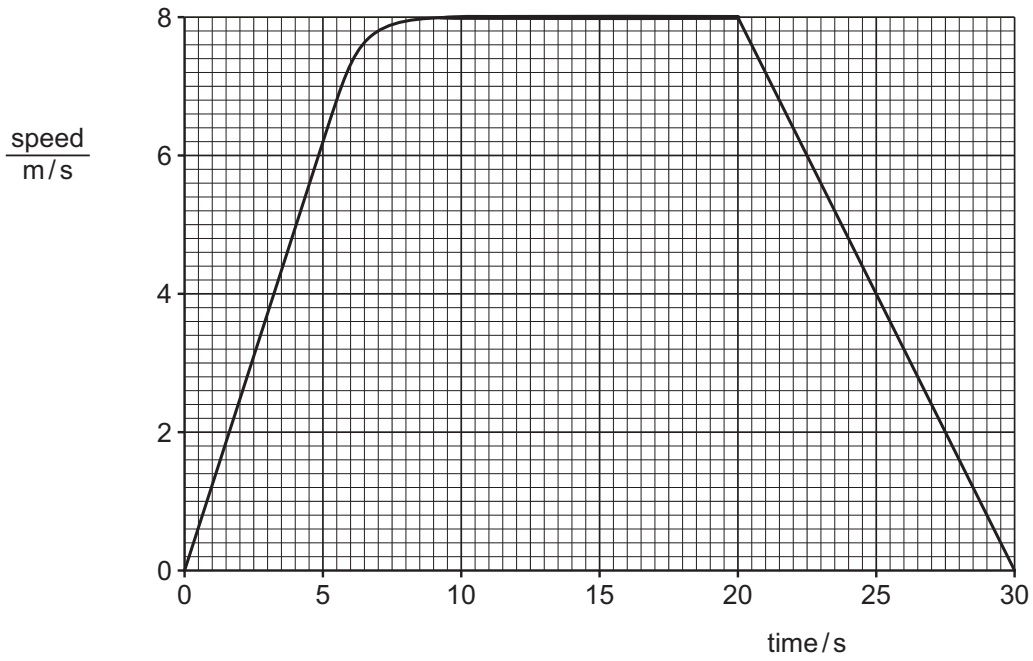
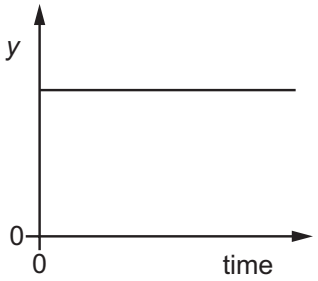


Fig. 1.1

(b) Describe the motion of the cyclist

（2024 冬季 0625/31 第1题(b)）

8. A train is on a straight track. The graph shows how a quantity *y* varies with time.



Which statements can be true?

1 The train is stationary and *y* represents the distance from the last station.

2 The train is moving and *y* represents the distance from the last station.

3 The train is stationary and *y* represents the speed of the train.

4 The train is moving and *y* represents the speed of the train.

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

（2023 冬季 0625/23 第2题）

三. 看斜率正负和变化

知识点 速率–时间图的纵轴表示速率，图线的_____表示加速度：$a=\frac{v_2-v_1}{t_2-t_1}$，单位是 $\mathrm{m/s^2}$。

斜率为正时速率增大；斜率为_____时速率减小；斜率为零时速率不变。

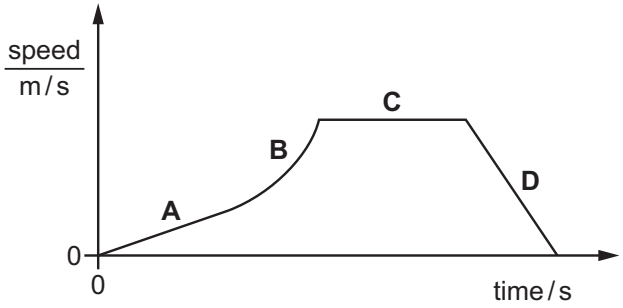
直线的斜率恒定，加速度恒定；曲线的斜率_____，加速度不恒定。

答案：加速度；负；随时间改变

怎么认 题目出现速率–时间图并问加速、减速或加速度是否恒定时，先看图线斜率的正负和是否变化。

例题 3 The graph shows the speed of a car travelling through a town.

Which section of the graph represents a period when the car is decelerating?



（2023 冬季 0625/11 第2题）

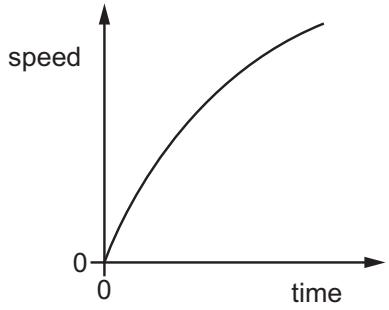
解：D 段中，时间增加而速率减小，故 $\Delta v < 0$，$\Delta t > 0$。

$a = \frac{\Delta v}{\Delta t} < 0$

图线斜率为负，汽车正在减速。故选 D。

针对练习

9. The diagram shows a speed–time graph for a moving object.



Which description of the object's motion is correct?

A decreasing acceleration

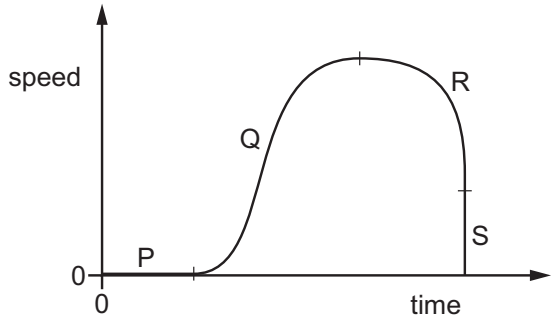
B decreasing speed

C constant acceleration

D constant speed

（2023 冬季 0625/23 第3题）

10. The speed–time graph for a racing car is divided into four sections, P, Q, R and S. The car starts the race but soon crashes into a wall of tyres.



Which sections of the graph show that there is an acceleration that is changing?

A P, Q, R and S

B Q, R and S only

C Q and R only

D R and S only

（2025 夏季 0625/21 第1题）

11. A drag car is a racing car that is powered by a rocket engine.

A drag car accelerates uniformly from rest until it reaches the finishing line. The engine is then switched off and a parachute opens. The car decelerates until it stops.

Fig. 2.1 shows a drag car decelerating after a race.

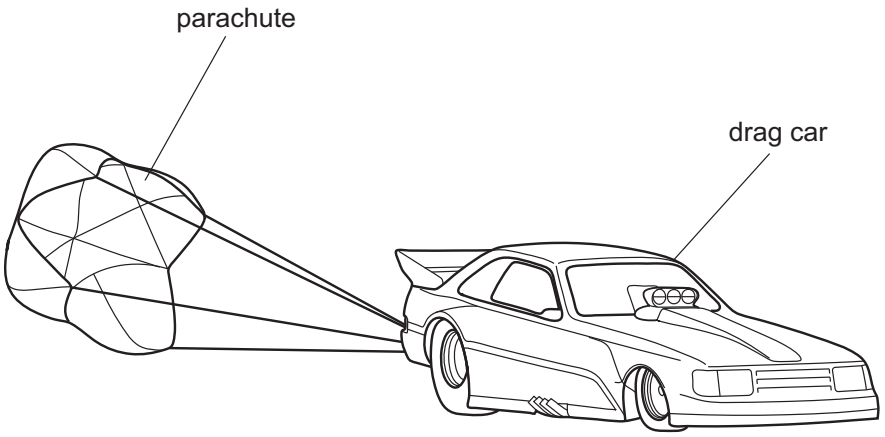


Fig. 2.1

This drag car has a mass of 1400 kg.

Fig. 2.2 is the speed–time graph for the car during a race on a straight horizontal track.

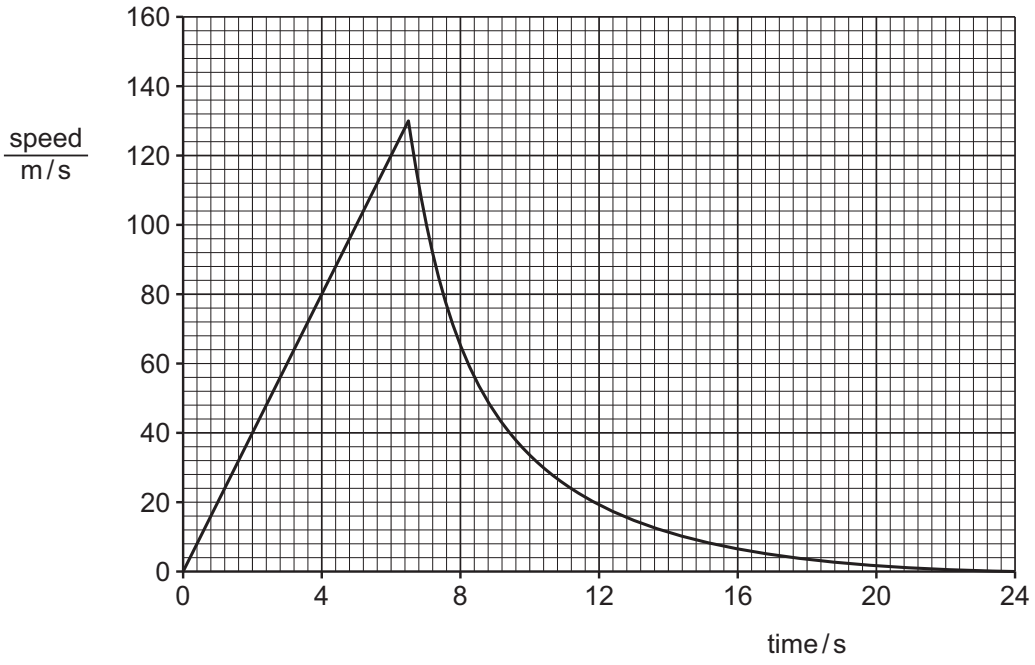


Fig. 2.2

The car reaches its maximum speed of 130 m / s at a time of 6.5 s.

(b) The parachute opens at 6.5 s and the car decelerates.

Describe how Fig. 2.2 shows that, after 6.5 s:

(i) the car decelerates

(ii) the deceleration of the car is **not** constant.

（2024 冬季 0625/41 第2题(b)）

12. **(b)** Fig. 1.2 shows a vertical speed–time graph for a parachutist who jumps from a stationary hot-air balloon.

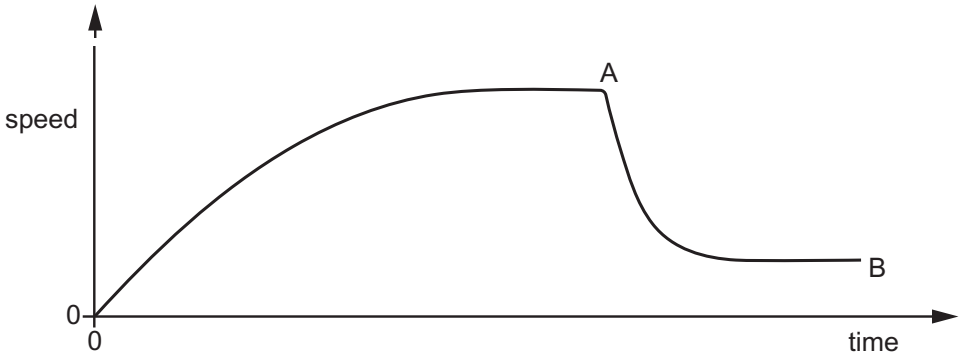


Fig. 1.2

The parachutist jumps from the balloon at time = 0 and reaches the ground at B. The point A indicates when the parachute opens.

(i) On Fig. 1.2, label a point on the graph where the acceleration is:
- zero with '1'
- negative with '2'
- decreasing with '3'.

(ii) Explain, in terms of forces, the changes in motion which occur from when the parachutist leaves the hot-air balloon until point A.

（2023 夏季 0625/42 第1题(b)）

四. 两点作差求加速度

知识点 加速度等于单位时间内速度的变化量，$a=\Delta\frac{v}{\Delta}t$；物体沿固定方向作直线运动时，也可由速率变化量计算。

在速率–时间图或速度–时间图的直线段上，取两点 (t_1,v_1)、(t_2,v_2)，斜率 $\frac{v_2-v_1}{t_2-t_1}$ 为加速度；水平线段的加速度为 _____。

在同一坐标尺度下，图线越陡，加速度的大小越 _____；减速段可用速率减少量除以时间求减速度大小，单位为 _____。

答案：0；大；$\mathrm{m/s^2}$

怎么认 题目出现速率–时间图或速度–时间图，并求加速度、减速度或比较大小时，先读纵轴，再在所求直线段取两点作差。

例题 4 Fig. 1.1 shows the speed–time graph for a car travelling along a flat straight road.

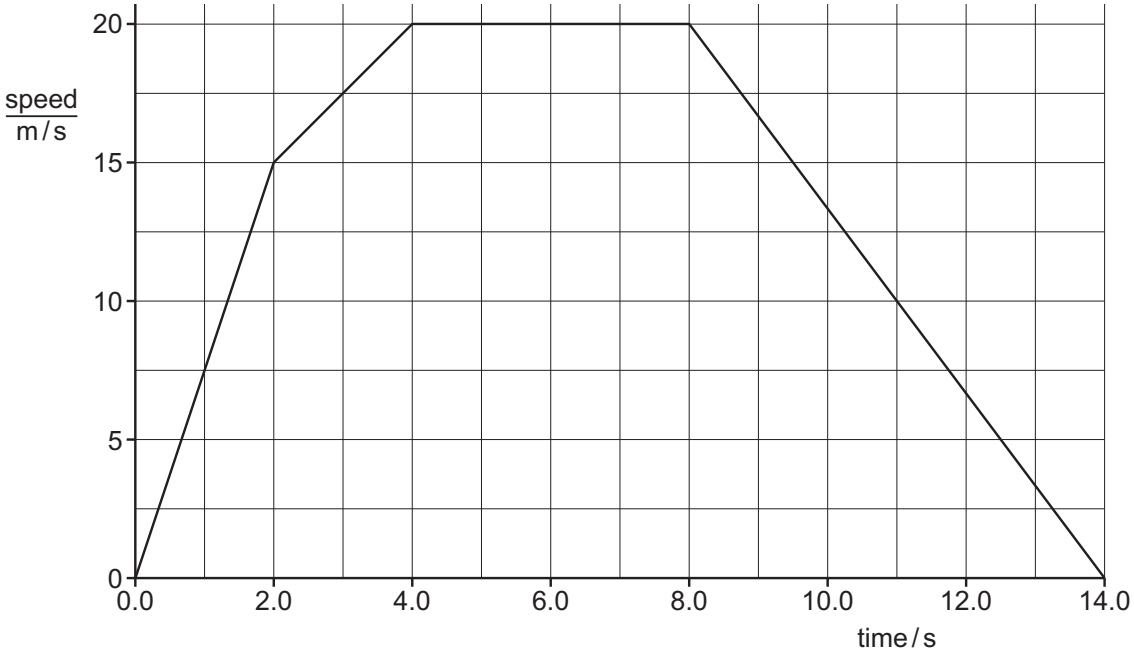


Fig. 1.1

(b) State the value of the acceleration of the car between time = 4.0 s and time = 8.0 s.

（2024 夏季 0625/32 第1题(b)）

解： 由速率–时间图的斜率得

$a = \frac{20-20}{8.0-4.0}$

$= 0\text{m/s}^2$。

答：加速度为 0m/s^2。

针对练习

13. How is the deceleration of an object calculated from a speed–time graph?

A It is the area under the graph.

B It is the gradient of the graph.

C It is the difference between two readings on the horizontal (*x*) axis.

D It is the difference between two readings on the vertical (*y*) axis.

（2025 冬季 0625/22 第2题）

14. Fig. 1.1 shows the speed–time graph for a cyclist beginning a race. The motion of the cyclist changes at points A, B and C.

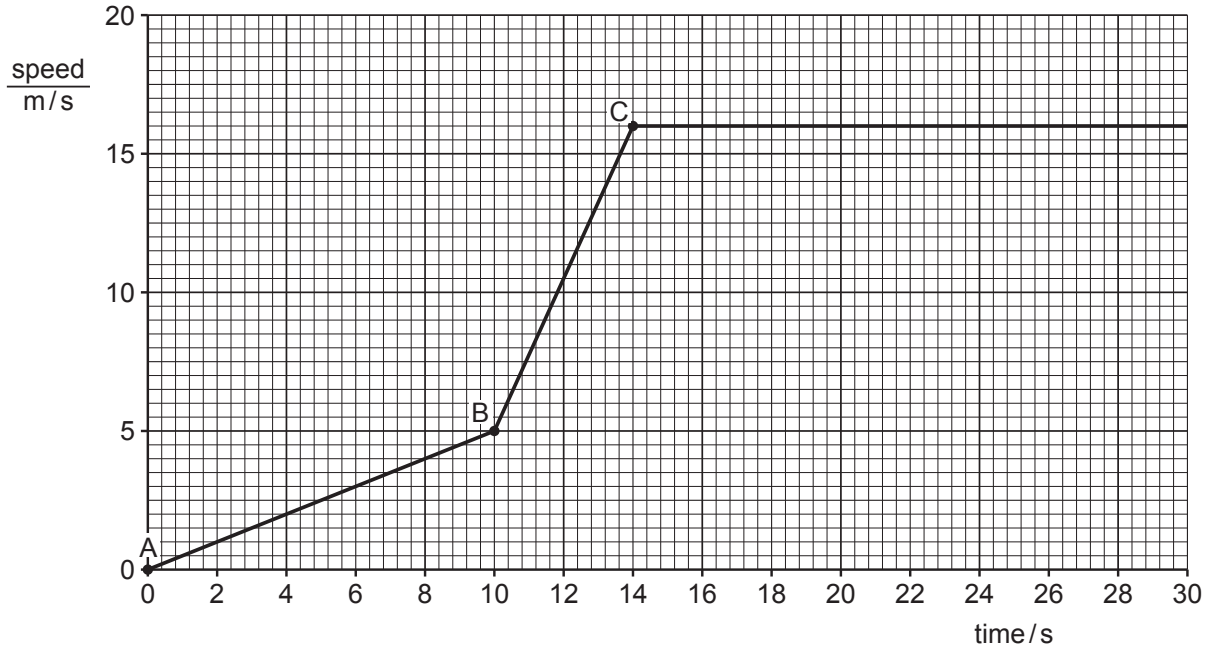


Fig. 1.1

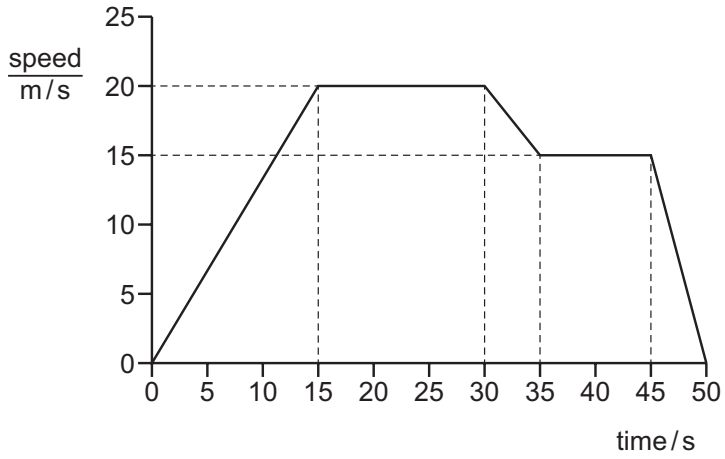
(b) (i) Describe the motion of the cyclist between point A and point B.

(ii) Describe how the motion of the cyclist between points B and C differs from the motion between points A and B.

Give a reason for your answer.

（2023 冬季 0625/32 第1题(b)）

15. The graph shows how the speed of a car changes during a period of 50 s.



Which row gives the car's greatest acceleration and the car's greatest deceleration?

	greatest acceleration m/s^2	greatest deceleration m/s^2
A	0.75	1.0
B	0.75	3.0
C	1.3	1.0
D	1.3	3.0

（2024 夏季 0625/23 第4题）

五. 曲线处先作切线

知识点 减速度是速度随时间的减小率，数值等于负加速度的大小。

速率–时间曲线在某时刻的斜率，由该点_____的斜率求得。

运动方向不变时，图线向下倾斜表示负加速度，减速度取斜率的_____。

在切线上取相距较远的两点，$a = \frac{v_2 - v_1}{t_2 - t_1}$，单位为_____。

答案：切线；绝对值；$m\ s^{-2}$

怎么认 题目出现速率–时间曲线并求指定时刻的加速度时，先读纵轴，再在该点作切线。

例题 5 Fig. 1.1 is a speed–time graph for an ice skater.

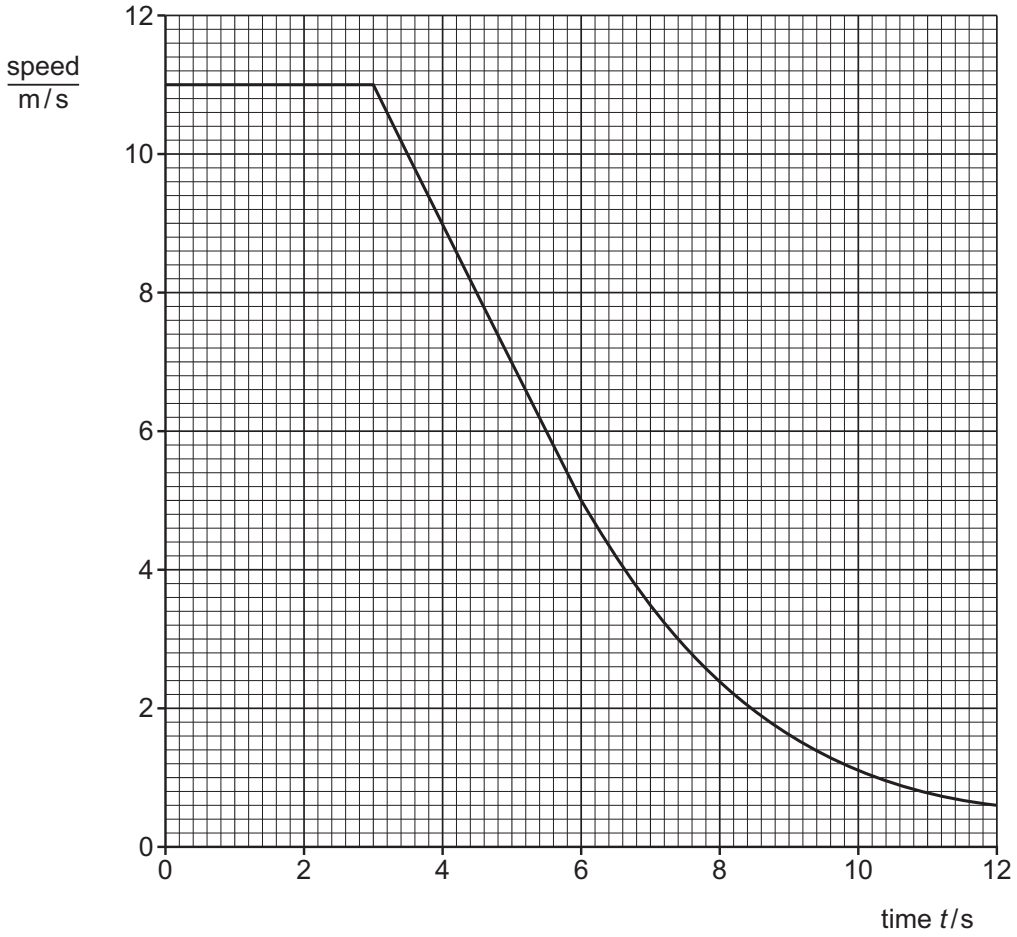


Fig. 1.1

(c) (i) State what is meant by deceleration.

(ii) Draw a tangent to the graph at t = 9.0 s.

Use the tangent to calculate the deceleration of the skater at t = 9.0 s.

（2025 夏季 0625/42 第1题(c)）

解：(i) 减速度是速度随时间的减小率，属于负加速度。

(ii) 在 $t = 9.0$ s 处作曲线的切线，取切线上的 $(8.0\ \text{s}, 2.4\ \text{m/s})$ 与 $(10.0\ \text{s}, 1.2\ \text{m/s})$ 两点。

$a = \frac{1.2-2.4}{10.0-8.0} = -0.60\text{m s}^{-2}$

故减速度为 0.60m s^{-2}。

答：(i) 速度随时间的减小率；(ii) 0.60m s^{-2}。

16. **(b)** Fig. 1.1 shows part of the speed-time graph for the rocket as it leaves the ground and travels into space.

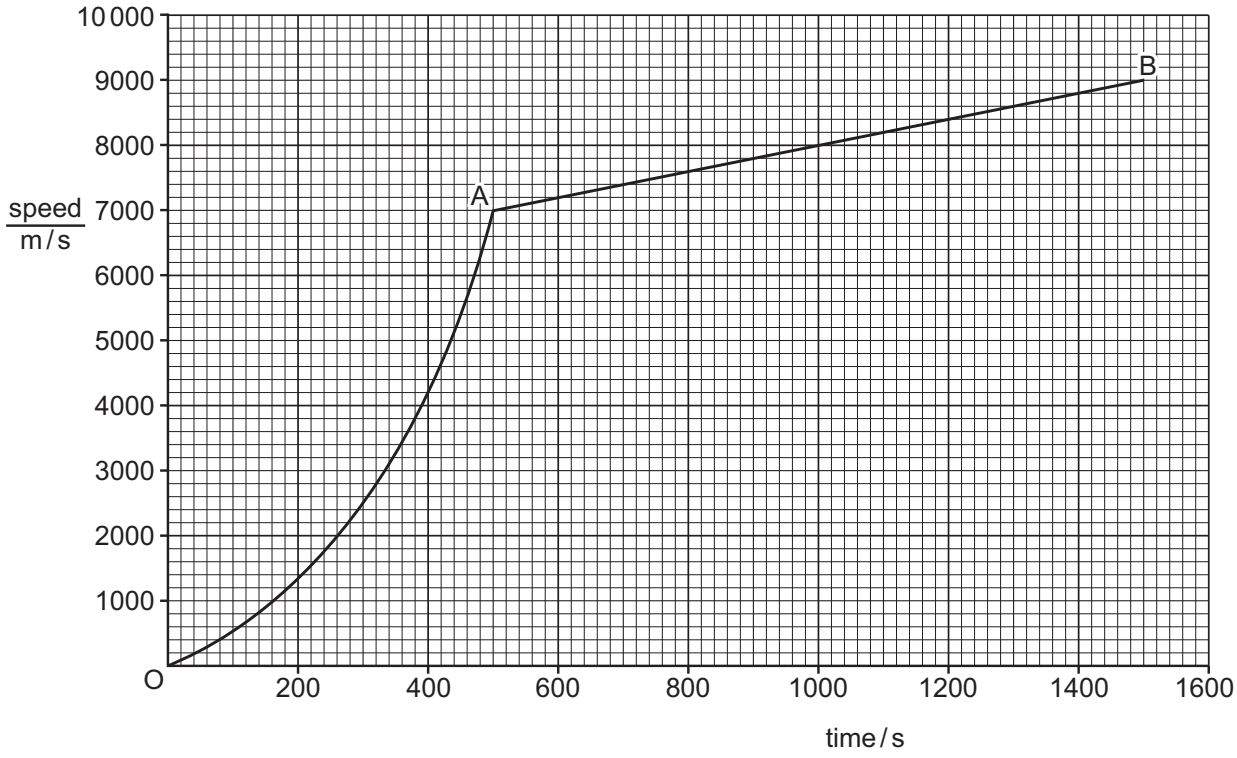


Fig. 1.1

(i) Describe the motion of the rocket:

(ii) Draw a tangent to the graph at time = 400 s and use this to calculate the acceleration of the rocket at this time. Show your working.

（2024 冬季 0625/42 第1题(b)）

17. A long tube contains oil. A small ball is held at rest at the surface of the oil. At time $t = 0$, the ball is released and begins to fall vertically through the oil.

Fig. 1.1 shows the ball falling through the oil.

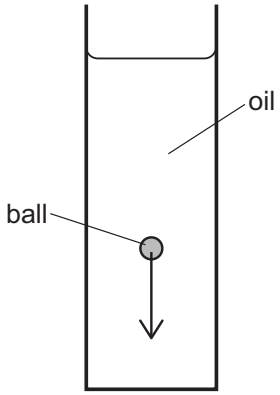


Fig. 1.1

As the ball begins to fall through the oil, it accelerates.

(c) As the ball falls, its speed v is recorded. Fig. 1.2 is the speed–time graph for the falling ball.

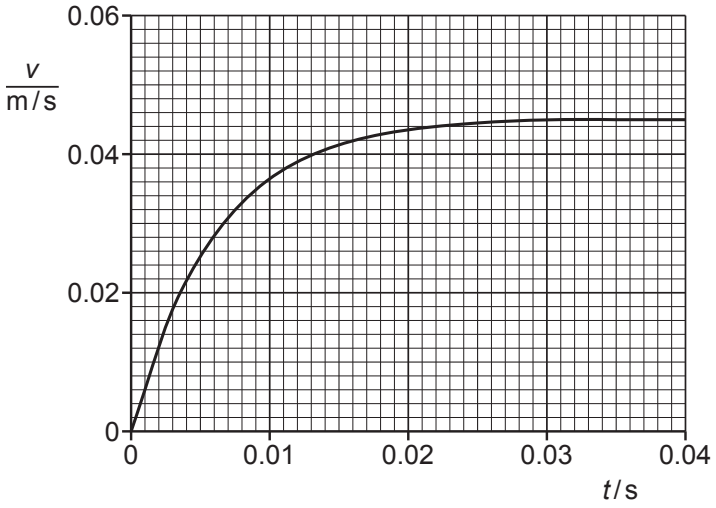


Fig. 1.2

(i) Describe what happens to the acceleration between $t = 0$ and $t = 0.040$ s.

Explain why this happens.

(ii) By drawing a tangent on Fig. 1.2, determine a value for the acceleration of the ball at $t = 0.010$ s.

（2024 夏季 0625/41 第1题(c)）

六. 按数据标点连图

知识点 速率–时间图的横轴表示时间，纵轴表示速率；点 (t, v) 表示时刻 t 的速率为 v。

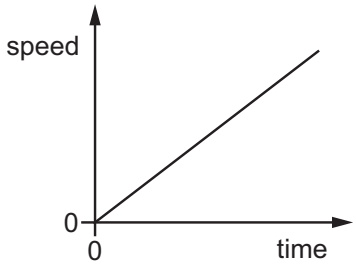
作图时先标出各_____及对应的纵轴值；匀加速或匀减速段用_____连接，匀速段画水平线。

时间单位为 s、速率单位为 m/s 时，图下方面积的单位为 m，表示相应时间内通过的路程。

答案：给定时刻；直线

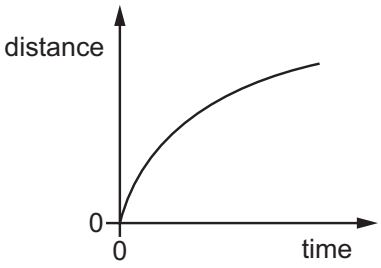
怎么认 题目出现各时刻的速率数据并要求补画速率–时间图时，先标出各时刻对应的坐标点。

例题 6 The speed–time graph represents a short journey.

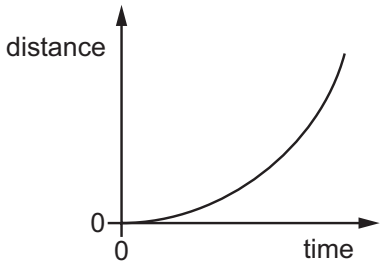


Which distance–time graph represents the same journey?

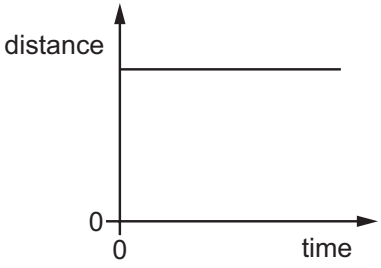
A



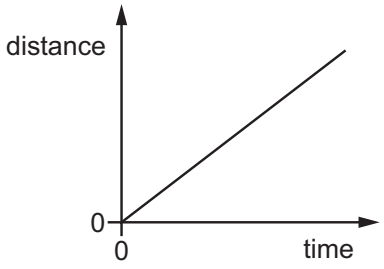
B



C



D



（2023 夏季 0625/12 第2题）

解： 距离–时间图的斜率表示速率。

由速率–时间图可知，速率从零开始均匀增大，故距离–时间图的斜率从零开始不断增大，图线向上弯曲。

故选 B。

18. Fig. 1.1 shows the speed–time graph for a bus journey.

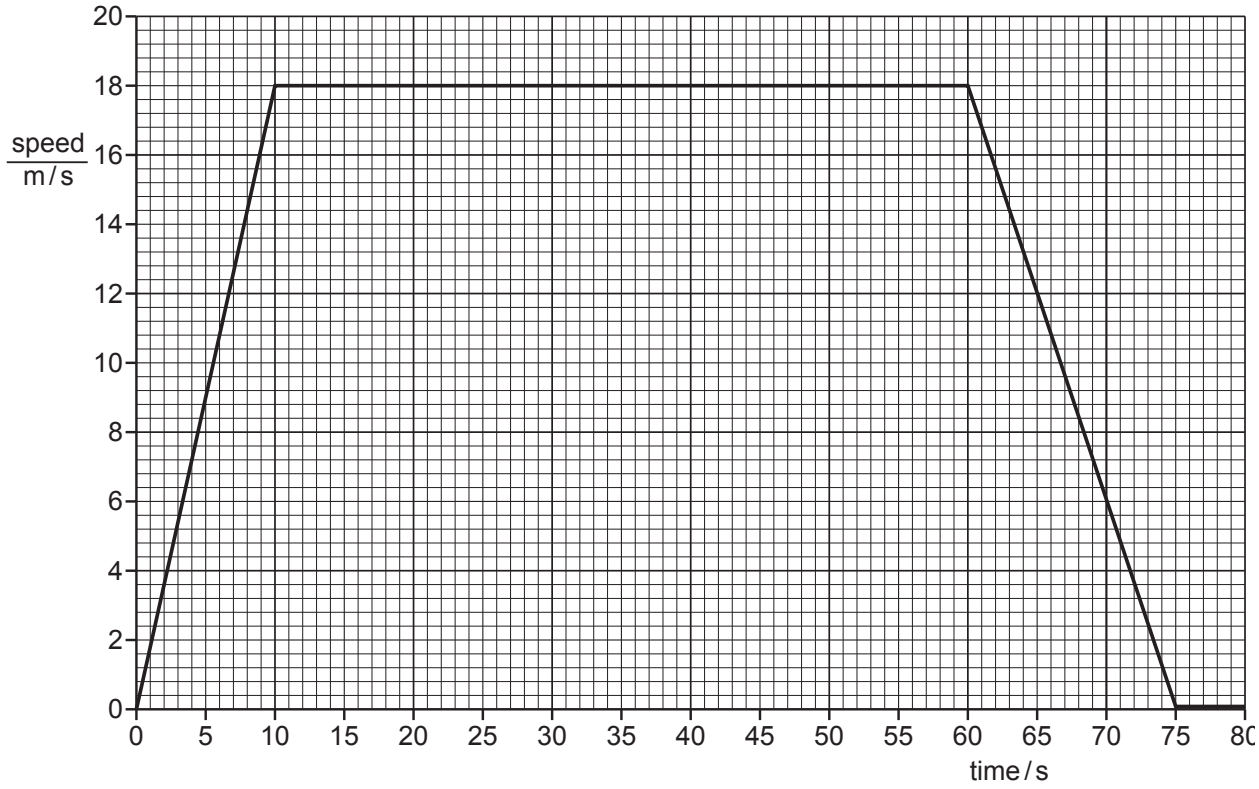


Fig. 1.1

(d) Fig. 1.2 shows the speed–time graph for another bus journey.

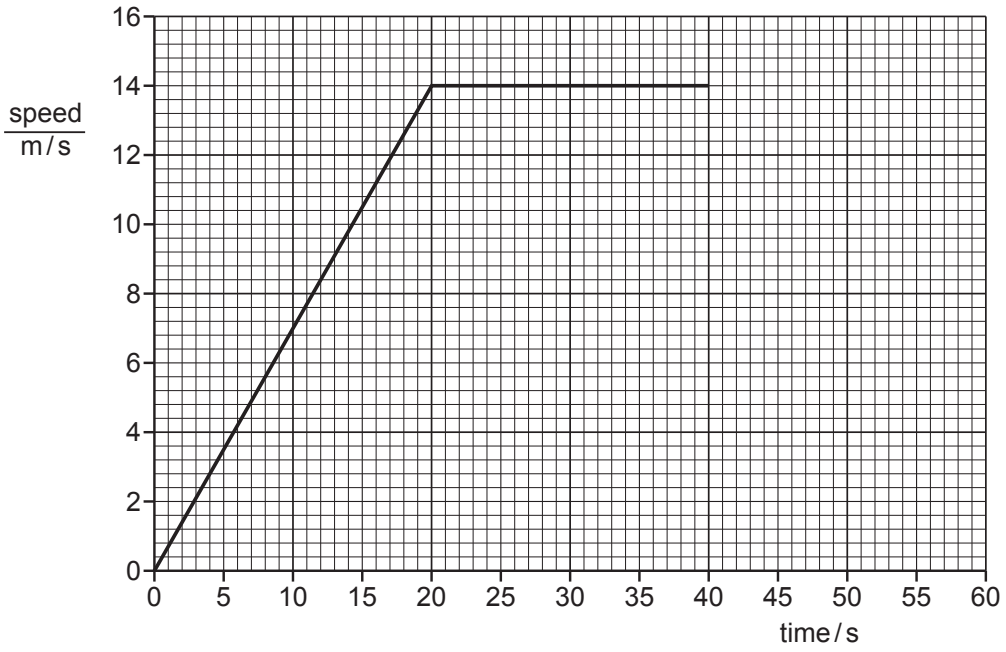


Fig. 1.2

The driver sees a hazard ahead and applies the brakes at time = 40 s.

The bus reduces its speed from 14.0 m / s to 6.0 m / s in a time of 5.0 s.

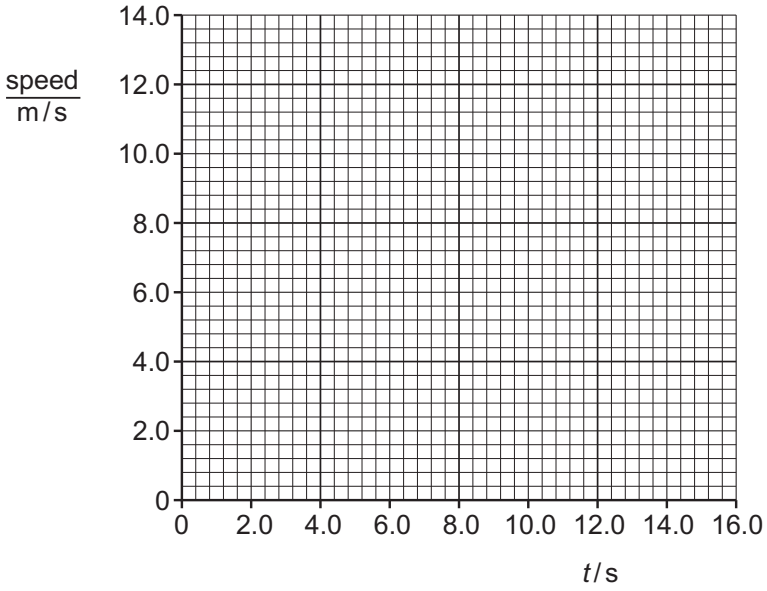
On Fig. 1.2, draw the speed–time graph for the bus as it reduces its speed.

（2023 冬季 0625/33 第1题(d)）

19. A car accelerates uniformly in a straight line from rest at time $t = 0$. At $t = 3.2\,s$, the speed of the car is $13.0\,m/s$.

(b) The car travels at $13.0\,m/s$ from $t = 3.2\,s$ to $t = 12.0\,s$.

(i) Plot the speed–time graph for the car from $t = 0$ to $t = 12.0\,s$.



(ii) Determine the distance travelled by the car between $t = 0$ and $t = 3.2\,s$.

（2023 冬季 0625/42 第1题(b)）

题型 5：图下方面积先定路程或位移（考频★★★★☆）

知识点 速率–时间图中，图线与时间轴之间的面积等于物体在相应时间内经过的_____；纵轴单位为 m/s、横轴单位为 s 时，面积单位为 m。

速度–时间图中，时间轴上方的面积取_____，下方的面积取负，带符号面积之和等于_____。

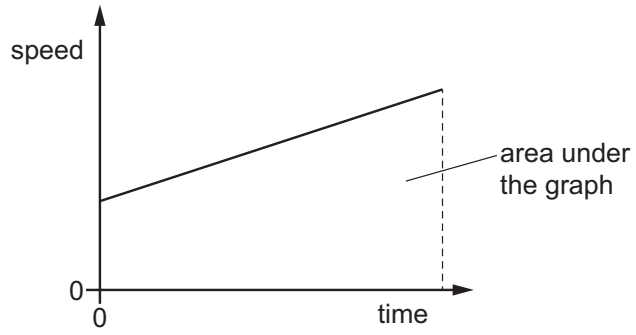
由速度–时间图求路程时，将时间轴上、下两侧面积的绝对值相加。

答案：路程；正；位移

怎么认 题目出现速率–时间图或速度–时间图并求图下面积时，先辨纵轴，再按路程或带符号位移处理。

一. 先认面积代表什么

例题 1 The motion of an object is represented by the speed–time graph shown.



Which quantity is equal to the area under the graph?

A acceleration

B average speed

C distance travelled

D kinetic energy

（2024 夏季 0625/22 第2题）

解： 由速率定义 $v = \frac{s}{t}$ 得

$s = vt$

速率–时间图下的面积表示各段路程之和，故该面积等于物体经过的路程。故选 C。

针对练习

1. Which quantity can be determined from the area under a speed–time graph?

A acceleration

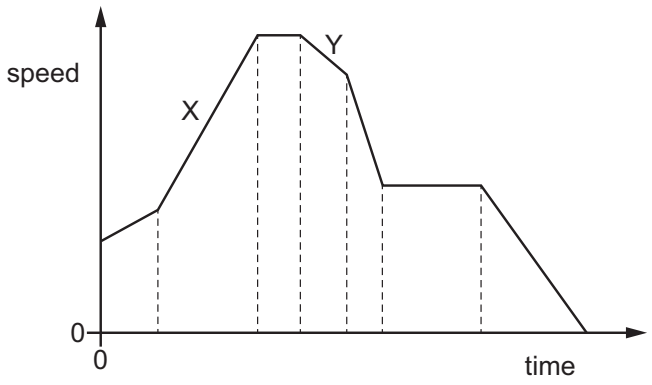
B distance

C speed

D velocity

（2025 夏季 0625/23 第3题）

2. The speed–time graph represents a journey.



How does the graph show that the distance travelled in section X of the journey is greater than the distance travelled in section Y?

A The area under section X of the graph is greater than the area under section Y.

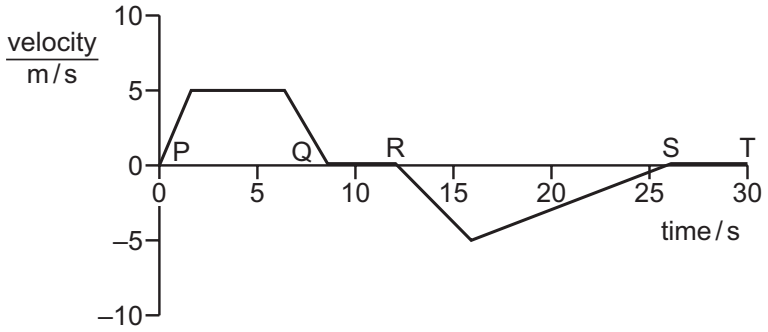
B The gradient of section X of the graph is greater than the gradient of section Y.

C The speed at the end of section X of the journey is greater than the speed at the end of section Y.

D The time for section X of the journey is greater than the time for section Y.

（2024 冬季 0625/12 第3题）

3. The graph shows how the velocity of an elevator varies with time. The elevator starts from the third floor of a tall building. Point P indicates the start of the elevator's journey.



When is the elevator on the third floor again?

A Q to R and S to T

B Q to R only

C S to T only

D The lift does not return to the third floor.

（2024 冬季 0625/23 第2题）

二. 单一矩形三角形求面积

知识点 在速率–时间图中，图线与时间轴围成的面积表示相应时间内通过的_____；在速度–时间图中，有向面积表示_____。

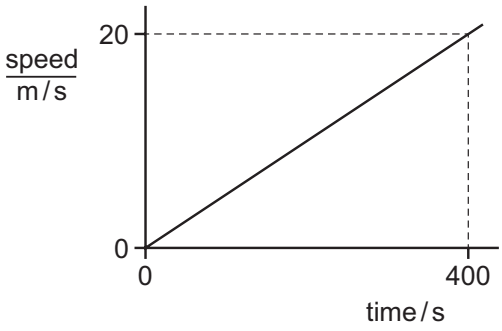
计算前应确定所求的_____，再按矩形、三角形或梯形计算图下区域的面积。

横轴单位为秒、纵轴单位为米每秒时，面积单位为米。

答案：路程；位移；时间区间

怎么认 题目出现速率–时间图并求某段时间内的路程时，先锁定时间区间，再求图下区域面积。

例题 2 The graph represents the motion of a vehicle.



What is the distance travelled by the vehicle in 400 s?

A 20 m **B** 400 m **C** 4000 m **D** 8000 m

（2023 夏季 0625/11 第2题）

解：由速率–时间图下方面积表示路程，图下区域为三角形。

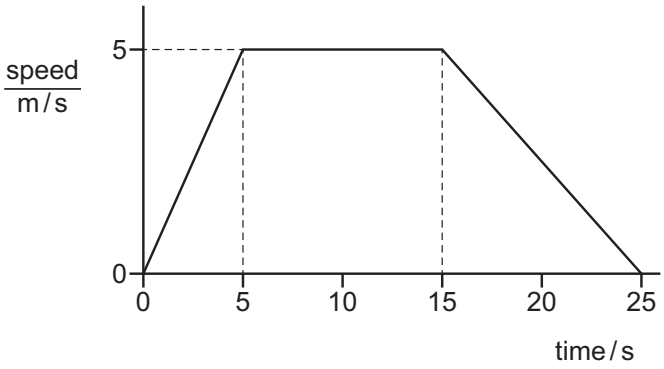
$d = \frac{1}{2} \times 400\ \text{s} \times 20\ \text{m/s}$

$d = 4000\ \text{m}$

故选 C。

针对练习

4. The speed–time graph shows the motion of an object.



How far does the object travel at constant speed?

A 25 m **B** 50 m **C** 75 m **D** 125 m

（2023 夏季 0625/13 第2题）

5. Fig. 1.1 shows the speed–time graph for a car travelling along a flat, straight road.
The graph has four sections, labelled JK, KL, LM and MN.

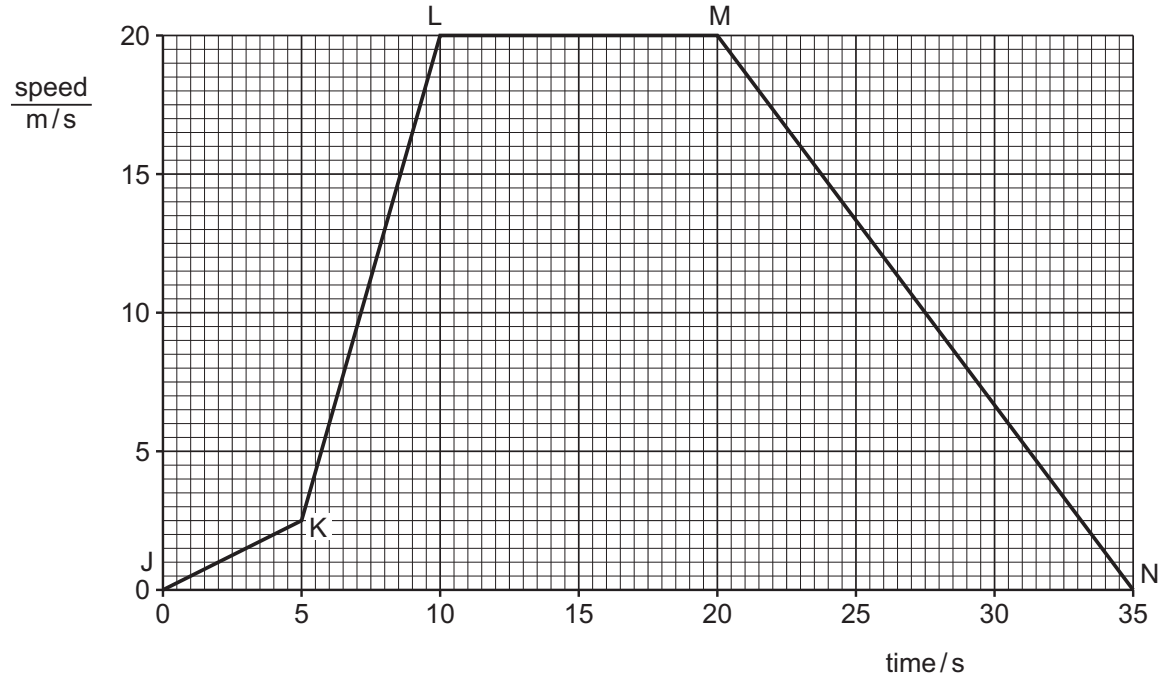
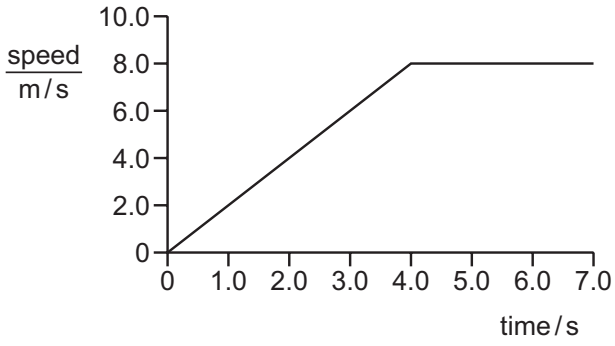


Fig. 1.1

(b) Calculate the distance travelled by the car between time = 20 s and time = 35 s.

（2025 夏季 0625/31 第1题(b)）

6. The graph shows the motion of a sprinter.



She accelerates steadily from rest to 8.0 m/s in 4.0 s.

How far does she travel in the last three seconds of her acceleration?

A 9.0 m **B** 15 m **C** 16 m **D** 24 m

（2023 冬季 0625/12 第3题）

三. 按折点分块再相加

知识点 在速率–时间图中，图线与时间轴围成的面积等于物体通过的_____；在速度–时间图中，该面积按正负计算，等于物体的_____。

图线有折点时，在各折点处分段，把复合区域拆成矩形、三角形或梯形；求路程时各块面积相加，求位移时按时间轴上方为正、下方为负相加。

横轴单位为 s、纵轴单位为 m/s 时，面积单位为_____。

答案：路程；位移；m

怎么认 题目出现分段速率–时间图或速度–时间图并求路程或位移时，先在折点处分段求各块面积。

例题 3 Fig. 1.1 shows the speed-time graph for a ball falling through the air.

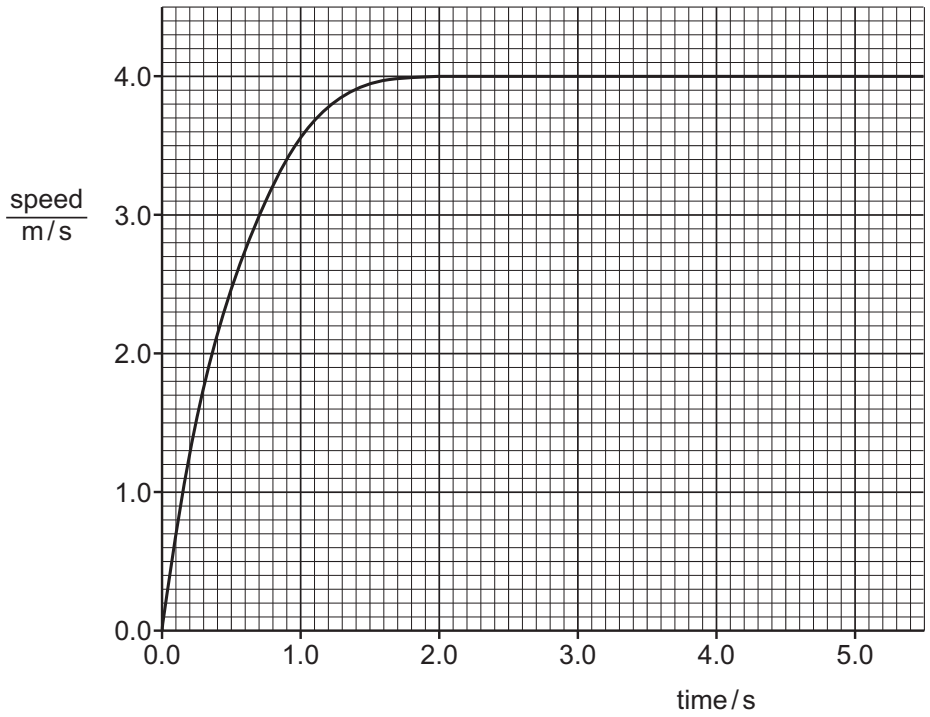


Fig. 1.1

(c) Calculate the distance moved by the ball between time = 2.0 s and time = 5.0 s.

（2025 春季 0625/32 第1题(c)）

解：由速率–时间图下的面积表示路程，$t = 2.0$ s 后球的速率为 4.0 m/s，

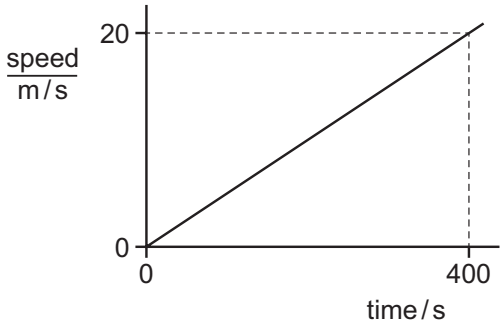
$s = 4.0 \times (5.0 - 2.0)$

$= 12$ m。

答：球通过的路程为 12 m。

针对练习

7. The graph represents the motion of a vehicle.

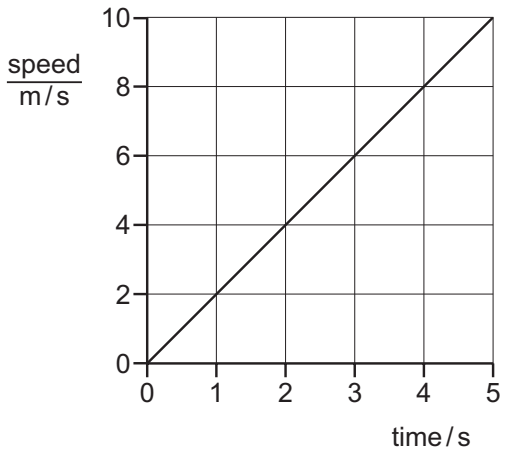


What is the distance travelled by the vehicle in 400 s?

A 20 m **B** 400 m **C** 4000 m **D** 8000 m

（2023 夏季 0625/21 第3题）

8. The graph represents the motion of a car.



How far has the car moved between 0 and 5 s?

A 2 m **B** 10 m **C** 25 m **D** 50 m

（2023 夏季 0625/12 第3题）

9. **(a)** Fig. 1.1 shows the speed–time graph for a cyclist at the beginning of a race.

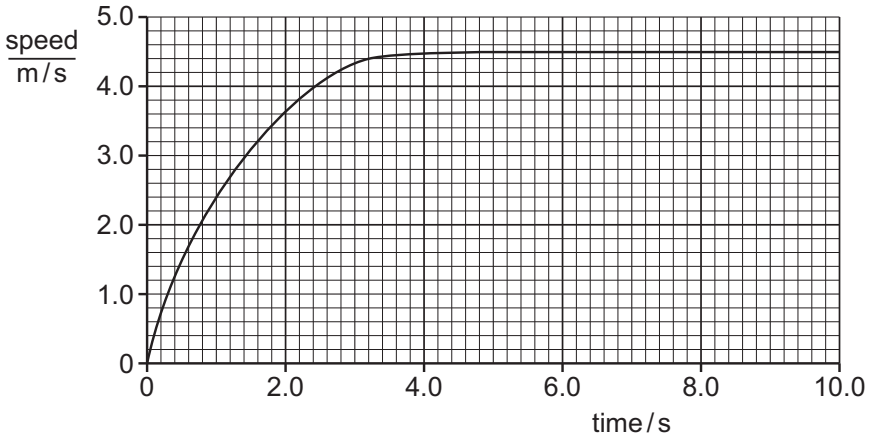


Fig. 1.1

(i) Describe the motion of the cyclist from time = 6.0 s to time = 10.0 s.

(ii) Determine the distance moved by the cyclist from time = 6.0 s to time = 10.0 s.

（2024 冬季 0625/33 第1题(a)）

10. Fig. 1.1 shows the speed–time graph for a car.

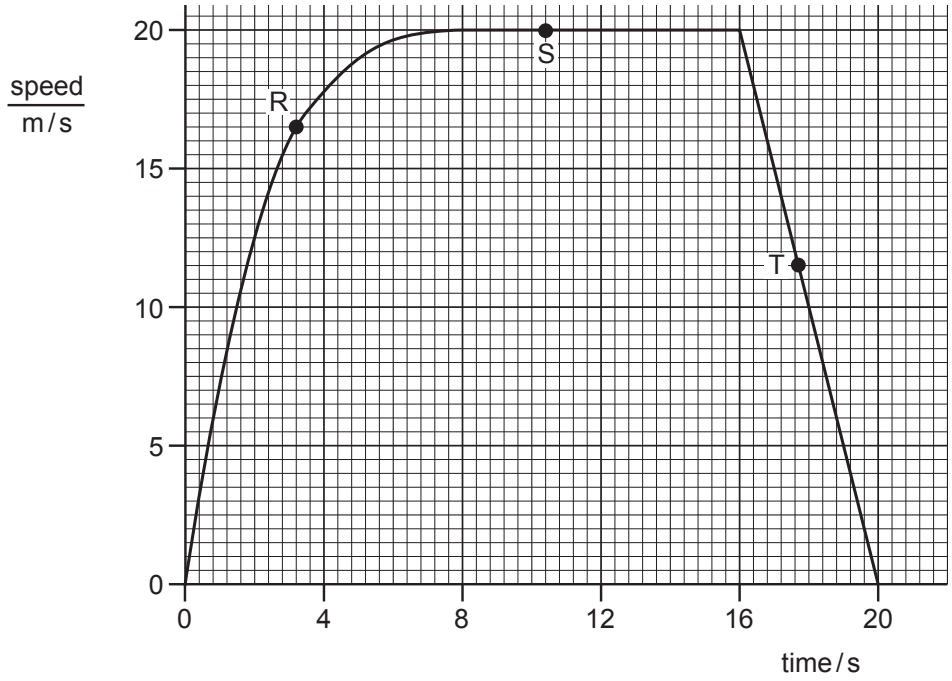


Fig. 1.1

(a) (i) For the graph in Fig. 1.1, match each letter, R, S and T, with the motion at that point.

Draw **one** line from each letter to the correct description. One has been done for you.

letter on the graph	**description of motion**
R	at rest
S	moving with constant speed
T	decelerating (negative acceleration)
	accelerating (positive acceleration)

(ii) Determine the speed of the car at time = 4.0 s.

(iii) Determine the distance moved by the car from time = 16.0 s to time = 20.0 s.

（2024 夏季 0625/31 第1题(a)）

1.3 质量与重量

题型 1：先分清质量和重量（考频★★★☆☆）

知识点 质量表示相对观察者静止的物体所含物质的量，符号为 m，单位是_____。

重量是重力场作用于有质量物体的力，符号为 W，单位是_____，可用测力计测量。

重力场强度满足 $g = \frac{W}{m}$，单位为 N/kg；在同一重力场中，天平可比较物体的_____和重量。

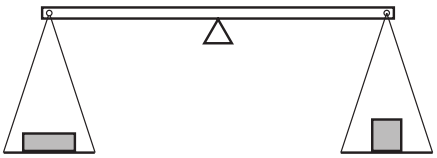
答案：kg；N；质量

怎么认 题目出现天平、测力计或质量与重量的表述时，先分清物质的量与重力。

一. 按定义单位和仪器辨认

例题 1

Two objects are placed on a balance, one on each side, as shown.



Which properties of the objects can be compared using the balance?

A weight, mass and volume

B weight and mass only

C volume and density

D density only

（2023 春季 0625/12 第4题）

解： 天平两端的物体处在同一重力场中，天平可比较两物体的重量。
由 $W = mg$，两侧的 g 相同，比较重量也能比较质量。
天平不能比较体积，也不能由此比较密度。
故选 B。

针对练习

1. Which statement about weight is correct?

A It is a measure of the quantity of matter in an object.

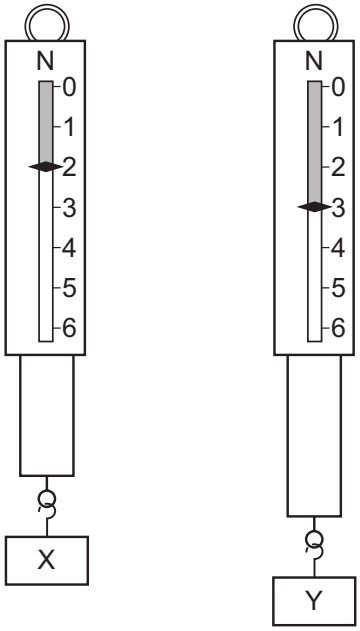
B It is the gravitational force on an object that has mass.

C It is equivalent to the acceleration of free fall.

D It is the gravitational force per unit mass.

（2024 冬季 0625/13 第4题）

2. The diagrams show two metal blocks, X and Y, suspended from identical force meters. X and Y have identical dimensions.



Which statement about X and Y is correct?

A They have different volumes and different weights.

B They have different volumes and equal weights.

C They have equal volumes and equal weights.

D They have equal volumes and different weights.

（2025 夏季 0625/21 第3题）

3. Students are asked for a statement about the weight of an object.

Three of the statements are listed.

1 The weight is the quantity of matter in the object.

2 The weight is the effect of a gravitational field on the object.

3 The weight is the force of attraction between the object and the Earth.

Which statements describe the weight of the object?

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

（2025 夏季 0625/23 第4题）

4. Two rectangular blocks consist of different materials.

Four different methods are suggested to compare the two masses.

1 Compare the accelerations with which they fall freely.

2 Compare the values of their lengths × breadths × heights.

3 Hang each in turn from the same spring. Compare the extensions.

4 Place one in the right-hand pan of a beam balance and the other in the left-hand pan.

Which methods give a comparison of the two masses?

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

（2023 夏季 0625/13 第4题）

二. 换地点时质量不变

知识点 质量表示相对观察者静止的物体所含物质的多少，单位为 kg；物体换到不同重力场时，质量_____。

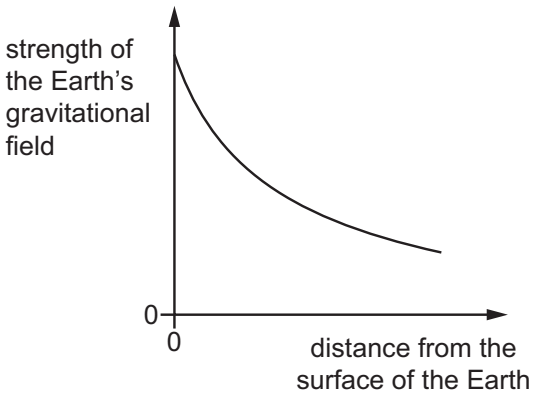
重量是重力场对有质量物体产生的重力，单位为 N；重力场强是单位质量受到的重力，$g = \frac{W}{m}$，单位为 N/kg。

同一物体在不同地点满足 $W = mg$；由于 m 不变，重量随 g 改变，g 越小，重量越_____。

答案：不变；小

怎么认 题目出现物体换地点或重力场强改变，并问质量、重量变化时，先判质量不变，再由 $W = mg$ 判重量。

例题 2 The graph shows how the strength of the Earth's gravitational field varies as the distance from the Earth's surface increases.



Which row describes the effect that this has on the mass and on the weight of an object as it moves further away from the Earth's surface?

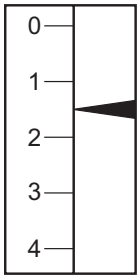
	mass of object	weight of object
A	decreases	decreases
B	decreases	unchanged
C	unchanged	decreases
D	unchanged	unchanged

（2025 春季 0625/22 第39题）

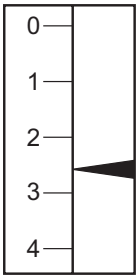
解：物体远离地球表面时，图像表明重力场强 g 减小。
物体所含物质的多少不变，故质量 m 不变。
由 $W = mg$ 得，m 不变而 g 减小，重量 W 减小。
故选 C。

针对练习

5. An object is suspended from a spring balance on the Earth. The same object is suspended from the same spring balance on another planet.



reading on Earth



reading on other planet

Which statement explains the difference between the two readings?

A Both the mass and the weight of the object are greater on the other planet.

B The mass of the object is greater on the other planet than on the Earth, but the weight is unchanged.

C The spring stretches more easily when on the other planet.

D The weight of the object is greater on the other planet than on the Earth, but the mass is unchanged.

（2023 冬季 0625/11 第4题）

6. An object is taken from the Earth to the Moon.

The acceleration of free fall is 9.8 m / s^2 on the Earth and is 1.6 m / s^2 on the Moon.

Which row describes the mass and the weight of the object on the Moon compared to on the Earth?

	mass	weight
A	greater than on the Earth	same as on the Earth
B	less than on the Earth	same as on the Earth
C	same as on the Earth	greater than on the Earth
D	same as on the Earth	less than on the Earth

（2024 夏季 0625/13 第4题）

7. Jupiter and the Earth are planets in our Solar System.

(b) The gravitational field strength at the surface of the Earth is approximately 9.8 N / kg. The gravitational field strength at the surface of Jupiter is approximately 23 N / kg.

(i) Define gravitational field strength.

(ii) State **one** factor which causes the difference between the gravitational field strength at the surface of Jupiter and the gravitational field strength at the surface of the Earth.

（2025 夏季 0625/41 第10题(b)）

8. An object of mass 1.0 kg is at rest on the Earth. An identical object is at rest on a planet with a gravitational field strength of twice that on the Earth.

Which row correctly compares the object on the planet to the object on the Earth?

	its weight	its acceleration when the same horizontal resultant force is applied
A	double	equal to that on the Earth
B	double	half that on the Earth
C	half	equal to that on the Earth
D	half	half that on the Earth

（2024 冬季 0625/23 第3题）

题型 2：重量换算先写 W=mg（考频★★★★☆）

知识点 重力场强 g 定义为物体所受重力 W 与质量 m 之比，即 $g=$ _____；由此得 $W=mg$。

g 表示每 1 kg 质量受到的重力，单位为 _____，其数值等于当地的 _____。

质量不随重力场强改变；重力场强随星球和位置而改变。

答案：$\frac{W}{m}$；N/kg；自由落体加速度

怎么认 题目出现重力场强、质量或重量时，先写 $g=\frac{W}{m}$ 或 $W=mg$。

一. 每千克受力就是 g

例题 1 Which statement about gravitational field strength *g* is correct?

A $g = \frac{\text{mass}}{\text{weight}}$

B g = mass × weight

C *g* is defined as the mass per unit force

D *g* is equal to the acceleration of free fall

（2024 夏季 0625/23 第5题）

解： 由重力场强的定义得

$g=\frac{W}{m}$。

重力场强的数值等于当地的自由落体加速度。

故选 D。

针对练习

1. Which statement about gravitational field strength is **not** correct?

A It changes the mass of an object.

B It is equivalent to the acceleration of free fall.

C It is measured in N / kg.

D Its magnitude is different on other planets in our Solar system.

（2024 冬季 0625/22 第4题）

2. Table 2.1 contains information about the planet Mars.

Table 2.1

mass	6.4×10^{23} kg
gravitational field strength at surface	3.7 N / kg
average density	3900 kg / m^3

(a) Define gravitational field strength.

（2025 冬季 0625/41 第2题(a)）

3. Which row shows the gravitational field strength on the Earth and the definition of velocity?

	gravitational field strength on the Earth	definition of velocity
A	9.8 kg / N	the change in the speed
B	9.8 N / kg	the change in the speed
C	9.8 kg / N	the speed in a given direction
D	9.8 N / kg	the speed in a given direction

（2024 夏季 0625/12 第3题）

二. 质量乘场强求重量

知识点 物体相对于观察者静止时，质量是物体所含物质的量，单位是 _____；重量是重力场对物体的作用力，单位是 _____。

重力场强定义为单位质量所受的重力，$g = \frac{W}{m}$，故 $W = mg$；计算时质量必须化为 kg，g 的单位可写成 N/kg 或 m/s^2。

自由落体加速度的数值等于当地的重力场强；重量方向指向产生该重力场的天体中心。

答案：kg；N

怎么认 题目出现质量和重力场强或自由落体加速度，并求重量时，先写 $W = mg$。

例题 2 On Mars, the acceleration of free fall is 3.7 m / s^2.

What is the weight of a 2.0 kg mass on Mars?

A 0.54 N **B** 1.9 N **C** 7.4 N **D** 20 N

（2024 春季 0625/12 第3题）

解： 火星表面的自由落体加速度数值等于重力场强，

$g = 3.7\ \mathrm{N/kg}$

由 $W = mg$ 得

$W = 2.0\ \mathrm{kg} \times 3.7\ \mathrm{N/kg} = 7.4\ \mathrm{N}$

故选 C。

针对练习

4. A vehicle sent to explore the surface of Mars has a mass of 200 kg.

The acceleration of free fall on Mars is 3.7 m / s^2.

What is the weight of the vehicle on Mars?

A 20 N **B** 54 N **C** 740 N **D** 2000 N

（2023 冬季 0625/13 第3题）

5. An astronaut of mass 80 kg is standing on a planet with gravitational field strength g = 3.8 N / kg.

What is the weight of the astronaut on this planet?

A 780 N **B** 300 N **C** 210 N **D** 21 N

（2024 夏季 0625/22 第3题）

6. A wooden beam is used in a see-saw.

(a) The mass of the wooden beam is 40 kg.

Calculate the weight of the wooden beam.

（2025 夏季 0625/31 第3题(a)）

7. A student holds a pile of books. The mass of the books is 3.2 kg.

(a) Calculate the weight of the books.

（2023 冬季 0625/32 第4题(a)）

三. 重量除场强求质量

知识点 质量表示相对观察者静止的物体所含物质的多少，单位是 kg。

重量是重力场对有质量物体的作用力，单位是 N。

物体处于重力场中时，$W = mg$，重力场强 g 的单位是 N/kg。

由 $W = mg$ 得 $m =$ _____；W 用 _____，所得质量的单位是 kg。

答案：$\frac{W}{g}$；N

怎么认 题目出现重量、重力场强并求质量时，先由 $W = mg$ 写出 $m = \frac{W}{g}$。

例题 3

(c) A clamp stand used in the experiment has a weight of 8.6 N.
Calculate the mass of the clamp stand.

（2023 春季 0625/32 第2题(c)）

解： 由 $W = mg$ 得

$m = \frac{W}{g}$

取 $g = 9.8\ \text{N/kg}$，代入得

$m = \frac{8.6\ \text{N}}{9.8\ \text{N/kg}}$

$\approx 0.88\ \text{kg}$

答：铁架台的质量为 0.88 kg。

针对练习

8. **(a)** A boy weighs 620 N.
Calculate the mass of the boy.

（2024 冬季 0625/33 第3题(a)）

9. A load is suspended from a thread. The vertical force on the thread due to the load is 0.75 N.

(a) Calculate the mass of the load.

（2024 夏季 0625/42 第1题(a)）

10. A stone has a weight of 5.7 N.

The gravitational field strength g is 9.8 N / kg.

What is the mass of the stone?

A 0.58 kg **B** 5.7 kg **C** 56 kg **D** 550 kg

（2025 春季 0625/12 第6题）

11. A sphere P, made of steel, has a weight of 10 N on Earth.

Another sphere Q, also made of steel, has a weight of 10 N on Mars.

The gravitational field strength on Earth is greater than the gravitational field strength on Mars.

Which statement is correct?

A The mass of sphere P is the same as the mass of sphere Q.

B The mass of sphere P is less than the mass of sphere Q.

C On Mars, the weight of sphere P is the same as the weight of sphere Q.

D On Earth, the weight of sphere Q is less than 10 N.

（2023 夏季 0625/22 第5题）

1.4 密度

题型 1：密度计算先写 ρ=m/V（考频★★★★☆）

知识点 密度表示单位体积的质量，关系为 $\rho = \frac{m}{V}$，其中 ρ 为密度，m 为质量，V 为体积。

由 $\rho = \frac{m}{V}$ 得 $m =$ _____；确定物质的密度，必须知道质量和体积。

质量和体积必须对应同一物体或同一份物质，所用单位要相配；质量用 kg、体积用 m^3 时，密度单位为 _____。

答案：ρV；$\mathrm{kg\ m^{-3}}$

怎么认 题目出现密度、质量、体积的符号或所求关系时，先写 $\rho = \frac{m}{V}$，再对准符号和单位。

一. 先对准 ρ、m、V

例题 1 Which equation is correct?

A $\text{mass} = \frac{\text{acceleration}}{\text{force}}$

B mass = density × volume

C $\text{mass} = \frac{\text{force}}{\text{impulse}}$

D $\text{mass} = \frac{\text{kinetic energy}}{\text{velocity}^2}$

（2025 春季 0625/12 第7题）

解：由密度关系得

$\rho = \frac{m}{V}$

故

$m = \rho V$

故选 B。

针对练习

1. Which equation is correct?

A density = mass × volume

B density = weight × volume

C mass = density × volume

D weight = density × volume

（2023 冬季 0625/12 第5题）

2. Which two quantities must be known to determine the density of a material?

A mass and area

B mass and volume

C weight and area

D weight and volume

（2023 夏季 0625/22 第6题）

3. A student uses the equation $\rho = \frac{m}{V}$.

Which row shows the correct meaning of these symbols?

	ρ	m	V
A	density	mass	velocity
B	density	mass	volume
C	pressure	mass	volume
D	pressure	moment	velocity

（2024 冬季 0625/13 第5题）

二. 质量除体积求密度

知识点 密度表示物质单位体积的质量，等于物体的_____除以_____。

质量 m 与体积 V 必须属于同一物体或同一份样品，$\rho = \frac{m}{V}$。

若题目给出容器总质量或组合尺寸，先求物质的净质量和实际体积，再代入关系式。

质量用 g、体积用 cm^3 时，密度单位为 g/cm^3；质量用 kg、体积用 m^3 时，密度单位为 kg/m^3。

答案：质量；体积

怎么认 题目出现物体的质量、体积并求密度时，先写 $\rho = \frac{m}{V}$。

例题 2 Fig. 1.1 shows two strips of staples.

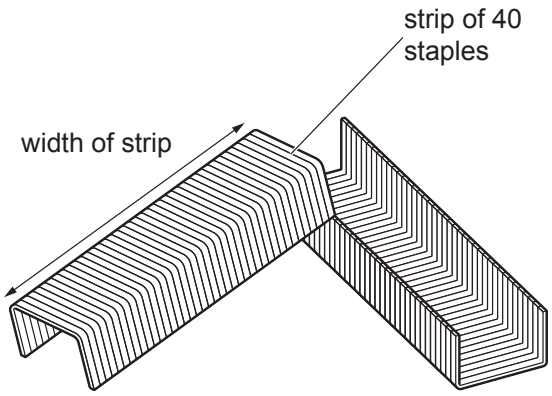


Fig. 1.1 NOT to scale

(c) The staples are made from a block of metal.
The mass of the block is 296 g. The volume of the block is 33.2 cm^3.
Calculate the density of the metal. Include the unit.

（2023 春季 0625/32 第1题(c)）

解： 由密度定义得

$\rho = \frac{m}{V}$

$\rho = \frac{296}{33.2} \approx 8.92\ g/cm^3$

答：金属的密度为 $8.92\ g/cm^3$。

针对练习

4. The mass of a solid metal cylinder is 400 g and its volume is 52 cm^3.

(a) Calculate the density of the metal. Include the unit.

（2023 冬季 0625/31 第2题(a)）

5. The mass of an object is 2.5 kg. The volume of the object is 480 cm^3.

What is the density of the object?

A $5.2 \times 10^{-3}\ g/cm^3$

B $5.2\ g/cm^3$

C $190\ g/cm^3$

D $1.2 \times 10^{3}\ g/cm^3$

（2024 夏季 0625/21 第4题）

三. 变形求质量或体积

知识点 密度是物质单位体积的质量，关系式为 _____，其中 m 表示质量，V 表示体积。

由密度关系式变形，求质量时用 _____，求体积时用 _____。

同一组数据应表示同一物体或同一份物质；密度用 $\frac{kg}{m^3}$ 时，质量和体积应分别用 kg 和 m^3，密度用 $\frac{g}{cm^3}$ 时则分别用 g 和 cm^3。

答案：$\rho = \frac{m}{V}$；$m = \rho V$；$V = \frac{m}{\rho}$

怎么认 题目给出密度、质量或体积中的两个量并求第三个量时，先写 $\rho = \frac{m}{V}$ 并统一单位。

例题 3 A rectangular swimming pool is 50 m long and 25 m wide.

It contains water at a depth of 2 m.

The density of the water is 1000 kg / m^3.

What is the mass of the water in the pool?

A 2.5 kg **B** 2500 kg **C** 77 000 kg **D** 2 500 000 kg

（2023 春季 0625/12 第5题）

解： 水的体积为

$V = 50 \times 25 \times 2 = 2500\text{m}^3$。

由 $\rho = \frac{m}{V}$ 得

$m = \rho V = 1000 \times 2500 = 2.5 \times 10^6$ kg。

故选 D。

针对练习

6. **(b)** Fig. 2.2 shows a metal block.

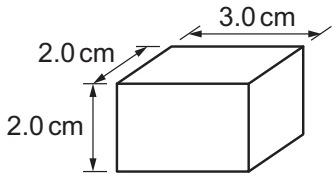


Fig. 2.2

The density of the metal is 8.0 g / cm^3.

Calculate the mass of the metal block.

（2025 春季 0625/32 第2题(b)）

7. The mass of a glass bottle is 0.18 kg.

(b) The bottle contains 2.7 kg of cooking oil. The density of the cooking oil is 0.92 g / cm^3.

Calculate the volume of the cooking oil.

（2023 冬季 0625/33 第3题(b)）

8. Fig. 9.1 shows the Sun as the central dot and the planets Saturn, Jupiter and Earth labelled S_0, J_0 and E_0. The planets orbit the Sun anticlockwise. From the Earth's orbit, the planets appear aligned.

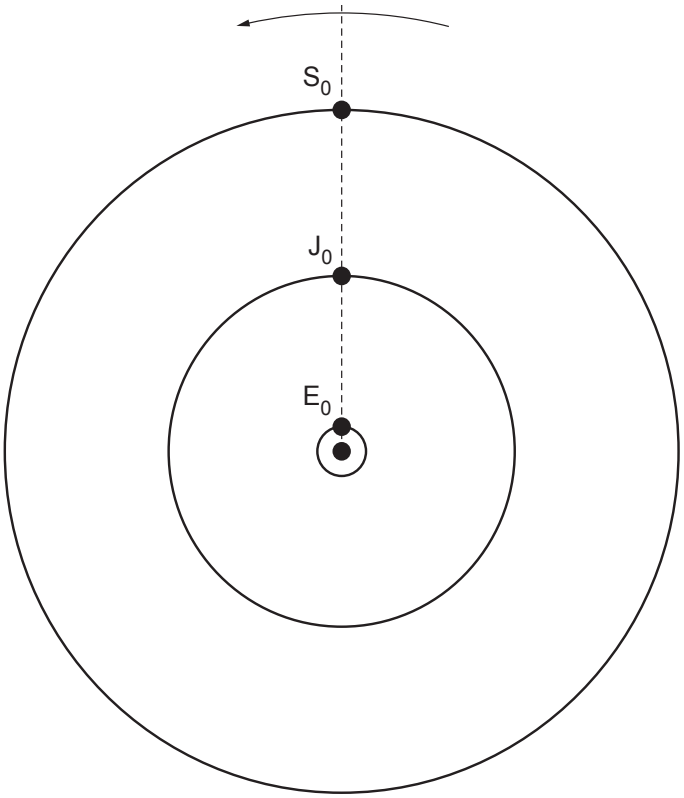


Fig. 9.1 (not to scale)

Assume that Saturn takes 30 years to orbit the Sun and that Jupiter takes 12 years to orbit the Sun.

(d) The average density of Jupiter is 1300 kg / m^3 and its volume is 1.4×10^{15} km^3.

Calculate the mass of Jupiter.

（2023 夏季 0625/43 第9题(d)）

9. A student wants to measure the diameter of a wire. The wire is thinner than a single gradation on her ruler. She coils the wire carefully and makes 12 loops as shown in Fig. 2.1.

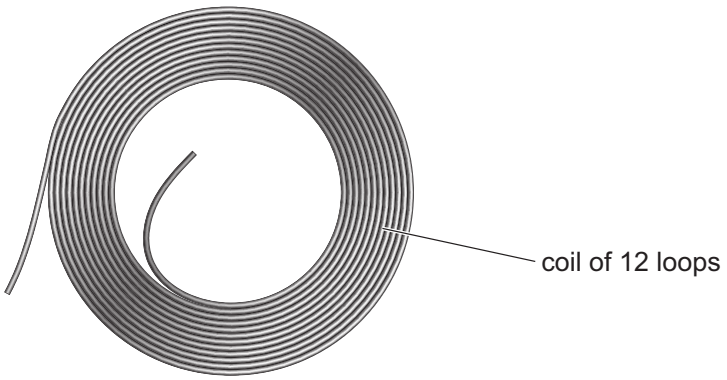


Fig. 2.1

(b) The student determines the density of the metal of the wire.
She folds some of the wire into a small shape as shown in Fig. 2.2.

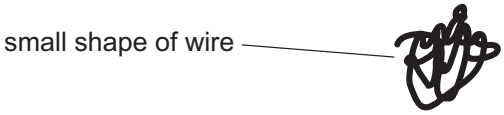


Fig. 2.2

She then puts this small shape of wire into a measuring cylinder containing water. The measuring cylinder is on an electric balance.

This procedure is shown in Fig. 2.3.

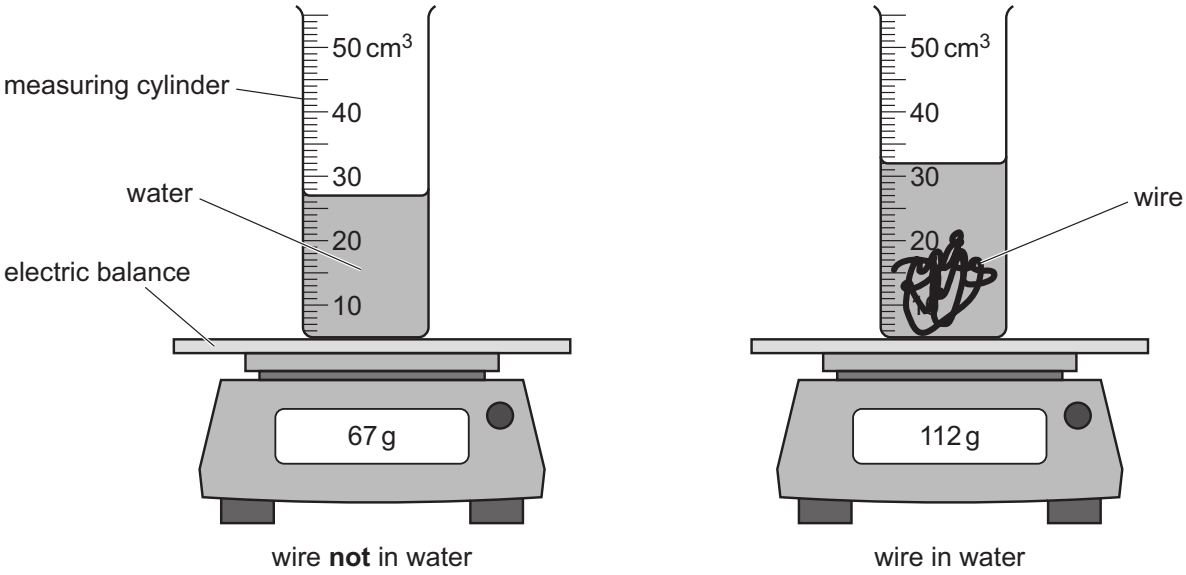


Fig. 2.3

Using the information in Fig. 2.3, calculate:

(i) the mass of the wire

(ii) the volume of the wire.

（2024 冬季 0625/32 第2题(b)）

题型 2：测密度先分别测质量体积（考频★★★★☆）

知识点 密度表示单位体积物质的质量，$\rho = \frac{m}{V}$，其中 m 和 V 必须对应同一物体。

测规则固体的密度时，用_____测质量，用_____测尺寸，再按形状公式求体积。

质量用 g、体积用 cm^3 时，密度单位为 g/cm^3；质量用 kg、体积用 m^3 时，密度单位为 kg/m^3。

答案：天平；直尺

怎么认 题目出现规则固体并要求测密度时，先测质量和尺寸，再求体积。

一. 规则固体量尺寸算体积

例题 1 A student determines the density of copper.

She has a rectangular block of copper.

Which other apparatus does she need?

	balance	ruler	stop-watch	thermometer
A	✓	✓	✓	✓
B	✓	✓	✓	✗
C	✓	✓	✗	✗
D	✓	✗	✗	✗

key

✓ = needed

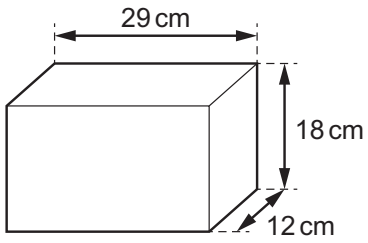
✗ = **not** needed

（2025 夏季 0625/22 第5题）

解： 由 $\rho = \frac{m}{V}$ 得，测密度需测质量和体积。
矩形铜块的质量用天平测量，体积由直尺测得长、宽、高后计算。
停表和温度计均不需要。
故选 C。

针对练习

1. A concrete building block has the dimensions shown.



The mass of the block is 15 000 g.

What is the density of the block?

A 43 g / cm^3 **B** 2.4 g / cm^3 **C** 0.42 g / cm^3 **D** 0.023 g / cm^3

（2024 冬季 0625/11 第5题）

2. Fig. 1.1 represents a stack of glass microscope slides.

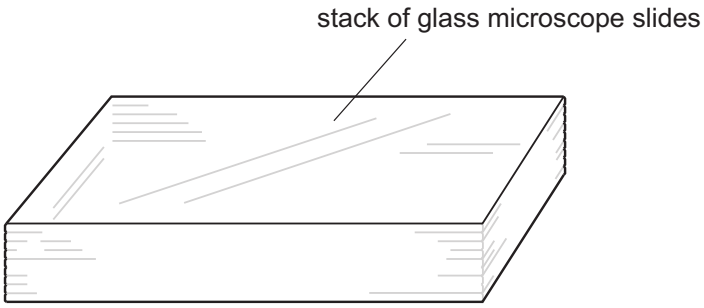


Fig. 1.1 (not to scale)

A student takes measurements from a stack of glass microscope slides in order to estimate the number of slides in the stack.

The sides of the stack have been covered with tape so that the student cannot count the number of slides in the stack.

Fig. 1.2 shows side views of the taped stack of slides given to the student. This figure has been drawn at full scale.

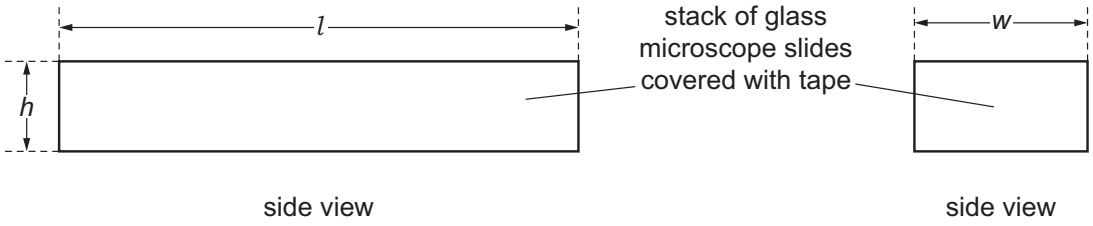


Fig. 1.2

(a) Using Fig. 1.2, measure the length l, the width w and the height h of the covered stack of slides in centimetres to the nearest millimetre.

(b) (i) The student uses a balance to measure the mass M of the covered stack of slides.

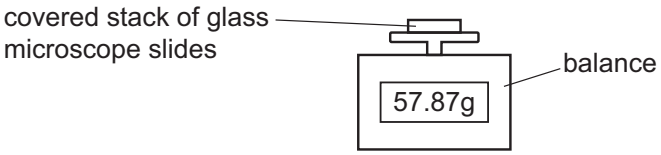


Fig. 1.3

Write down the mass M of the covered slides to the nearest 0.1 g.

(ii) Calculate the density ρ of the glass. Use your results from **(a)** and **(b)(i)** and the equation shown.

$$\rho = \frac{M}{lwh}$$

Give the unit for your answer.

（2024 冬季 0625/62 第1题(b)）

二. 不规则固体用排水体积

知识点 密度表示物质_____，用 ρ 表示；$\rho = \frac{m}{V}$，其中 m 为质量，V 为体积。

密度的国际单位是 $\mathrm{kg\ m^{-3}}$，也常用 $\mathrm{g\ cm^{-3}}$；计算时质量与体积的单位应相互对应。

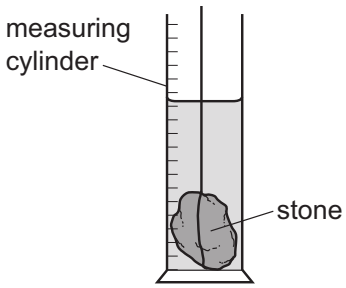
不溶于液体且能完全浸没的不规则固体，其体积为浸没后与浸没前的量筒读数之差，即 $V =$ _____。

测量颗粒材料时，液体应进入颗粒间的空隙，使读数差表示颗粒本身的总体积。

答案：单位体积的质量；$V_2 - V_1$

怎么认 题目出现不规则固体、量筒浸没前后读数和求密度时，先用读数差求体积。

例题 2 A student determines the density of an irregularly shaped stone. The stone is slowly lowered into a measuring cylinder partly filled with water.



Which other apparatus does the student need to calculate the density of the irregularly shaped stone?

A a balance

B a thermometer

C a metre rule

D a stop-watch

（2023 夏季 0625/11 第6题）

解：量筒浸没前后的读数差为石块的体积。

$V = V_2 - V_1$

由 $\rho = \frac{m}{V}$，还需用天平测量石块的质量。

故选 A。

针对练习

3. Which piece of equipment is useful in determining the density of an irregularly-shaped stone?

A stop-watch

B metre ruler

C measuring cylinder

D voltmeter

（2025 冬季 0625/13 第4题）

4. A girl has a gold necklace.

Which apparatus does she need to find the density of the gold?

	balance	measuring cylinder	thermometer	ruler
A	✓	✓	✓	✓
B	✓	✓	✓	✗
C	✓	✓	✗	✗
D	✓	✗	✗	✗

key
✓ = needed
✗ = **not** needed

（2025 夏季 0625/21 第4题）

5. In this experiment, you will take measurements of a stack of glass microscope slides to estimate the number of slides in the stack.

Fig. 1.1 shows the stack of slides.

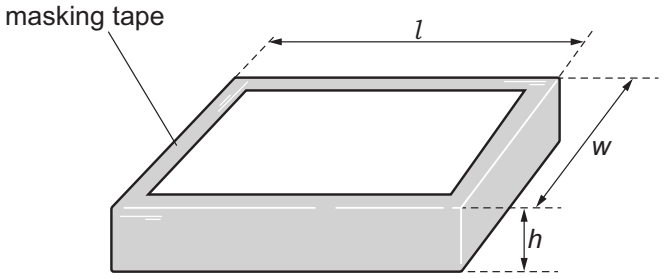


Fig. 1.1

(a) Measure the length *l*, the width *w* and the height *h* of the stack of slides in centimetres to the nearest millimetre.

Do **not** remove any slides from the stack.

(b) **(i)** Use the balance provided to measure the mass *M* of the stack of slides to the nearest 0.1 g.

(ii) Calculate the density ρ of the glass. Use your results from **(a)** and **(b)(i)** and the equation shown.

$$\rho = \frac{M}{lwh}$$

Give the unit for your answer.

（2024 冬季 0625/52 第1题(b)）

三. 流体先扣容器质量

知识点 密度表示单位体积物质的质量，定义式为 $\rho = \frac{m}{V}$，其中 m 与 V 必须对应同一部分物质。测液体密度时，用量筒测体积 V；用天平测空容器质量 m_1 和装入液体后的总质量 m_2，液体质量为 $m =$ _____。

液体密度为 $\rho =$ _____，常用单位为 $\mathrm{kg\ m^{-3}}$ 或 $\mathrm{g\ cm^{-3}}$。

答案：$m_2 - m_1$；$\frac{m}{V}$

怎么认 题目出现液体、天平和量筒并要求测密度时，先用总质量减空容器质量，再读取体积。

例题 3 A student has a bottle of cooking oil.

She determines the density of the cooking oil.

Which apparatus does she need?

	balance	measuring cylinder	ruler	thermometer
A	✓	✓	✓	✓
B	✓	✓	✓	✗
C	✓	✓	✗	✗
D	✓	✗	✗	✗

key

✓ = needed

✗ = not needed

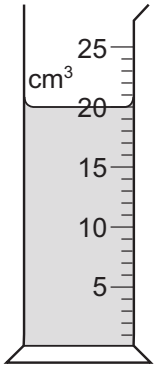
（2023 冬季 0625/11 第5题）

解： 由 $\rho = \frac{m}{V}$ 得，测定食用油的密度，需要测出食用油的质量和体积。
用天平分别测空量筒与装油后量筒的质量，以两次质量之差求油的质量；用量筒读出油的体积。
故选 C。

针对练习

6. The diagram shows some liquid in a measuring cylinder.

The mass of the liquid is 16 g.



What is the density of the liquid?

A $0.80\,g/cm^3$ **B** $1.3\,g/cm^3$ **C** $36\,g/cm^3$ **D** $320\,g/cm^3$

（2024 夏季 0625/13 第5题）

7. A sealed container of volume 2000 cm^3 contains air at high pressure.

The container is placed on a top-pan balance.

The balance reads 200.00 g.

All the air is removed by a vacuum pump and the balance reading changes to 196.00 g.

What was the density of the pressurised air?

A 0.00200 g/cm^3

B 0.098 g/cm^3

C 4.00 g/cm^3

D 10.2 g/cm^3

（2024 夏季 0625/22 第4题）

8. **(a)** A student determines the density of a liquid, by using the equipment shown in Fig. 2.1.

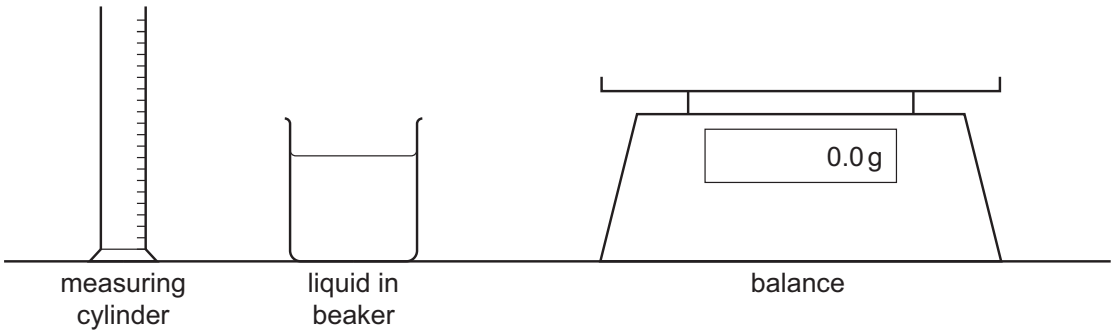


Fig. 2.1

Describe how the student uses the equipment to determine the density of the liquid.

（2025 春季 0625/32 第2题(a)）

9. **(a)** A scientist determines the density of a sample of sea water.

Describe an experiment to determine the density of the sea water. You may draw a diagram as part of your answer.

Include any equations in your answer.

（2025 冬季 0625/33 第3题(a)）

题型 3：浮沉分层先比较密度（考频★★★☆☆）

知识点 密度表示单位体积的质量，$\rho = \frac{m}{V}$，其中 m 为质量，V 为体积；常用单位为 $kg\ m^{-3}$ 或 $g\ cm^{-3}$。
判断物体浮沉时，应比较物体的整体平均密度与液体密度。
物体平均密度_____液体密度时上浮或漂浮，_____液体密度时下沉；二者相等时物体可悬浮。
空心物体应以总质量除以外部总体积，求出_____后再比较。

答案：小于；大于；整体平均密度

怎么认 题目出现物体和液体的密度，或给出物体质量与体积并问浮沉时，先求物体平均密度并比较。

一. 物体与液体比密度

例题 1 A student is asked to predict whether a solid floats in a liquid.

Which information does the student require?

A the density of the liquid and the mass of the solid

B the density of the solid and the density of the liquid

C the density of the solid and the mass of the liquid

D the mass of the solid and the mass of the liquid

（2025 冬季 0625/11 第4题）

解： 由浮沉条件，判断固体能否漂浮，应比较固体的平均密度与液体密度。
因此需要固体的密度和液体的密度。
故选 B。

针对练习

1. Fig. 2.1 shows a ship loaded with containers.

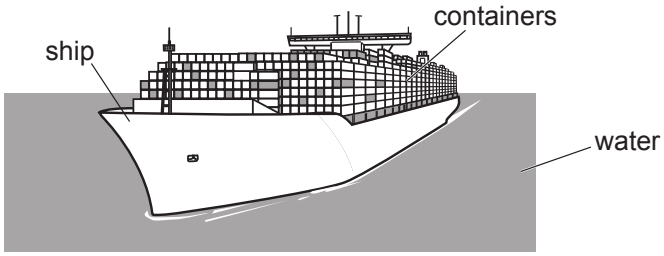


Fig. 2.1

(a) The ship is made of steel.

The density of steel is 7800 kg / m^3 and the density of water is 1000 kg / m^3.

Explain why the ship floats in the water.

（2023 春季 0625/42 第2题(a)）

2. Four hollow glass balls, P, Q, R and S, each have a volume of 30 cm^3.

The mass of each ball is shown.

ball	mass / g
P	15
Q	25
R	35
S	45

Which balls will float in a liquid of density 0.95 g / cm^3?

A P and Q **B** P only **C** R and S **D** S only

（2025 夏季 0625/12 第5题）

3. A plastic ball has a mass of 4.0 g and a volume of 20 cm^3.

There is a crack in the ball's surface.

The ball is placed in a bath of water. Water leaks into the ball without changing the volume of the ball and eventually the ball sinks.

The density of water = 1.0 g / cm^3.

Which mass of water has entered the ball when the top of the ball is first level with the water surface?

A 5.0 g **B** 16 g **C** 20 g **D** 24 g

（2023 冬季 0625/22 第4题）

4. **(b)** Table 3.1 shows the density of four materials.

Table 3.1

material	density / g/cm^3
plastic	0.905
wood	0.720
sea water	1.03
baby oil	0.815

Predict whether solid objects made from plastic or wood float in sea water or baby oil.

Use the data in Table 3.1.

Complete Table 3.2 by writing **Yes** or **No** in each space.

Table 3.2

liquid	does a plastic object float?	does a wooden object float?
sea water		
baby oil		

（2025 冬季 0625/33 第3题(b)）

二. 密度小的液体在上

知识点 密度表示单位体积物质的质量，$\rho = \frac{m}{V}$，常用单位为 g cm^{-3} 或 kg m^{-3}。

互不混溶的液体静置分层时，密度_____的液体在上，密度_____的液体在下。

因此，各液层从上到下按密度由_____到大排列。

答案：较小；较大；小

怎么认 题目出现互不混溶的液体及质量、体积或密度时，先求出或比较各液体的密度。

例题 2

(a) Oil of density 0.80 g / cm^3 is poured gently onto the surface of water of density 1.0 g / cm^3. The oil and the water do **not** mix.

Describe and explain the final position of the oil relative to the water.

（2023 冬季 0625/43 第1题(a)）

解：油与水互不混溶，且 $\rho_{油} = 0.80\ \mathrm{g\ cm^{-3}} < \rho_{水} = 1.0\ \mathrm{g\ cm^{-3}}$。
互不混溶的液体中，密度较小的液体浮在密度较大的液体上。
答：油最终浮在水面上。

针对练习

5. The table gives data about four liquids, W, X, Y and Z.

liquid	mass / g	volume / cm^3
W	10	10
X	20	15
Y	30	50
Z	40	50

None of the liquids mixes with any of the other liquids.

All the liquids are put in the same container and settle to form four separate layers.

Which statement is correct?

A W forms the layer below X.

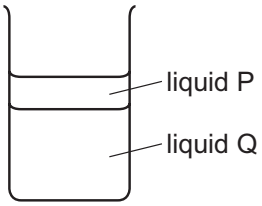
B X forms the top layer.

C Y forms the bottom layer.

D Z forms the layer below Y.

（2024 春季 0625/22 第5题）

6. The diagram shows one liquid floating on top of another liquid.



Which statement explains why liquid P floats on top of liquid Q?

A The mass of liquid Q is greater than the mass of liquid P.

B The mass of 1 cm^3 of liquid Q is greater than the mass of 1 cm^3 of liquid P.

C The volume of liquid Q is greater than the volume of liquid P.

D The volume of 1 g of liquid Q is greater than the volume of 1 g of liquid P.

（2025 冬季 0625/21 第4题）

7. Samples of three different liquids have equal masses.

The volumes of the samples are 190 cm^3, 200 cm^3 and 235 cm^3.

The liquids are poured into a large measuring cylinder and the liquids form three separate layers because they do **not** mix.

What are the readings on the measuring cylinder at the two boundaries between the samples?

A 190 cm^3 and 390 cm^3

B 190 cm^3 and 425 cm^3

C 235 cm^3 and 425 cm^3

D 235 cm^3 and 435 cm^3

（2025 夏季 0625/23 第5题）

8. The mass of a glass bottle is 0.18 kg.

(c) A cookery student pours some cooking oil into a glass bowl containing water, as shown in Fig. 3.1.

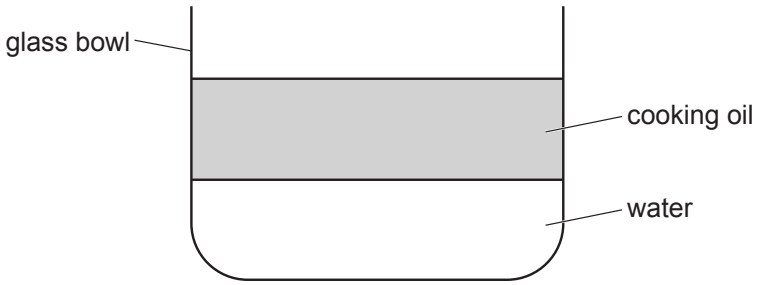


Fig. 3.1

The student accidently drops a plastic spoon and a metal spoon into the bowl.
The densities of the spoons and liquids are shown in Table 3.1.

Table 3.1

material	density / g/cm^3
plastic spoon	0.76
metal spoon	8.7
cooking oil	0.92
water	1.0

On Fig. 3.1, label a suggested position for each spoon after each has fallen into the bowl.

Use the letter P to label the position of the plastic spoon and the letter M to label the posit of the metal spoon.

（2023 冬季 0625/33 第3题(c)）

1.5.1 力的作用

题型 1：先认力会改变什么（考频★★★☆☆）

知识点 力可改变物体的形状、大小、速率或运动方向，但不会改变物体的_____。
接触面间发生相对运动时，摩擦力通常阻碍相对运动，并把机械能转移到_____，因而产生热。
合力不为零时，物体的速度发生改变；由 $F = ma$，力的单位是_____。

答案：质量；内能库；牛顿（N）

怎么认 题目出现形变、速率或方向变化，或问接触发热时，先判断力产生的作用。

一. 看形变或速度变化

例题 1 Which force produces heating during contact with a moving object?

A weight

B friction

C electrostatic force

D magnetic force

（2023 春季 0625/12 第7题）

解：物体与接触面发生相对运动时，摩擦力阻碍相对运动，并把机械能转移到内能库，使物体发热。故选 B。

针对练习

1. Which property of an object **cannot** be changed by applying forces?

A mass

B shape

C speed

D volume

（2024 夏季 0625/23 第6题）

2. Which property of an object **never** changes when a force acts on the object?

A mass

B shape

C size

D speed

（2025 冬季 0625/11 第5题）

3. **(b)** Complete the sentence about effects of forces. Choose a word from the box.

charge	mass	power	shape	velocity

A load stretching a spring is an example of a force changing the size and the

（2023 春季 0625/32 第2题(b)）

4. **(b)** A train has a total mass of 520 000 kg. The train accelerates at 1.1 m/s^2.

(i) Calculate the time taken for the train to increase its speed from 15 m/s to 28 m/s.

(ii) Calculate the force required to produce an acceleration of 1.1 m/s^2 for this train.

(iii) The train uses electric motors.

Explain why the force on the train due to the motors is greater than the value calculated in **(ii)**.

（2024 夏季 0625/42 第2题(b)）

二. 制动先看摩擦大小

知识点 汽车制动时，轮胎与路面间的摩擦力提供制动力；合力可改变汽车的速率。

在质量和初速相同、制动至静止且减速度恒定时，摩擦力越_____，由 $F = ma$ 得减速度越小，再由 $0 = u^2 - 2as$ 得停车距离越_____。

F 的单位为 N，a 的单位为 m s^{-2}，s 的单位为 m。

答案：小；长

怎么认 题目出现路面干湿变化并问制动距离时，先判断轮胎与路面间的摩擦力怎样变化。

例题 2 A car accelerates uniformly in a straight line from rest at time t = 0. At t = 3.2 s, the speed of the car is 13.0 m/s.

(c) The car decelerates from 13.0 m/s to 0 m/s at a constant deceleration. The mass of the car is 1350 kg. The car travels 13 m in 2.0 s as it decelerates.

Show that the work done by the car as it decelerates is approximately 1.1 × 10^5 J.

(d) On another day, the car in **(c)** travels a longer distance while it decelerates from 13.0 m/s to 0 m/s. The deceleration is constant.

Suggest and explain what causes the stopping distance to increase.

（2023 冬季 0625/42 第1题(d)）

解：答：路面变湿，使轮胎与路面间的摩擦力减小，制动力随之减小。

由 $F = ma$ 得，汽车的减速度减小。

由 $0 = 13.0^2 - 2as$ 得，减速度越小，停车距离 s 越大。

针对练习

5. **(b)** A car travels on a dry road. The driver presses the brakes. The car travels a distance before it comes to rest. This distance is called the braking distance.

State and explain how the braking distance changes when the road is wet.

（2025 冬季 0625/42 第5题(b)）

6. A train travels with a constant velocity of 56 m/s on a horizontal track. The mass of the train is 440 000 kg.

(c) **(i)** The train has a uniform deceleration of 1.2 m/s^2.

Calculate the constant braking force which brings the train to rest.

(ii) Calculate the distance travelled by the train as it comes to rest.

（2025 冬季 0625/41 第1题(c)）

题型 2：受力箭头题先求合力（考频★★★★☆）

知识点 合力是作用效果与几个力共同作用相同的一个力。

同一直线上的力方向相同时大小_____，方向相反时大小_____；合力方向与较大的力相同。

选定正方向后，正向力取正，反向力取负，带符号相加所得结果就是合力，单位为牛顿，符号为 N。

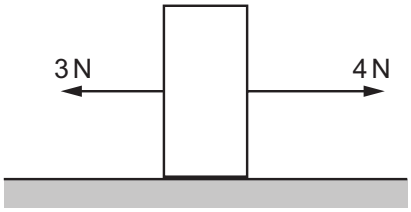
非零合力可使物体的速率或运动方向改变；合力与运动方向相同时，速率_____。

答案：相加；相减；增大

怎么认 题目出现同一直线上相反的受力箭头，并求合力或运动变化时，先选定正方向，将各力带符号相加。

一. 同线反向力先相减

例题 1 The diagram shows a solid object on a flat surface, with two forces acting on the object.



What is the resultant force on the object?

A 1 N to the left

B 1 N to the right

C 7 N to the left

D 7 N to the right

（2024 春季 0625/22 第2题）

解： 取向右为正。

$F = 4\ \text{N} - 3\ \text{N} = 1\ \text{N}$

所得数值为正，合力向右。故选 B。

针对练习

1. Fig. 2.1 shows the horizontal forces acting on an ice skater. The ice skater is moving forwards.

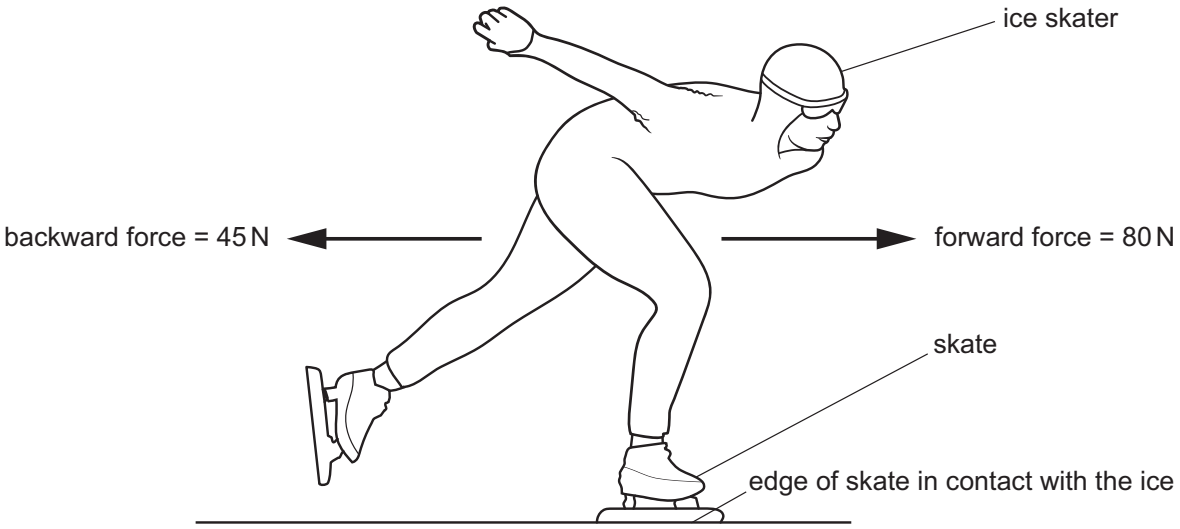


Fig. 2.1

(a) Calculate the resultant horizontal force acting on the ice skater. Determine the direction of the resultant force.

（2025 冬季 0625/32 第2题(a)）

2. Fig. 2.1 shows the speed–time graph for a cyclist.

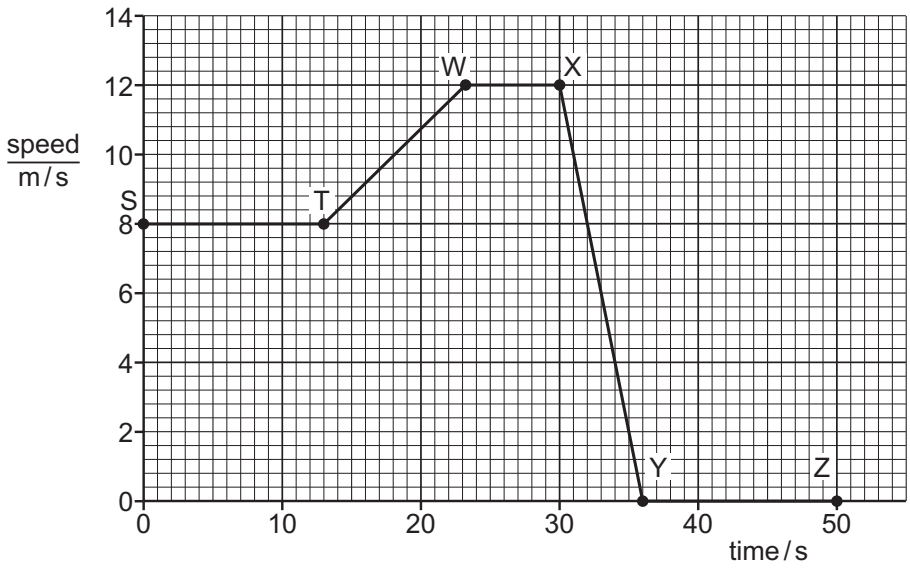


Fig. 2.1

(c) Fig. 2.2 shows the horizontal forces on a cyclist.



Fig. 2.2

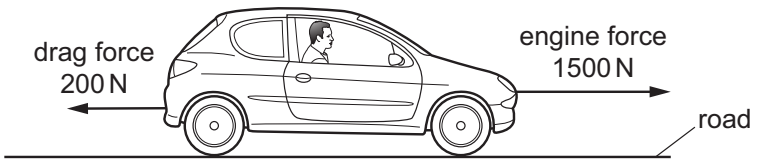
(i) Calculate the size of the resultant force on the cyclist.

(ii) State the effect, if any, of the resultant force on the motion of the cyclist.

（2023 夏季 0625/32 第2题(c)）

3. The diagram shows a car moving along a road.

The force due to the engine is 1500 N and the total drag force is 200 N.



What is the motion of the car?

A decreasing speed forward

B increasing speed forward

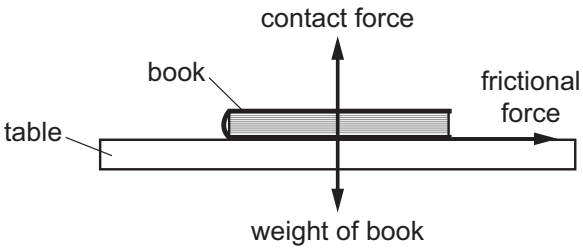
C reversing

D constant speed

（2024 冬季 0625/23 第5题）

4. A train is travelling horizontally in a straight line. A book is on a table in the train.

The diagram shows all the forces acting on the book.



How is the train moving?

A accelerating to the left of the diagram

B accelerating to the right of the diagram

C moving at uniform speed to the left of the diagram

D moving at uniform speed to the right of the diagram

（2023 夏季 0625/21 第7题）

二. 垂直分力用勾股合成

知识点 多个力共同作用的效果可由一个力代替，这个力称为_____。

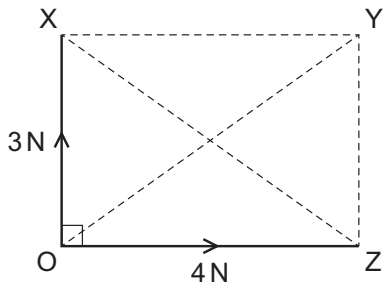
两力互相垂直时，以两力为平行四边形的邻边，合力沿从共同作用点出发的_____，大小为 $F=\sqrt{F_1^2+F_2^2}$，单位为 N。

若 θ 为合力与某一分力的夹角，则 $\tan\theta=\frac{\text{对边分力}}{\text{邻边分力}}$；该关系适用于两分力互相垂直的情形。

答案：合力；对角线

怎么认 题目出现两个互相垂直的力及其大小，并求合力时，先把两力作为直角三角形的两条直角边。

例题 2 Forces of 3 N and 4 N act at right angles, as shown.



What is the resultant force?

A 1 N along XZ

B 5 N along XZ

C 5 N along OY

D 7 N along OY

（2023 夏季 0625/22 第1题）

解：两力互相垂直，由勾股定理得

$F=\sqrt{3^2+4^2}\ \text{N}=5\ \text{N}$

平行四边形中由 O 指向 Y 的对角线为 OY，合力沿 OY。故选 C。

针对练习

5. Two forces with magnitudes F_1 and F_2 act on an object at right angles to each other.

What is the magnitude of the resultant force?

A $\sqrt{F_1^2 + F_2^2}$ **B** $\sqrt{F_1} + \sqrt{F_2}$ **C** $\sqrt{F_1^2} + \sqrt{F_2^2}$ **D** $\sqrt{F_1 + F_2}$

（2024 冬季 0625/22 第1题）

6. **(b)** Fig. 3.2 shows the directions of two forces acting on a different balloon as it moves.

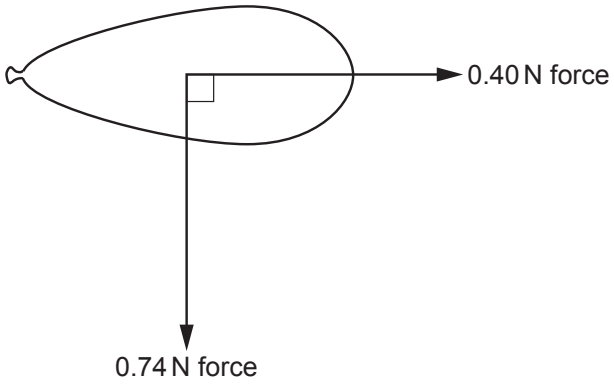


Fig. 3.2 (not to scale)

Determine the magnitude and direction of the resultant force on the balloon.

（2023 冬季 0625/42 第3题(b)）

7. A load is suspended from a thread. The vertical force on the thread due to the load is 0.75 N.

(b) Fig. 1.1 shows the load suspended from the thread.

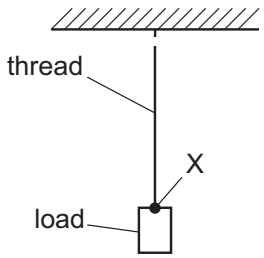


Fig. 1.1

A wire is attached to the load at point X and pulled horizontally to the right.

The tension in the horizontal wire is 1.2 N.

By drawing a scale diagram or by calculation, determine:

- the magnitude of the resultant of the force at X due to the load and due to the tension in the wire
- the direction of the resultant relative to the vertical direction.

Show your working.

（2024 夏季 0625/42 第1题(b)）

三. 静止匀速令合力为零

知识点 物体静止或做匀速直线运动时，运动状态不变，所受合力为 _____。

同一直线上的力同向相加、反向相减，合力的单位是 _____；计算前规定正方向。

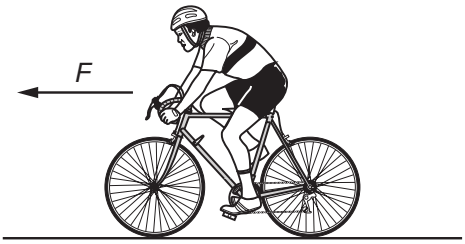
平衡时，方向相反的力大小 _____；不平衡时，$F_{合} = F_{驱} - F_{阻}$（取驱动力方向为正）。

答案：零；N；相等

怎么认 题目出现静止、匀速直线运动或大小相等的反向力时，先令合力为零并配平各力。

例题 3 A cyclist is travelling in a straight line along a horizontal road at a constant speed.

A constant driving force *F* acts on the cyclist in the forward direction shown.



Which statement about the magnitude of the frictional forces acting on the cyclist is correct?

A The magnitude is equal to *F*.

B The magnitude is smaller than *F*, but greater than zero.

C The magnitude is greater than *F*.

D The magnitude is zero.

（2023 夏季 0625/13 第6题）

解： 骑车人做匀速直线运动，故合力为零。

取前进方向为正，由力的平衡得

$F_{合} = F - f = 0$

$f = F$

摩擦力大小等于 F，故选 A。

8. Table 2.1 contains information about the planet Mars.

Table 2.1

mass	6.4×10^{23} kg
gravitational field strength at surface	3.7 N / kg
average density	3900 kg / m^3

(c) Fig. 2.1 shows a space buggy that is tested on Earth. The buggy is travelling at a constant speed in a straight line. The driving force on the buggy is 30 N.

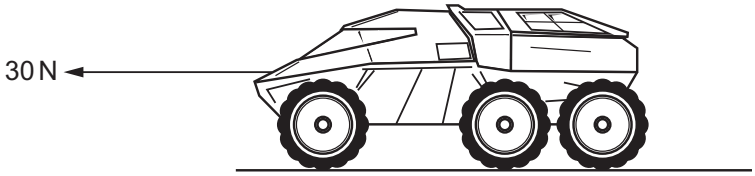


Fig. 2.1

(i) Draw and label **one** arrow on Fig. 2.1 to show the size and direction of the resistive forces on the buggy.

(ii) Air resistance on Mars is less than air resistance on Earth.
The same driving force, 30 N, is exerted on the buggy on Mars.

1. State the effect this has on the resultant force on the buggy on Mars.

2. State the relationship between resistive forces, driving force and resultant force.

（2025 冬季 0625/41 第2题(c)）

9. A rocket is travelling vertically upwards. Three vertical forces act on it.

The thrust acts upwards and is equal to 100 000 N.

The weight acts downwards and is equal to 80 000 N.

What is the air resistance force acting on the rocket when it is travelling upwards at a constant speed?

A 20 000 N downwards

B 20 000 N upwards

C 180 000 N downwards

D 180 000 N upwards

（2024 春季 0625/12 第4题）

10. **(c)** The student drops the piece of metal into a tank of water. Two vertical forces act on the piece of metal as it falls through the water in the tank.
On Fig. 2.1, each arrow represents a vertical force.

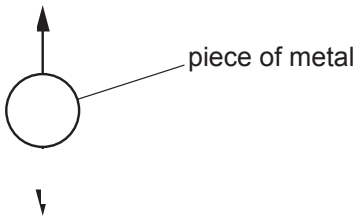


Fig. 2.1

(i) Complete the diagram in Fig. 2.1 by labelling the two forces.

(ii) The upward force is the same size as the downward force.

Describe the motion of the piece of metal as it falls through the water.

（2024 春季 0625/32 第2题(c)）

四. 合力除质量求加速度

知识点 物体所受各力的矢量和称为合力；同一直线上的力应先规定正方向，再按方向相加。
质量不变时，合力、质量与加速度满足 $F=ma$，故 $a=\frac{F}{m}$；加速度方向与_____方向相同。
F 的单位为_____，m 的单位为 kg，a 的单位为 $\mathrm{m\ s^{-2}}$。

答案：合力；N

怎么认 题目出现质量、合力或同一直线上的多个力，并求加速度时，先确定有方向的合力。

例题 4 Fig. 1.1 shows a balloon filled with helium gas.

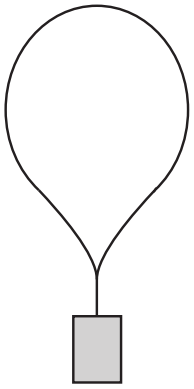


Fig. 1.1

The mass of the balloon is 120 kg.

(b) The resultant force on the balloon is 54 N.

Show that the acceleration of the balloon is $0.45\,\mathrm{m/s^2}$.

（2023 夏季 0625/43 第1题(b)）

解： 由 $F=ma$ 得
$a=\frac{F}{m}$
$=\frac{54}{120}$
$=0.45\mathrm{m\ s^{-2}}$。答：气球的加速度大小为 $0.45\mathrm{m\ s^{-2}}$。

针对练习

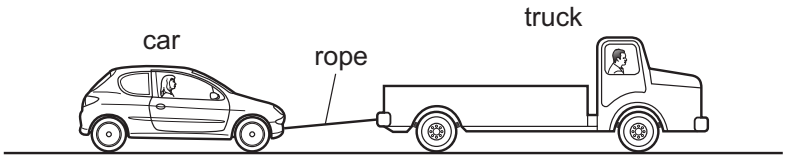
11. A train has a maximum speed of 200 km/h. It accelerates from rest with constant acceleration of 0.70 m/s^2.

(b) (i) The train has a total mass of 440 000 kg. Calculate the force which causes the acceleration of the train.

(ii) The train travels into a headwind. The force of this headwind opposes the motion of the train. State and explain the effect of this force on the motion of the train.

（2025 春季 0625/42 第4题(b)）

12. A truck is towing a car along a straight horizontal road at a constant speed.



The rope breaks.

Which row gives the direction of the initial acceleration of the truck after the rope breaks and the reason for the acceleration?

	direction of acceleration of the truck	reason
A	left	the driving force is greater than the resistive forces on the truck
B	left	the driving force is smaller than the resistive forces on the truck
C	right	the driving force is greater than the resistive forces on the truck
D	right	the driving force is smaller than the resistive forces on the truck

（2023 夏季 0625/22 第7题）

13. A spring is suspended from a clamp. Fig. 1.1 shows a pointer attached to the lower end of the spring.

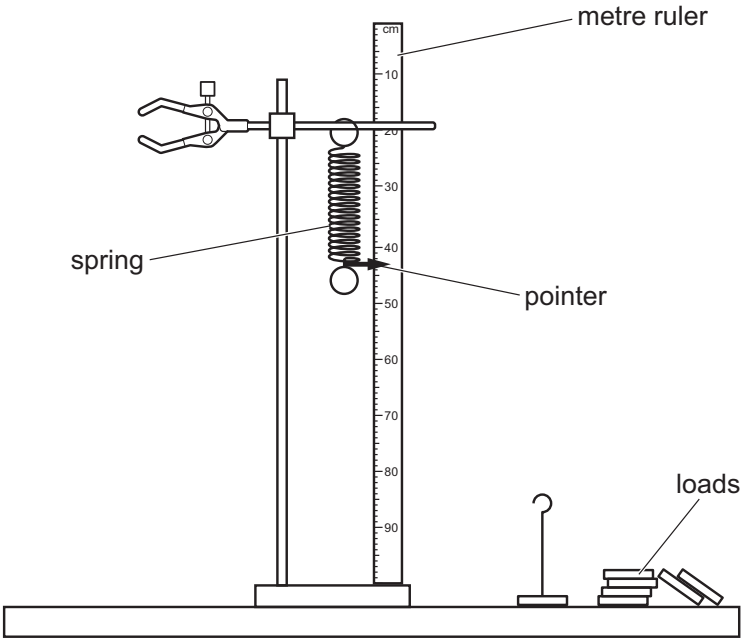


Fig. 1.1

A student suspends loads of different weights from the spring and records the readings on the metre ruler.

Fig. 1.2 is the reading–weight graph that the student obtains.

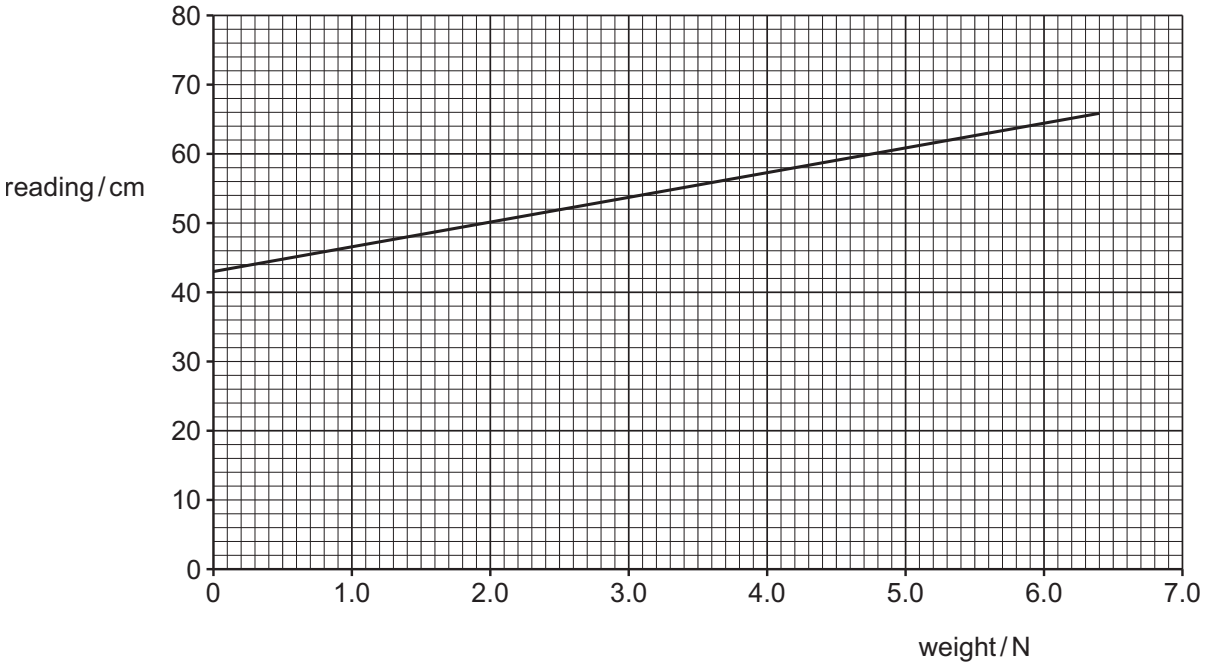


Fig. 1.2

(c) An object of mass 0.50 kg is attached to the spring.

(i) Calculate the weight of the object.

(ii) The object is pulled downwards until the tension in the spring is 6.5 N.

The object is released.

Calculate the acceleration of the object immediately after it is released.

（2024 冬季 0625/41 第1题(c)）

14. The drag force on a car increases with speed. At 20 m / s, the total drag force is 400 N. The mass of the car is 1200 kg and the driving force is constant at 700 N.

Which statement about the acceleration of the car at 20 m / s is correct?

A The acceleration is 0.25 m/s^2 but will decrease as time passes.

B The acceleration is 0.25 m/s^2 but will increase as time passes.

C The acceleration is 0.58 m/s^2 but will decrease as time passes.

D The acceleration is 0.58 m/s^2 but will increase as time passes.

（2023 春季 0625/22 第4题）

题型 3：弹簧题先求伸长量（考频★★★★☆）

知识点 弹簧未受力时的长度称为原长 l_0，受力后长度为 l；伸长量 x 等于_____减_____，即 $x = l - l_0$。

拉伸时 $x > 0$，压缩时 $x < 0$；若求压缩量的大小，取 $|x|$。

在不超过比例限度时，$F = kx$，其中 F 为力，k 为弹簧常量；各长度须采用_____单位，k 的单位可为 $\mathrm{N\ m^{-1}}$ 或 $\mathrm{N\ cm^{-1}}$。

答案：受力后长度；原长；相同

怎么认 题目出现弹簧原长、受力后长度或长度表时，先用 $x = l - l_0$ 求伸长量。

一. 总长减原长得伸长

例题 1 A student measures the length of a spring. She then attaches different weights to the spring. She measures the length of the spring for each weight.

The table shows her results.

weight / N	length / mm
0	520
1.0	524
2.0	528
3.0	533
4.0	537
5.0	540

What is the extension of the spring with a weight of 3.0 N attached to it?

A 4 mm **B** 5 mm **C** 12 mm **D** 13 mm

（2023 春季 0625/12 第9题）

解： 零载荷时，弹簧的原长为

$l_0 = 520\ \mathrm{mm}$

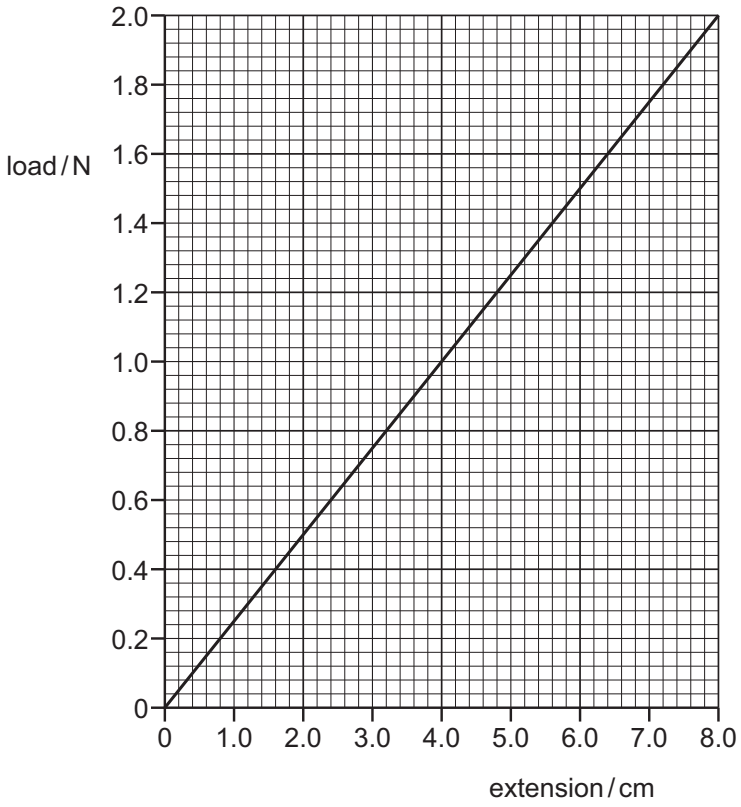
挂上 3.0 N 的重物后，弹簧长度为

$l = 533\ \text{mm}$
由 $x = l - l_0$ 得
$x = 533\ \text{mm} - 520\ \text{mm} = 13\ \text{mm}$。
故选 D。

针对练习

1. The diagram shows a load–extension graph for a steel spring.

The length of the spring with no load attached is 2.0 cm.



Which load increases the length of the spring to 6.0 cm?

A 0.5 N **B** 1.0 N **C** 1.5 N **D** 2.0 N

（2024 夏季 0625/12 第5题）

2. A spring has an unstretched length of 3.0 cm. When a force of 60 N is applied to the spring, its length increases to 5.0 cm. The limit of proportionality is not exceeded.

What is the spring constant of the spring?

A 7.5 N / cm **B** 12 N / cm **C** 20 N / cm **D** 30 N / cm

（2023 夏季 0625/23 第7题）

3. Fig. 1.1 shows a force–extension graph for a spring.

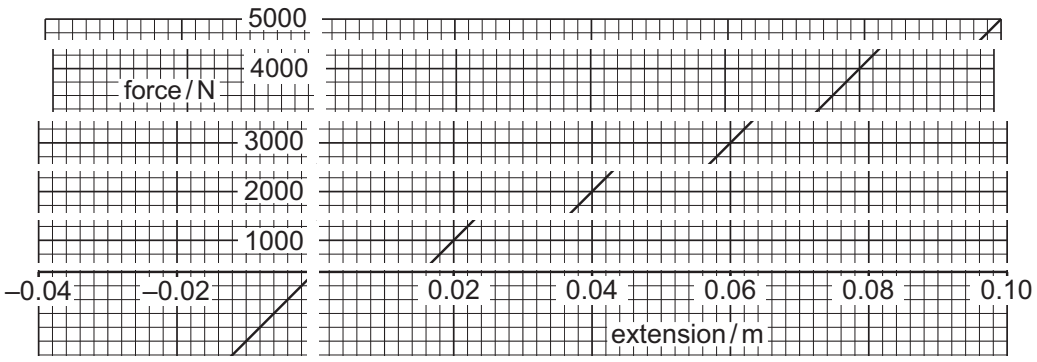


Fig. 1.1

(c) Springs can be compressed by forces. The spring described by Fig. 1.1 is compressed by a force *F* and has an extension of –0.025 m.

Determine *F*.

（2025 春季 0625/42 第1题(c)）

二. 用 F=kx 换算

知识点 弹簧的伸长量等于_____与原长之差，即 $x = l - l_0$。

比例限度是伸长量与载荷保持正比时可施加的最大载荷；在此范围内，$F = kx$，故 $k =$ _____。

若给出两组载荷和长度，则 $k = \Delta\frac{F}{\Delta}x$；质量悬挂时，先由 $W = mg$ 求载荷。

F 用 N、x 用 m 时，k 的单位为 N/m；x 用 cm 时，单位为_____。

答案：受力后长度；$\frac{F}{x}$；N/cm

怎么认 题目出现弹簧原长、受力后长度或两组载荷，并要求弹簧常量时，先求伸长量或伸长量的变化。

例题 2 A spring is suspended from a clamp. Fig. 1.1 shows a pointer attached to the lower end of the spring.

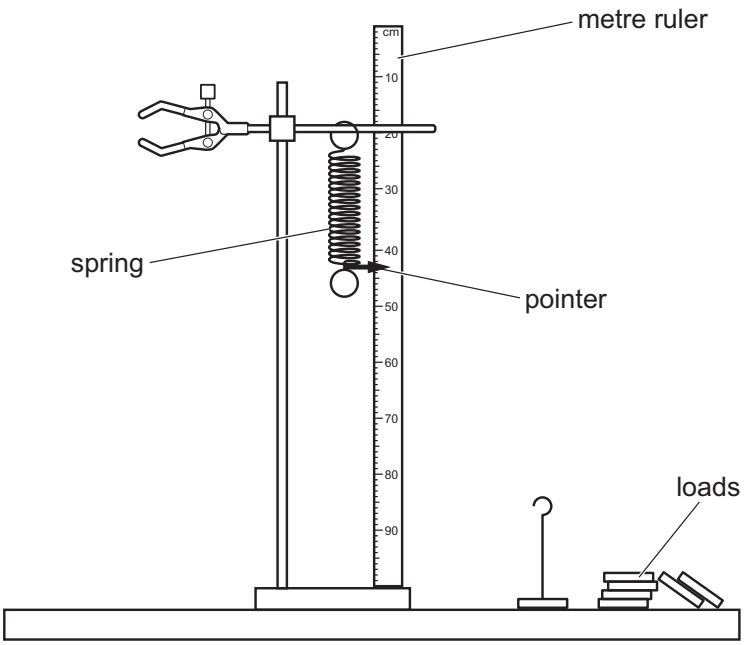


Fig. 1.1

A student suspends loads of different weights from the spring and records the readings on the metre ruler.

Fig. 1.2 is the reading–weight graph that the student obtains.

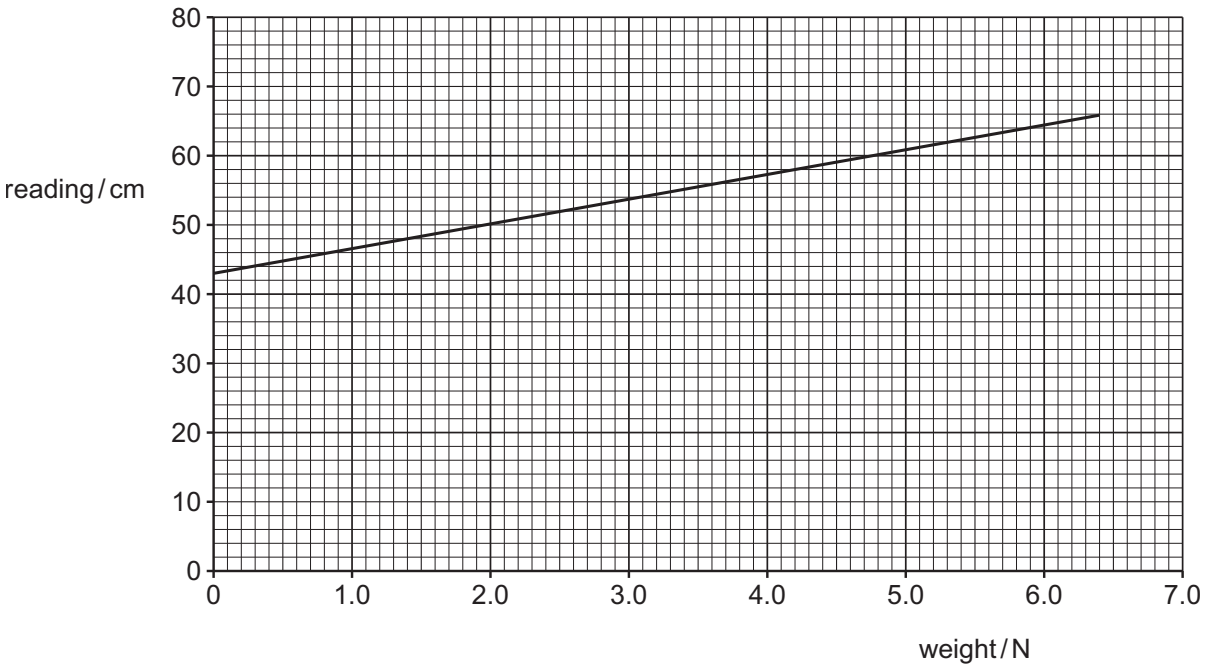


Fig. 1.2

(a) (i) Using Fig. 1.2, determine the reading on the metre ruler when

(ii) Calculate the **extension** of the spring when the weight attached is 5.6 N.

(b) Using the values found in **(a)**, calculate the spring constant of the spring.

（2024 冬季 0625/41 第1题(b)）

解：由图得未挂载荷时读数为 43 cm，挂 5.6 N 载荷时读数为 63 cm。

$x = 63 - 43 = 20$ cm

在比例限度内，由 $F = kx$ 得

$k = \frac{F}{x} = \frac{5.6}{20} = 0.28$ N/cm。

答：弹簧常量为 0.28 N/cm。

针对练习

4. A spring has a length of 25 cm when a load of 2.0 N is suspended from it.

The spring has a length of 35 cm when a 7.0 N load is used.

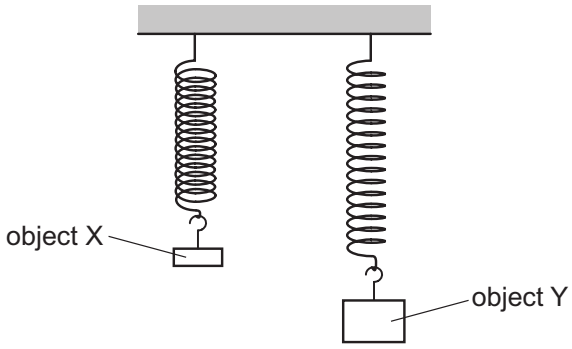
What is the spring constant of the spring?

A 0.20 N/cm **B** 0.50 N/cm **C** 2.0 N/cm **D** 5.0 N/cm

（2025 夏季 0625/21 第5题）

5. The diagram shows two objects, X and Y, suspended from identical springs.

The extension of each spring is different.



Which row compares the mass and the weight of the two objects?

	mass	weight
A	both objects have the same mass	both objects have the same weight
B	both objects have the same mass	the weight of X is less than the weight of Y
C	the mass of X is less than the mass of Y	both objects have the same weight
D	the mass of X is less than the mass of Y	the weight of X is less than the weight of Y

（2024 夏季 0625/11 第2题）

6. **(b)** Fig. 2.1 shows a baby in a baby bouncer. The baby bouncer consists of a holder suspended from a spring. The baby pushes his feet on the ground and bounces gently up and down.

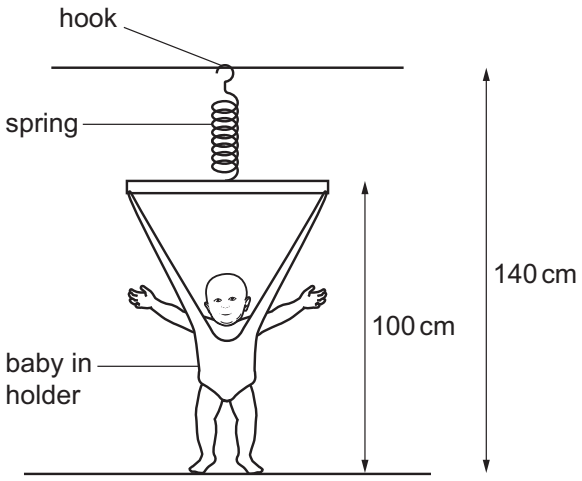


Fig. 2.1

(i) Two springs Q and R are tested to determine their spring constants.

Each spring is tested up to its limit of proportionality.

Define 'limit of proportionality'.

(ii) Table 2.1 shows the results of the tests.

spring	spring constant / N/cm
Q	7.8
R	1.1

Table 2.1

The total weight of the baby and the holder is 120 N.

Calculate the extension of each spring for this weight.

(iii) The unstretched length of each spring is 25 cm.

State and explain which spring would be more suitable for the baby bouncer in Fig. 2.1.

（2024 冬季 0625/43 第2题(b)）

7. A 0.15 kg mass is suspended from a vertical spring.

The mass is pulled downwards until the spring has extended by 12 cm from its unstretched length.

The spring constant of the spring is 30 N/m.

What is the magnitude of the initial acceleration of the spring when it is released?

A $14\,m/s^2$ **B** $24\,m/s^2$ **C** $28\,m/s^2$ **D** $34\,m/s^2$

（2025 夏季 0625/22 第6题）

三. 图上先找直线正比段

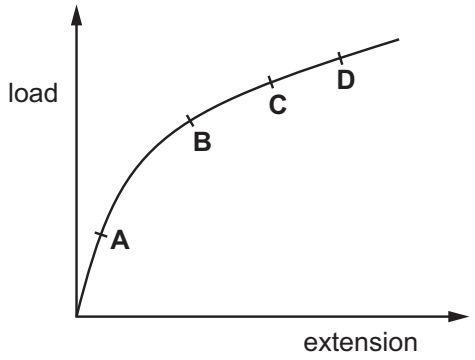
知识点 在比例限度内，弹簧所受载荷 F 与伸长量 Δx 成_____，满足 $F = k\Delta x$。
比例限度是正比关系成立的最大载荷；图线开始偏离直线处为_____。
在载荷–伸长图中，弹簧常量 $k = \frac{F}{\Delta x}$，等于直线段的_____，单位为 $\mathrm{N\ m^{-1}}$。

答案：正比；比例限度；斜率

怎么认 题目出现载荷–伸长图并问比例限度时，先找直线正比段结束、图线开始弯曲处。

例题 3 The load–extension graph for a material is shown.

Which point indicates the limit of proportionality?



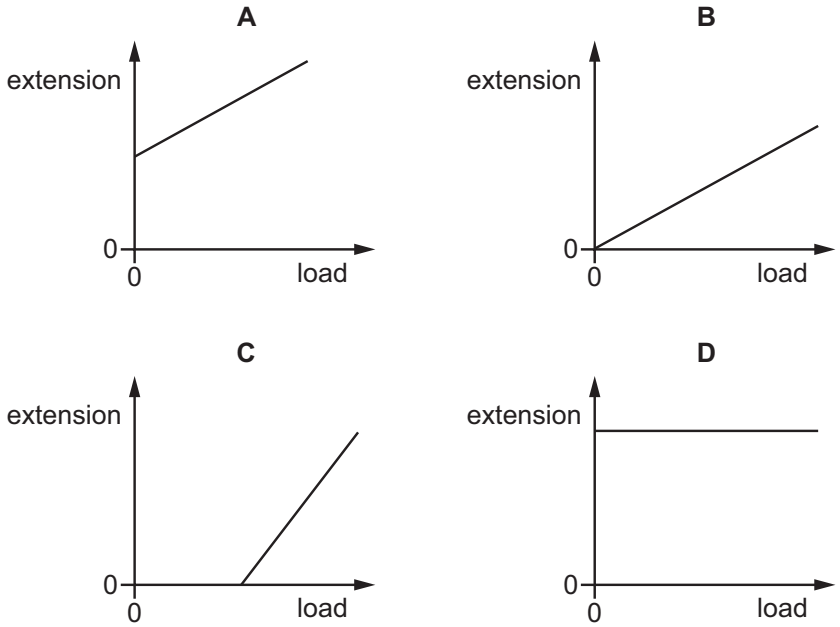
（2025 春季 0625/22 第5题）

解：在比例限度内，载荷与伸长量成正比，图线为过原点的直线。
点 A 是图线开始偏离初始直线的位置，因此点 A 表示比例限度。
故选 A。

针对练习

8. A spring is stretched by adding loads to it.

Which diagram shows the extension–load graph for the spring?



（2024 冬季 0625/13 第7题）

9. Fig. 1.1 shows a force–extension graph for a spring.

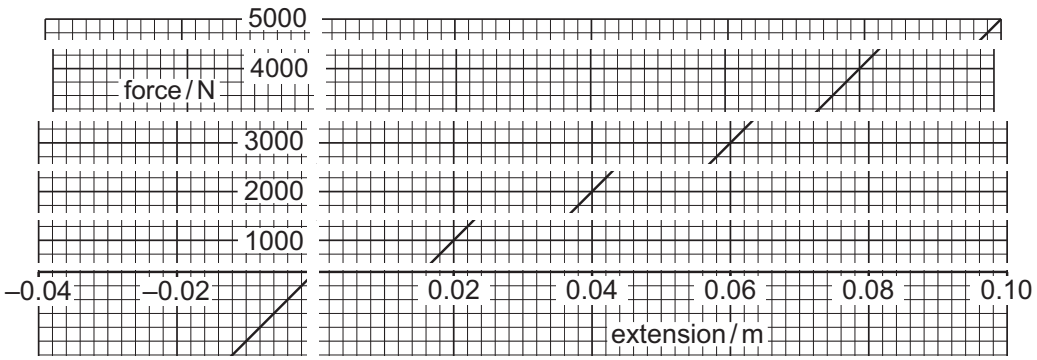


Fig. 1.1

(a) Calculate the spring constant *k* of the spring.

（2025 春季 0625/42 第1题(a)）

10. **(a)** Fig. 2.1 is a graph that shows how the extension of a spring varies with the load suspended from it.

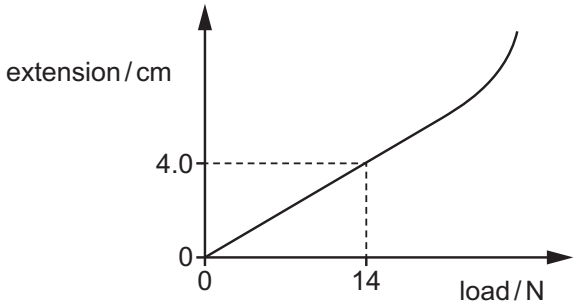
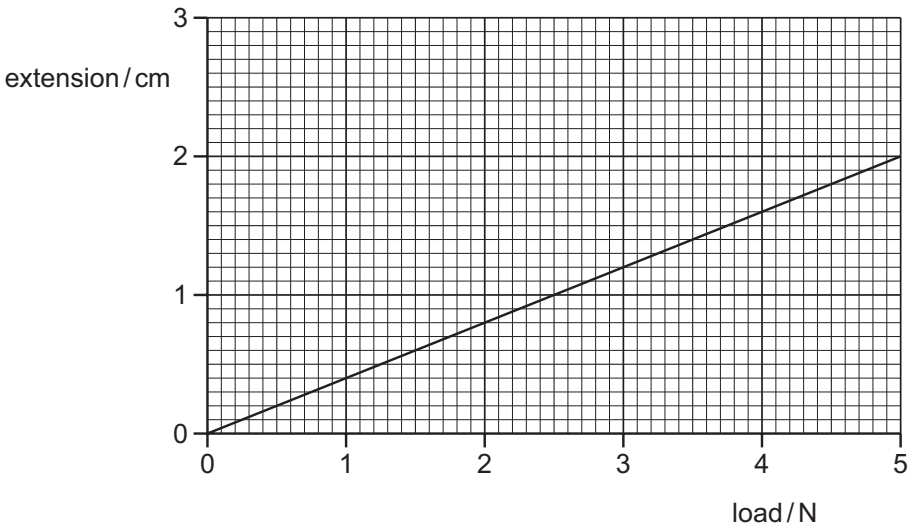


Fig. 2.1

(i) Determine the spring constant of this spring.

（2023 冬季 0625/43 第2题(a)）

11. The extension–load graph for a spring is shown. The unstretched length of the spring is 15.0 cm.



When an object of unknown weight is suspended on the spring, the length of the spring is 16.4 cm.

What is the weight of the object?

A 0.55 N **B** 0.67 N **C** 3.5 N **D** 4.1 N

（2024 夏季 0625/11 第4题）

题型 4：下落题先比较重力与阻力（考频★★☆☆☆）

知识点 物体在空气中竖直下落，且竖直方向只受重力和空气阻力时，重力竖直向下，空气阻力竖直向上。

刚下落时，重力大于空气阻力，物体加速；随速率增大，空气阻力增大，合力和加速度逐渐减小。

当空气阻力与重力_____时，合力为_____，物体以恒定的_____下落。

力的单位是牛顿，符号为 N；速率单位为 $\mathrm{m/s}$，加速度单位为 $\mathrm{m/s^2}$。

答案：相等；零；终端速率

怎么认 题目出现物体在空气中下落、速率–时间图趋于水平或终端速率时，先比较重力与空气阻力。

例题 1 Fig. 1.1 shows the speed-time graph for a ball falling through the air.

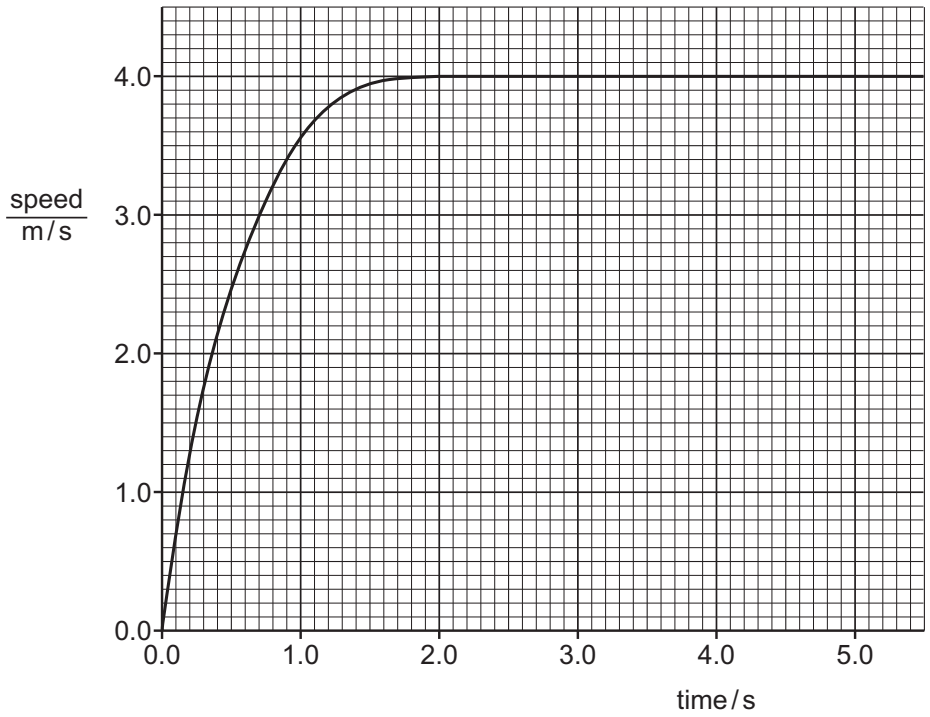


Fig. 1.1

(d) Fig. 1.2 shows the two vertical forces acting on the ball at time = 3.0 s.

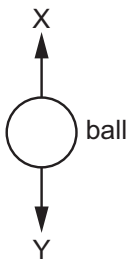


Fig. 1.2

Give the term used to describe each force.

（2025 春季 0625/32 第1题(d)）

解：由图 1.1 知，$t = 3.0$ s 时球的速率不变，故加速度为零，竖直合力为零。
球向下运动，向上的 X 为空气阻力，向下的 Y 为重力。
答：X 为空气阻力，Y 为重力。

针对练习

1. An object is falling in a uniform gravitational field.

After a certain time, it reaches terminal velocity.

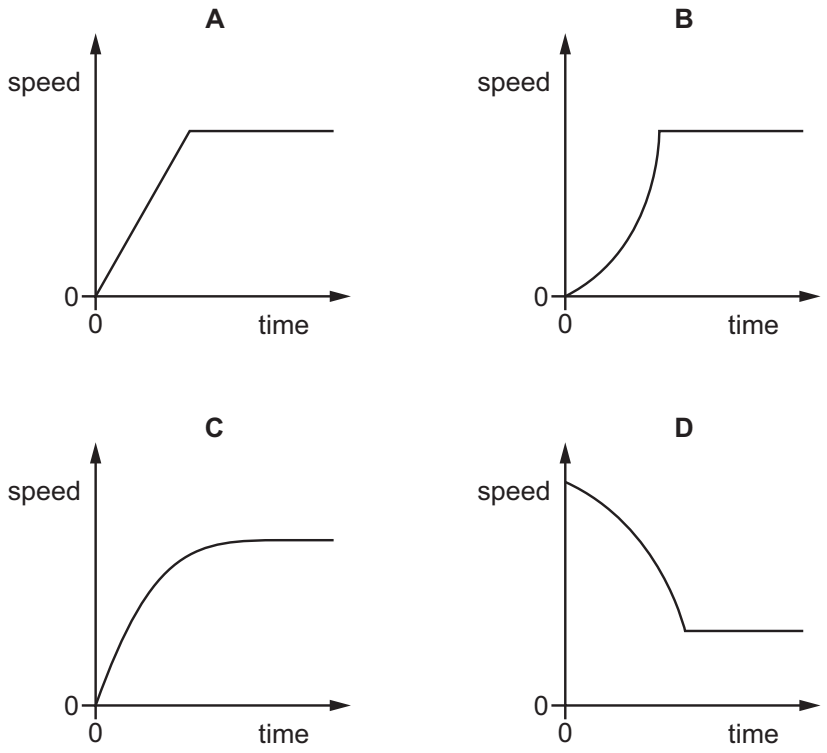
Which row is correct?

	velocity of object	acceleration of object
A	increases then decreases	positive then negative
B	increases then decreases	positive then zero
C	increases then constant	positive then negative
D	increases then constant	positive then zero

（2025 冬季 0625/23 第3题）

2. An object reaches terminal velocity after being dropped and falling through air.

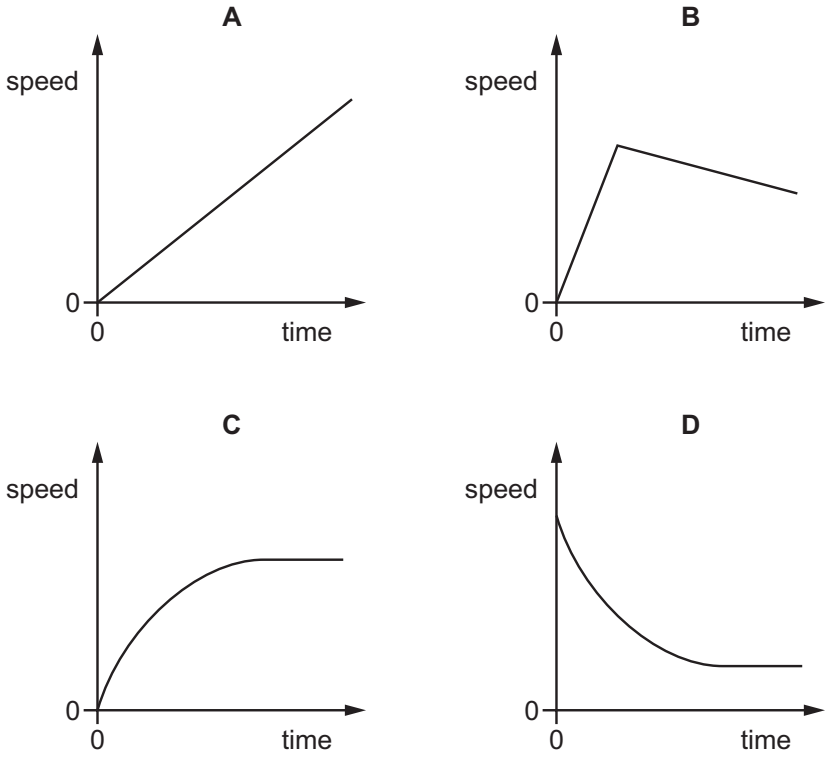
Which graph shows how its speed varies with time?



（2023 冬季 0625/21 第3题）

3. A small, light ball is dropped from the top of a tall building.

Which graph shows how the speed of the ball changes with time?



（2024 冬季 0625/22 第3题）

4. Fig. 2.1 shows a space vehicle which consists of a capsule and a nose cone.

The space vehicle is moving at a velocity of 7800 m/s. The mass of the space vehicle is 840 kg.

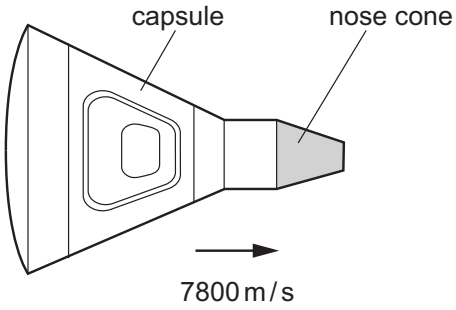


Fig. 2.1

(c) A different space capsule returns to Earth.
Fig. 2.3 shows this capsule just before it lands in the sea.
The capsule travels at terminal velocity.

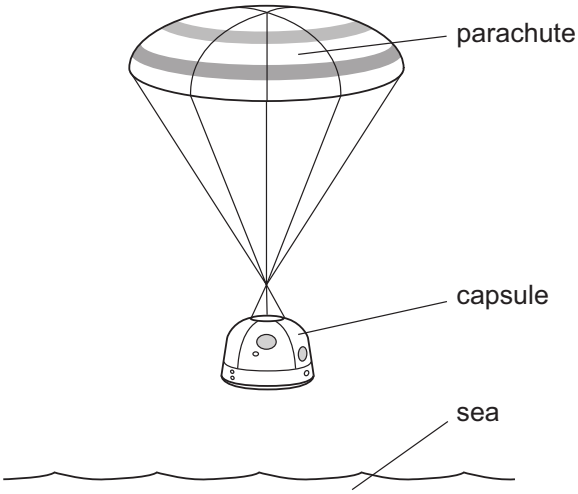


Fig. 2.3

The upward vertical force acting on the capsule is 120 kN.

Calculate the mass of the capsule.

（2025 夏季 0625/43 第2题(c)）

题型 5：转弯题先找指向圆心的力（考频★★☆☆☆）

知识点 物体做圆周运动时，即使速率不变，运动方向仍不断改变，因此速度不断改变。

匀速圆周运动中，合力始终指向_____，并与该处的运动方向_____。

物体质量和速率相同时，合力越大，转弯半径越_____。

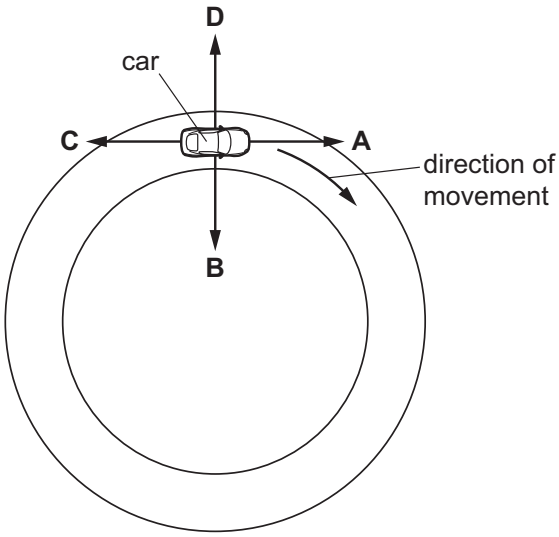
力的单位是牛顿，符号为 N。

答案：圆心；垂直；小

怎么认 题目出现物体以恒定速率沿圆形轨道或弯道运动并问合力方向时，先找圆心所在方向。

例题 1 A car is travelling around a circular track at a constant speed, as shown.

In which direction is the resultant force on the car?

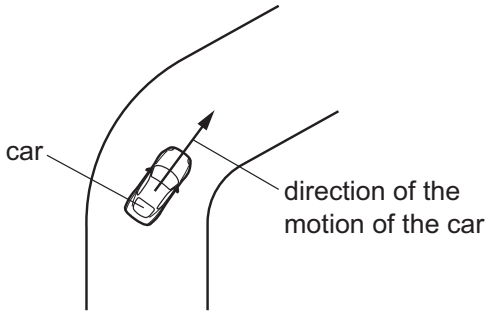


（2025 夏季 0625/23 第7题）

解：汽车以恒定速率沿圆形轨道运动，速度方向不断改变。
匀速圆周运动的合力指向圆心，图中圆心在汽车下方，即 B 方向。
故选 B。

针对练习

1. A car is driven round a bend in the road at a constant speed.



What is the direction of the resultant force on the car when it is going round the bend?

A parallel to the motion and in the same direction as the motion

B parallel to the motion and in the opposite direction to the motion

C perpendicular to the motion and towards the inside of the bend

D perpendicular to the motion and towards the outside of the bend

（2024 冬季 0625/21 第5题）

2. A satellite orbits the Earth at constant speed in a circular orbit.

Which statement is correct?

A The resultant force on the satellite is zero.

B The resultant force on the satellite is towards the Earth.

C The resultant force on the satellite is away from the Earth.

D The resultant force on the satellite is in the direction of its motion.

（2023 冬季 0625/22 第5题）

3. Fig. 2.1 shows an electric tumble dryer used to dry wet clothes.

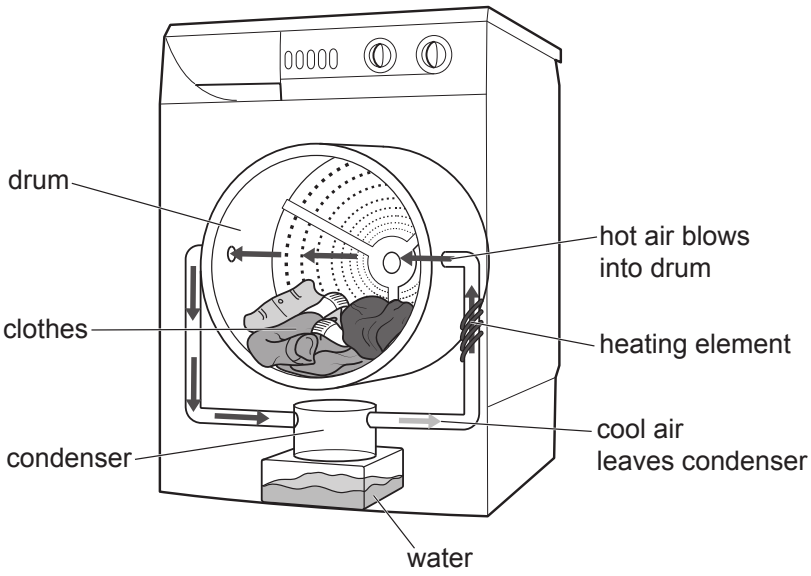


Fig. 2.1

(b) The drum of the tumble dryer rotates, lifting up the wet clothes which then fall down through the hot air.

(i) Name the force that causes the clothes to fall down.

(ii) When the drum rotates too fast the clothes remain in contact with the wall of the drum.

State the direction of the resultant force on the clothes during the circular motion.

（2023 冬季 0625/42 第2题(b)）

4. Fig. 2.1 shows a motorcyclist accelerating along a straight horizontal section of track.

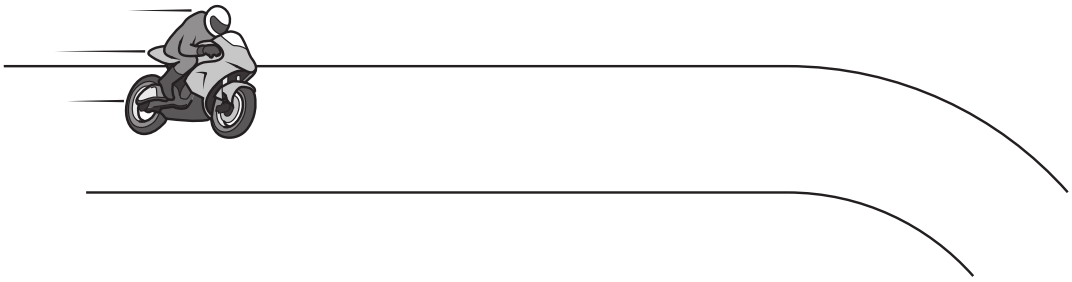


Fig. 2.1

The motorcyclist and motorcycle have a combined mass of 240 kg.

(b) At the end of the straight section, the track remains horizontal but bends to the right, as shown in Fig. 2.1.

When the motorcyclist reaches the bend, she travels around the bend in a circular path at a constant speed.

(i) Velocity is a vector quantity.

State how a vector quantity differs from a scalar quantity.

(ii) Describe what happens to the velocity of the motorcyclist as she travels around the bend at constant speed.

(iii) Explain why there must be a resultant force on the motorcyclist as she travels around the bend.

（2023 夏季 0625/41 第2题(b)）

1.5.2 力的转动效应

题型 1：力矩题先找垂直力臂（考频★★★★☆）

知识点 力矩是力的_____的量度；它由力、支点和力的作用线共同确定。

对指定支点，力矩等于力与支点到力的作用线的_____距离的乘积，即 $M = Fd$。

F 的单位为 N，d 的单位为 m，力矩的单位为_____。

答案：转动效应；垂直；N m

怎么认 题目出现支点、力及其作用位置，或问力矩定义时，先找支点到力的作用线的垂直距离。

一. 先认力矩三要素

例题 1 What is meant by the moment of a force?

A the magnitude of the force

B the work done by the force

C the time for which the force acts

D the turning effect of the force

（2025 春季 0625/12 第8题）

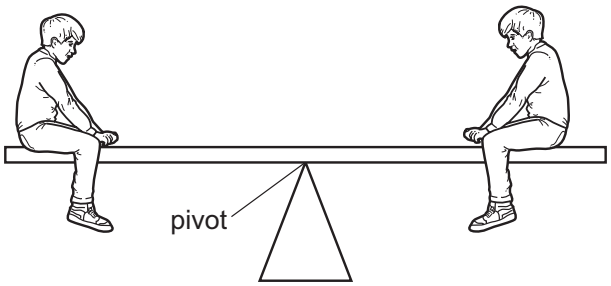
解：力矩表示力的转动效应，故选 D。

针对练习

1. **(a)** Define the moment of a force and describe the effect that it measures.

（2024 冬季 0625/41 第3题(a)）

2. Two boys are sitting on a see-saw. The see-saw is in equilibrium and remains horizontal.



What affects the moment of each boy about the pivot?

A his distance from the pivot only

B his height above the ground and his weight

C his weight only

D his weight and distance from the pivot

（2023 夏季 0625/12 第6题）

3. Fig. 2.1 shows a balanced, uniform metre ruler made of wood.

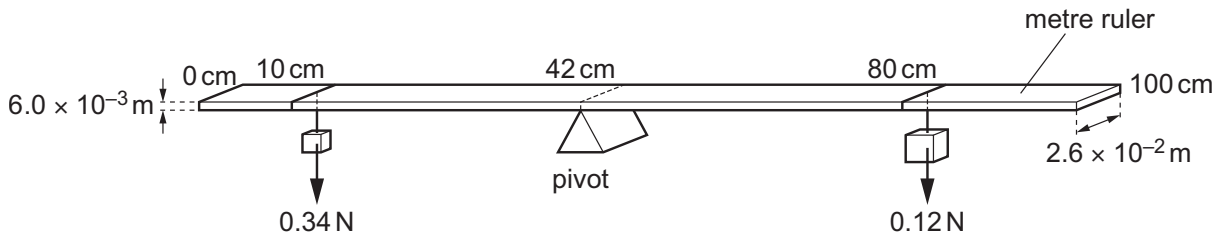


Fig. 2.1

The width of the metre ruler is 2.6×10^{-2} m and the thickness of the ruler is 6.0×10^{-3} m.

(a) Define the 'moment' of a force in words.

（2025 夏季 0625/42 第2题(a)）

4. Which statement about the moment of a force is **not** correct?

A If an object is balanced about a pivot, the resultant moment on the object must be zero.

B The moment of a force is a measure of its turning effect.

C The moment of a force about a point is equal to: force × perpendicular distance from the point.

D The moment of a force about a point increases when the perpendicular distance of the force from the point decreases.

（2025 冬季 0625/21 第6题）

二. 从支点量到作用线

知识点 力矩是力对物体转动效应的量度。

力对支点的力矩等于力与支点到力的_____的距离之积，即 $M = Fd$。

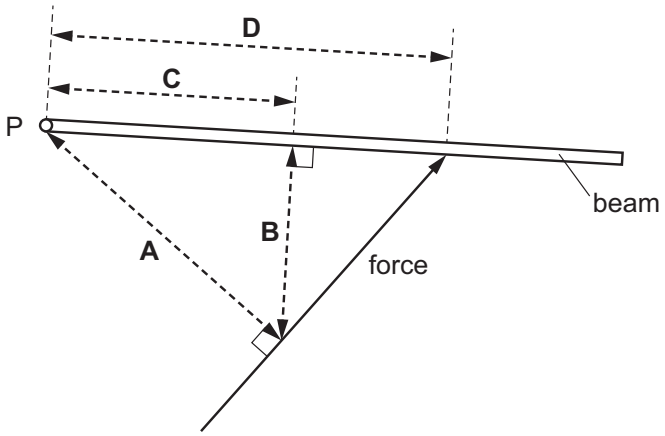
其中 d 必须取支点到力的作用线的_____距离；F 用 N、d 用 m 时，力矩单位为 N m。

答案：作用线；最短垂直

怎么认 题目出现支点、斜向力和多段候选距离时，先延长力的作用线，再作支点到该线的垂线。

例题 2 A beam is pivoted at P. A force is applied to the beam.

Which distance is multiplied by the force to give the moment of the force about P?



（2023 夏季 0625/13 第7题）

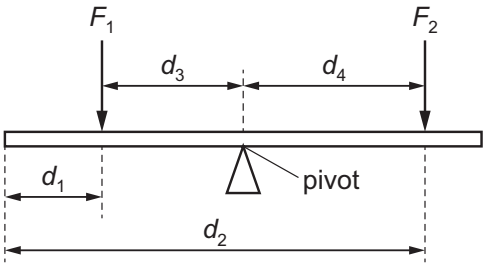
解： 由力矩定义，$M = Fd$，其中 d 为支点到力的作用线的垂直距离。

图中距离 A 从支点 P 量到力的作用线，且与作用线垂直。

故选 A。

5. The diagram shows a uniform beam pivoted at its centre.

A student applies two forces, F_1 and F_2, as shown.



Which row is correct?

	clockwise moment about the pivot	anticlockwise moment about the pivot
A	F_2d_2	F_1d_1
B	F_2d_2	F_1d_3
C	F_2d_4	F_1d_1
D	F_2d_4	F_1d_3

（2024 冬季 0625/22 第6题）

6. Fig. 3.1 shows a computer on the surface of a desk.

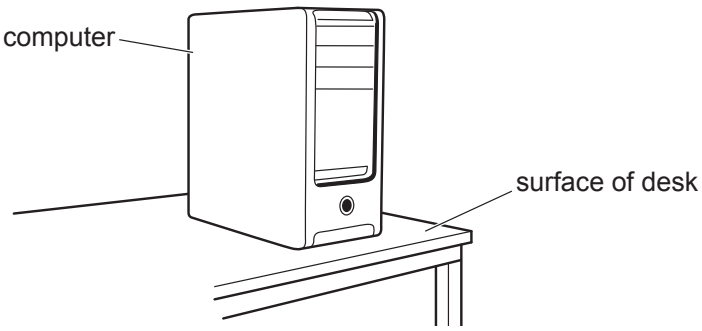


Fig. 3.1

(b) A student uses a force of 12 N to tilt the computer as shown in Fig. 3.2.

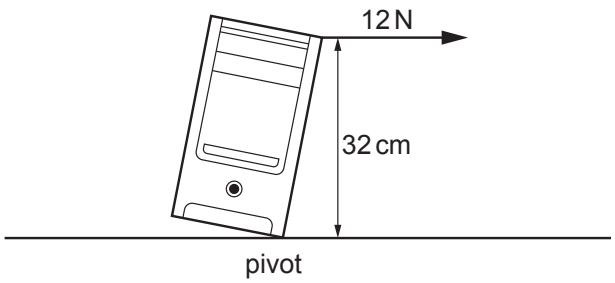


Fig. 3.2

Calculate the moment of the 12 N force about the pivot.

（2024 春季 0625/32 第3题(b)）

7. Fig. 3.1 shows the horizontal forces acting on a boat.

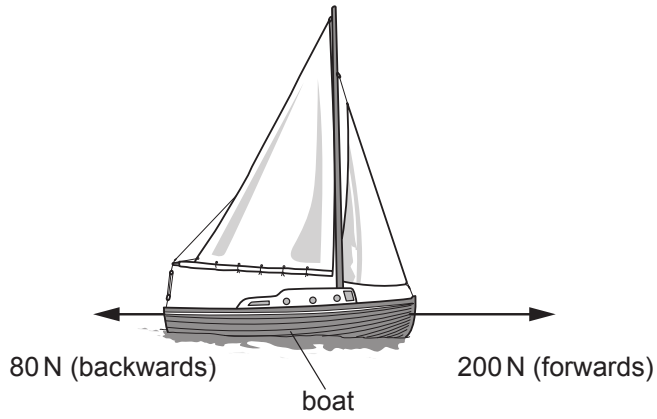


Fig. 3.1

(b) Fig. 3.2 shows the wheel used to steer a boat.

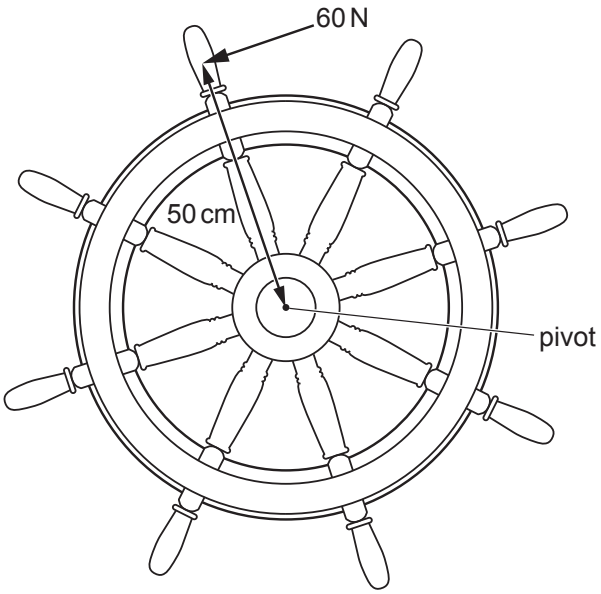


Fig. 3.2

A force of 60 N acts at a perpendicular distance of 50 cm from the wheel's pivot.

Calculate the moment of the 60 N force about the pivot. Include the unit.

（2024 夏季 0625/31 第3题(b)）

三. 力乘垂距并判转向

知识点 力矩是力对物体转动效应的量度，关于支点的力矩 $M = Fd$，其中 d 为支点到力的作用线的_____距离。

同一支点处，顺时针力矩与逆时针力矩方向相反，合力矩按方向合成。

物体平衡时合力和合力矩均为零，即顺时针力矩之和与逆时针力矩之和_____；力矩常用单位为_____。

答案：垂直；相等；N m 或 N cm

怎么认 题目出现支点、作用力及垂直距离并求力矩或判断平衡时，先按转向分别计算力矩。

例题 3 Fig. 2.1 shows a concrete beam resting on the ground.

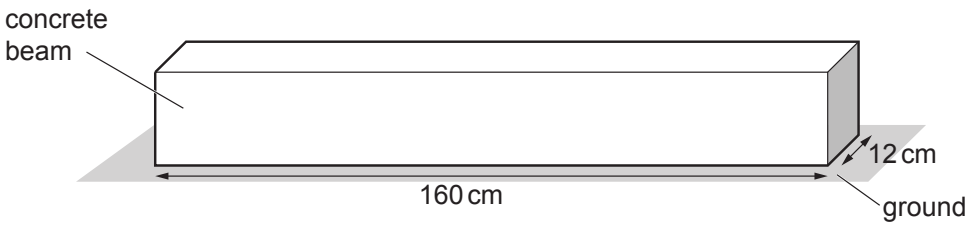


Fig. 2.1 (not to scale)

(b) A builder starts to raise one end of the beam.

He uses a force of 1030 N at a perpendicular distance of 120 cm from the pivot. Fig. 2.2 shows the arrangement.

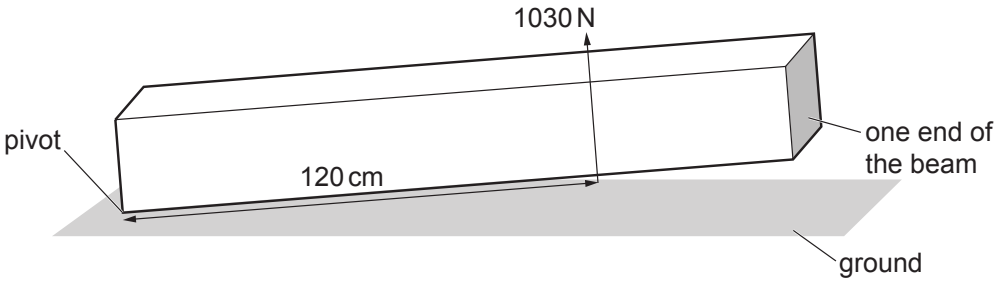


Fig. 2.2 (not to scale)

Calculate the moment of the 1030 N force about the pivot.

（2023 夏季 0625/31 第2题(b)）

解： 由图知，1030 N 的力使横梁绕支点逆时针转动，垂直力臂为 120 cm。

由 $M = Fd$ 得

$M = 1030 \times 120 = 123600$ N cm

$M \approx 1.2 \times 10^5$ N cm

答：力矩为 1.2×10^5 N cm，方向为逆时针。

8. Fig. 2.1 shows a road sign on the ground.

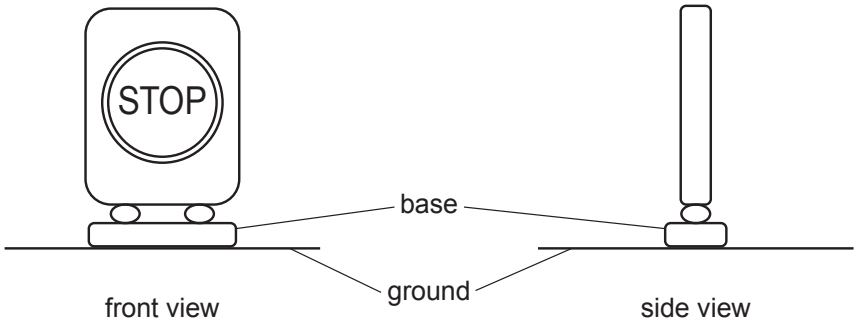


Fig. 2.1

(a) A strong wind blows and the sign begins to fall over. A man catches the sign before it falls completely.

Fig. 2.2 shows the force applied to the sign by the man.

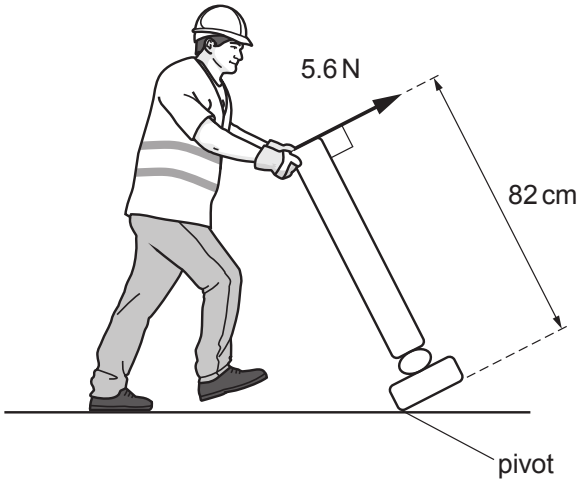


Fig. 2.2

Calculate the moment of the 5.6N force about the pivot. Use the information in Fig. 2.2.

（2024 夏季 0625/33 第2题(a)）

9. Fig. 3.1 shows a cross-section through the centre of a solid cone and a cross-section through the centre of a solid cuboid. The cone and the cuboid are placed on the ground as shown in Fig. 3.1.
The solid cone is more stable than the solid cuboid.
The symbol × indicates the position of the centre of gravity of each object.

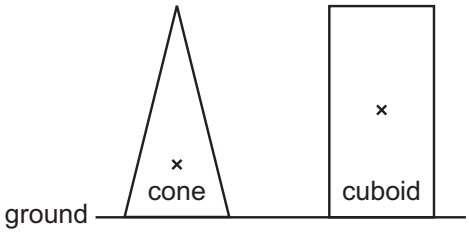


Fig. 3.1

(c) A horizontal force of 15 N tilts the solid cone, as shown in Fig. 3.2.

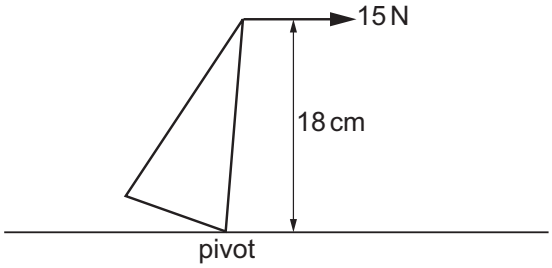


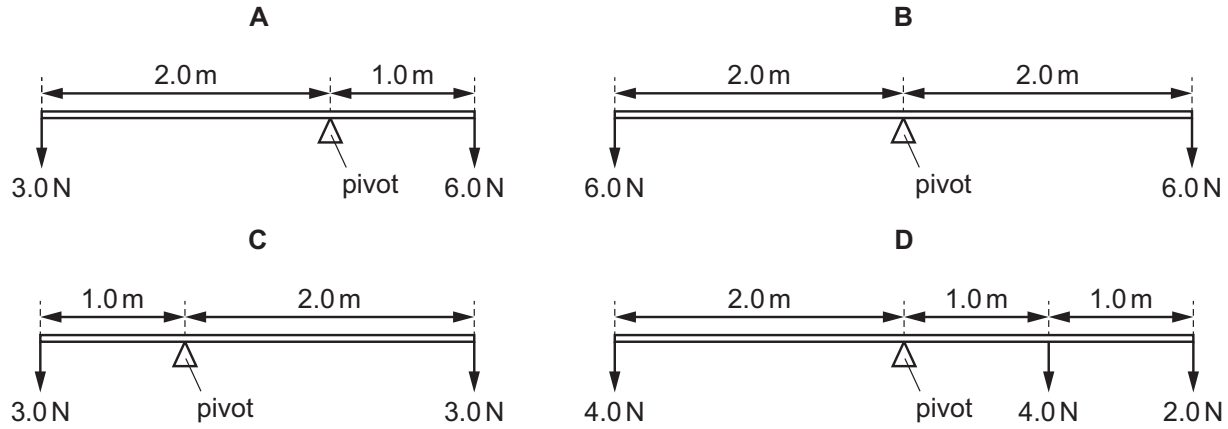
Fig. 3.2

Calculate the moment of the 15 N force about the pivot.

（2025 春季 0625/32 第3题(c)）

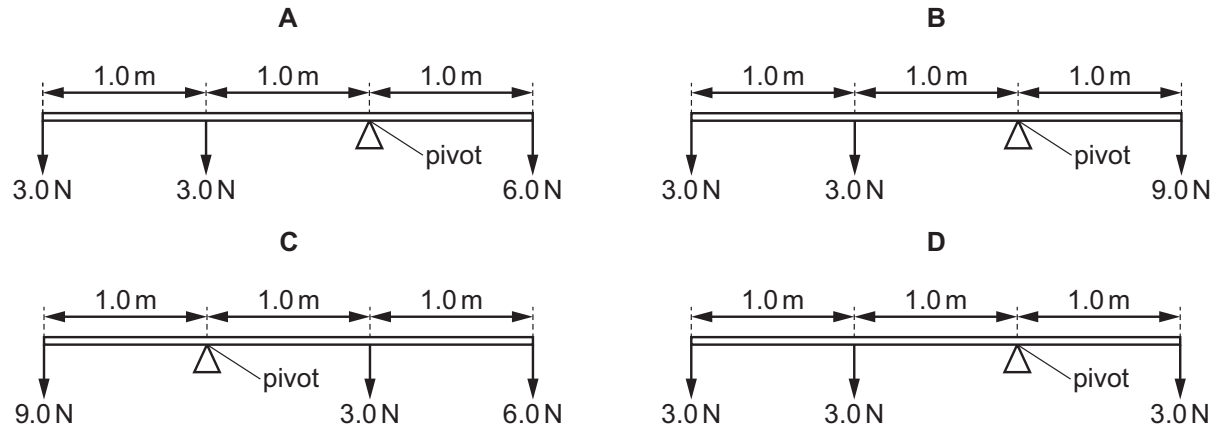
10. The diagrams show four beams, each of negligible weight and freely pivoted.

Which beam is **not** in equilibrium?



（2023 夏季 0625/21 第8题）

11. Which beam is balanced? (Ignore the weight of the beam.)



（2025 冬季 0625/23 第7题）

四. 要省力就增大力臂

知识点 力矩是力的转动效应的量度，绕支点的力矩等于力与支点到力的作用线的_____距离之积：$M = Fd$。

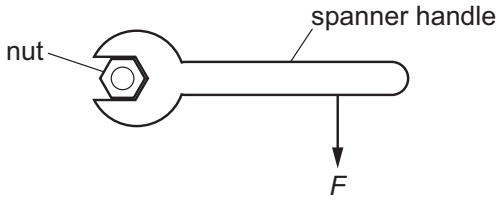
其中 F 的单位为 N，d 的单位为 m，力矩单位为 N m。

所需力矩一定时，$F = \frac{M}{d}$，_____垂直力臂可减小所需的力；力不变时，增大垂直力臂可增大力矩。

答案：垂直；增大

怎么认 题目出现扳手、杠杆或绕支点转动并比较省力时，先找垂直力臂。

例题 4 A force *F* is applied to a spanner, as shown.



Which action increases the moment of *F* about the centre of the nut?

A applying the force *F* to the right-hand end of the spanner handle

B applying the force *F* parallel to the spanner handle

C spraying oil on the nut

D using a shorter spanner

（2025 冬季 0625/22 第5题）

解： 设螺母中心到力的作用线的垂直距离为 d，则

$M = Fd$

将大小、方向不变的力施加在手柄右端，垂直力臂增大，即 $d' > d$，故

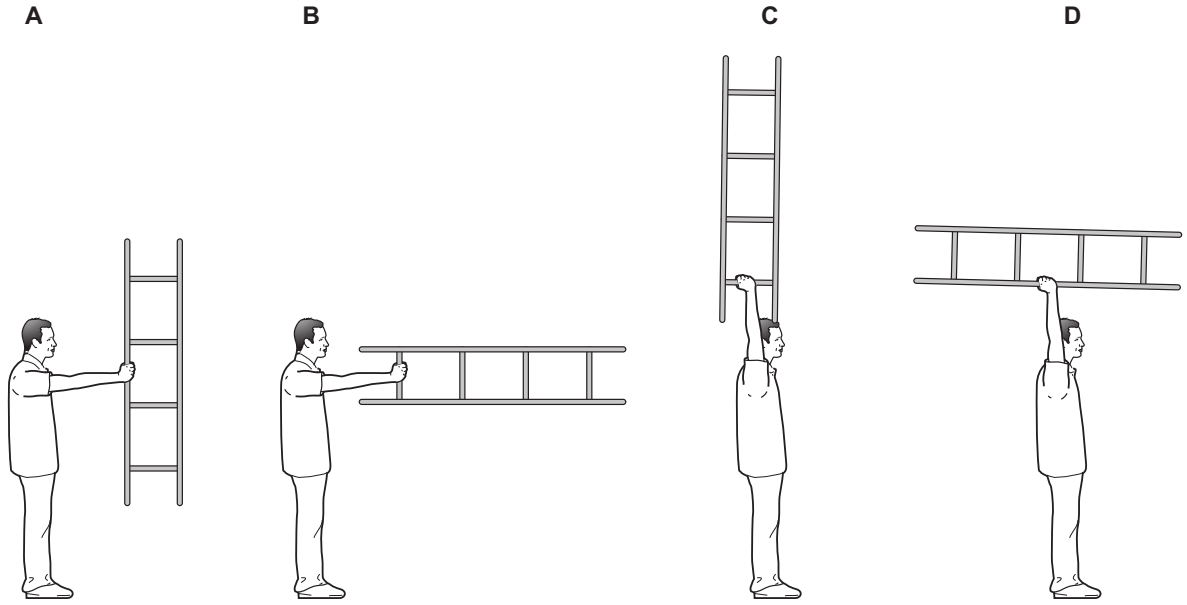
$M' = Fd' > Fd = M$

故选 A。

12. A man holds a ladder in four different positions, pivoting around his shoulder.

The weight of the ladder causes a moment about the man's shoulder.

In which position is the moment greatest?



（2025 冬季 0625/13 第6题）

13. Fig. 2.1 shows a concrete beam resting on the ground.

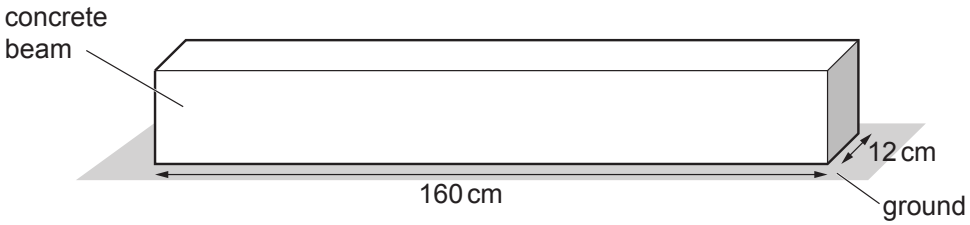


Fig. 2.1 (not to scale)

(c) Describe how the builder can use a smaller force to lift the beam.

（2023 夏季 0625/31 第2题(c)）

14. A car has a fault. A mechanic uses a machine to pull the car onto a recovery vehicle as shown in Fig. 3.1.

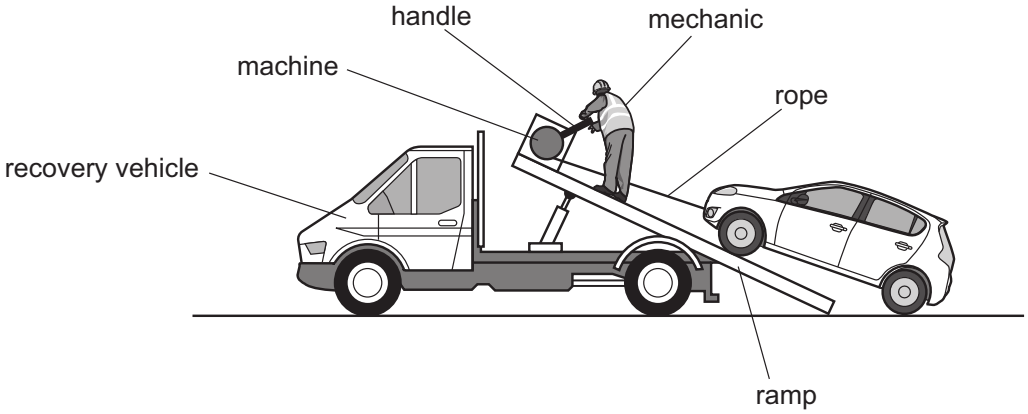


Fig. 3.1

(a) Fig. 3.2 shows how the mechanic applies a force to the handle of the machine.

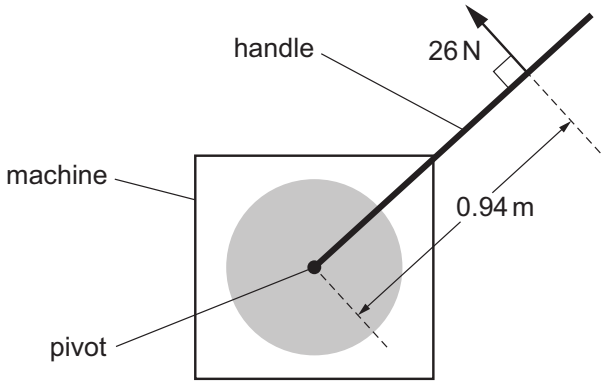


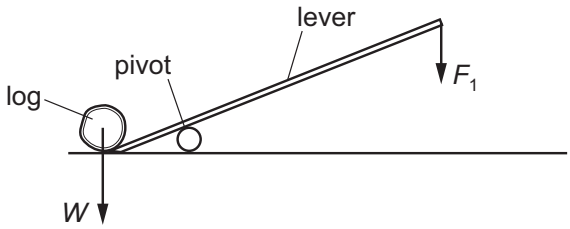
Fig. 3.2

(i) Calculate the moment of the 26 N force about the pivot. Use the information in Fig. 3.2.

(ii) Describe **one** way the mechanic can increase the moment of the 26 N force about the pivot.

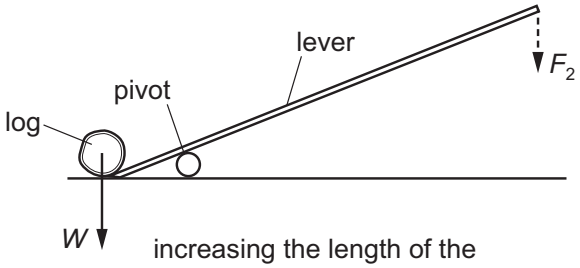
（2024 冬季 0625/32 第3題(a)）

15. The diagram shows the minimum force F_1 acting vertically on a lever required to lift a heavy log of weight W.



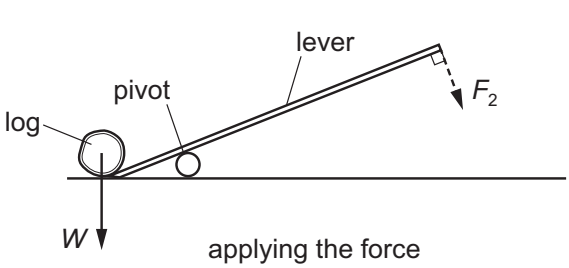
The log needs to be lifted by a smaller force than F_1. The diagrams show the changes tried. Each diagram has only **one** change from the original diagram. In each case, F_2 is the minimum force required to lift the log.

P



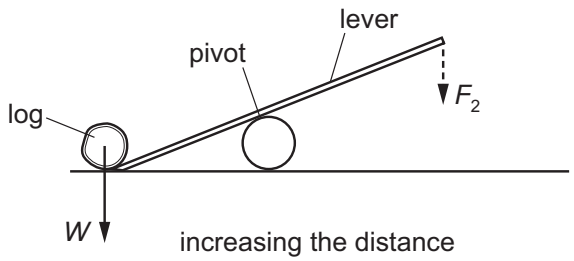
increasing the length of the lever to the right of the pivot

Q



applying the force perpendicular to the lever

R



increasing the distance from the log to the pivot

In which situations will F_2 be smaller than F_1?

A P, Q and R **B** P and Q only **C** P only **D** Q and R only

（2023 夏季 0625/23 第8题）

题型 2：平衡杆先令顺逆力矩相等（考频★★★★☆）

知识点 力矩是力使物体绕支点转动效应的量度，$M = Fd$，其中 d 为支点到力作用线的_____距离；单位为 N m，也可按题中长度写成 N cm。

物体平衡时，合力为 0 且合力矩为 0；以同一支点取矩，总顺时针力矩_____总逆时针力矩。

支点两侧各有一个力时，$F_1 d_1 = F_2 d_2$，各力臂必须相对于同一支点确定。

答案：垂直；等于

怎么认 题目出现物体绕支点平衡、两侧各有一个力及力臂时，先写顺时针力矩等于逆时针力矩。

一. 一边一个力矩配平

例题 1 A metre rule is balanced at its midpoint.

It remains balanced when a 3.0 N load is hung from the 40 cm mark and a second load is hung from the 80 cm mark.

What is the weight of the second load?

A 1.0 N **B** 1.5 N **C** 3.0 N **D** 9.0 N

（2023 春季 0625/12 第8题）

解： 取 50 cm 刻度处为支点，米尺重力作用线通过支点，其力矩为 0。

$d_1 = 50 - 40 = 10$ cm

$d_2 = 80 - 50 = 30$ cm

由顺时针力矩等于逆时针力矩得

$3.0 \times 10 = W \times 30$

$W = \frac{3.0 \times 10}{30} = 1.0$ N

故选 A。

针对练习

1. A wooden beam is used in a see-saw.

(b) Two children balance the wooden beam horizontally on a log. The wooden beam pivots on the log to make the see-saw.
Fig. 3.1 shows the children on the see-saw.

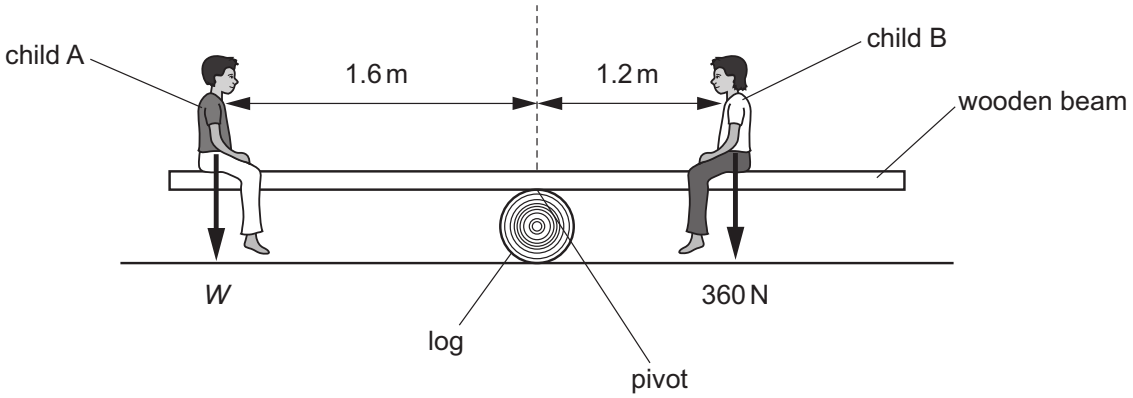


Fig. 3.1 (not to scale)

The see-saw balances horizontally, as shown in Fig. 3.1. The weight of child B is 360 N.

Calculate the weight *W* of child A.

State and use the principle of moments in your answer.

（2025 夏季 0625/31 第3题(b)）

2. Fig. 3.1 shows two solid shapes, a cylinder and a cone, which are made from the same material.

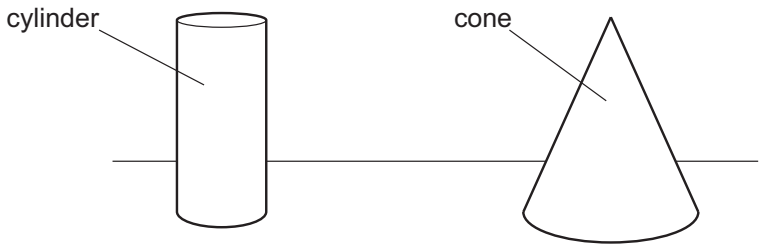


Fig. 3.1

(c) A horizontal force of 3.0 N tilts the cone. The cone balances on one edge, as shown in Fig. 3.2.

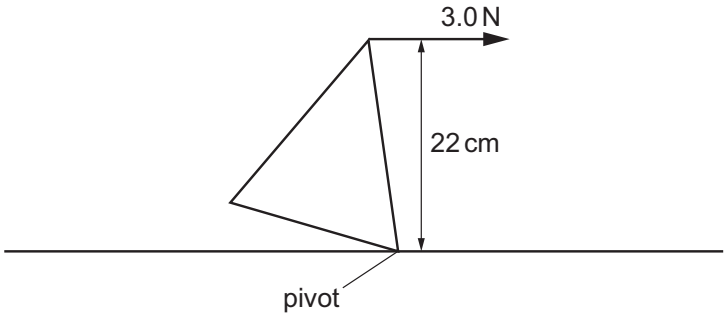


Fig. 3.2

(i) Calculate the moment of the 3.0 N force about the pivot in Fig. 3.2.

(ii) Determine the moment of the weight of the cone about the pivot.
Use ideas about the principle of moments.

（2024 夏季 0625/32 第3題(c)）

3. A student investigates the balancing of a metre ruler.

Fig. 1.1 shows the apparatus.

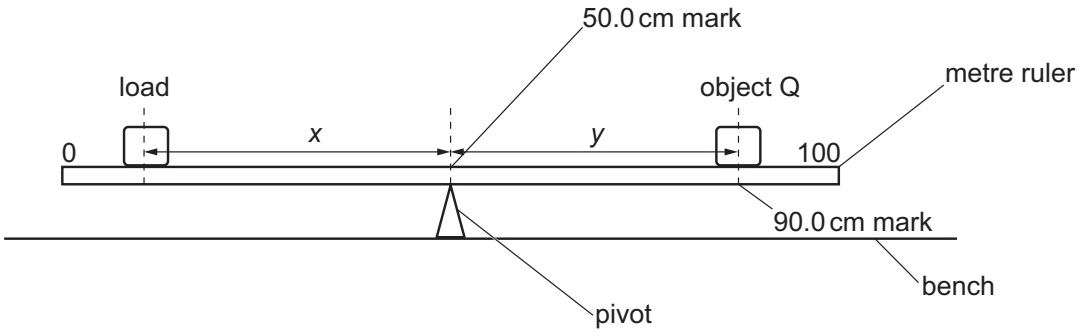


Fig. 1.1

(b) She places a 2.0 N load on the metre ruler.

She adjusts the position of the load so that the metre ruler is as near as possible to being balanced.

She measures the distance x from the centre of the load to the 50.0 cm mark.

x = ... 21.5 ..... cm

(i) Calculate the weight W of object Q, using the equation $W = \frac{x}{y} \times 2.0\,\text{N}$.

Give your answer to a suitable number of significant figures for this experiment.

She repeats the procedure, using a 3.0 N load. She does not change the position of object Q.

x = ... 14.8 ..... cm

(ii) Calculate a new value of the weight W of object Q, using the equation $W = \frac{x}{y} \times 3.0\,\text{N}$.

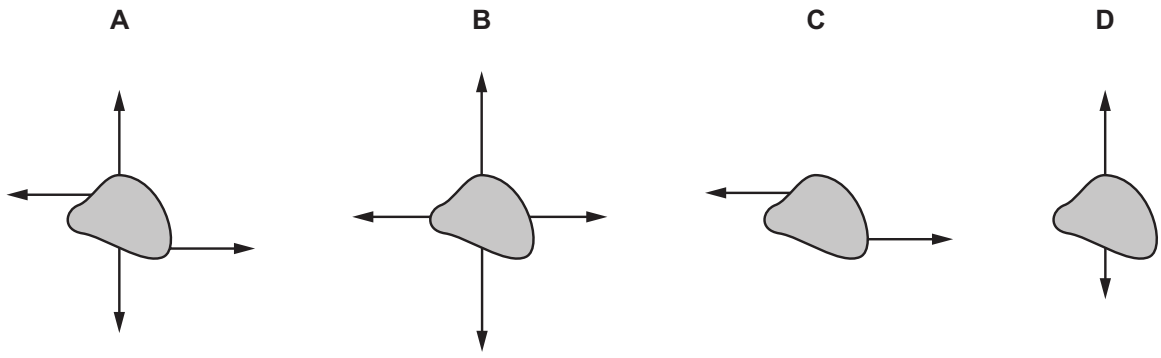
Give your answer to a suitable number of significant figures for this experiment.

（2025 冬季 0625/61 第1题(b)）

4. Forces are applied to four identical objects.

The length of each arrow indicates the magnitude of the force.

Which object is in equilibrium?



（2023 冬季 0625/11 第6题）

二. 多力先分方向求总矩

知识点 力矩是力对物体转动效应的量度，$M = Fd$，其中 d 为支点到力的作用线的垂直距离，单位为 N m。

同一支点周围，顺时针总力矩与逆时针总力矩_____时，物体无合力矩；合力也为零时，物体处于平衡。

均匀杆的重力作用在杆的_____；重力作用线经过支点时，该力矩为零。

多个力作用时，应把各力按_____分类，分别求总力矩后列平衡关系。

答案：相等；重心；顺时针和逆时针方向

怎么认 题目出现平衡杆、多个力及杆自重时，先按顺、逆时针方向分类并分别求总力矩。

例题 2

A uniform metre rule is pivoted in equilibrium at the 50 cm mark. A mass of 25 g is placed at the 30 cm mark on the rule.

What is the smallest mass that can be placed on the rule to restore equilibrium?

A 5 g **B** 10 g **C** 15 g **D** 25 g

（2023 夏季 0625/12 第7题）

解：均匀米尺的重心在 50 cm 刻度处，重力作用线经过支点，力矩为零。

25 g 物体到支点的距离为 20 cm；要使所需质量最小，应将它放在另一侧离支点最远的 100 cm 刻度处，力臂为 50 cm。

设所求质量为 m g，两侧重力场强相同，由力矩平衡得

$25 \times 20 = m \times 50$

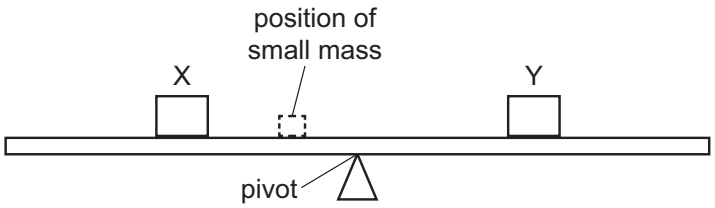
$m = 10$ g

故选 B。

针对练习

5. A uniform beam is pivoted at the centre and two identical masses, X and Y, are placed so that the beam balances.

A smaller mass is then added at the position shown.



How can the masses be positioned so the beam balances again?

A Move X away from the pivot.

B Move X towards the pivot.

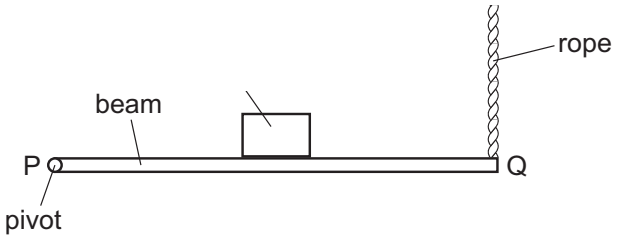
C Move Y towards the pivot.

D Move the small mass away from the pivot.

（2023 夏季 0625/22 第8题）

6. The diagram shows a wooden beam PQ which is attached to a wall by a pivot at P and kept in a horizontal position by a vertical rope attached at Q.

A box has been placed on the beam.



Which changes **must** reduce the tension in the rope at Q?

A Decrease the mass of the box and move it towards P.

B Decrease the mass of the box and move it towards Q.

C Increase the mass of the box and move it towards P.

D Increase the mass of the box and move it towards Q.

（2023 冬季 0625/11 第7题）

7. Fig. 2.1 shows a balanced, uniform metre ruler made of wood.

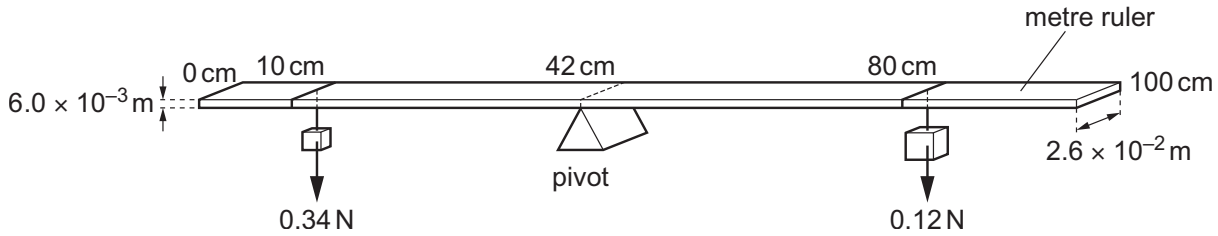


Fig. 2.1

The width of the metre ruler is 2.6×10^{-2} m and the thickness of the ruler is 6.0×10^{-3} m.

(c) (i) Show that the mass of the metre ruler is 0.081 kg.

(ii) Calculate the density of the wood of the metre ruler.

（2025 夏季 0625/42 第2题(c)）

8. Fig. 3.1 shows two children balanced on a seesaw. A seesaw is a length of wood which rotates about a central pivot.

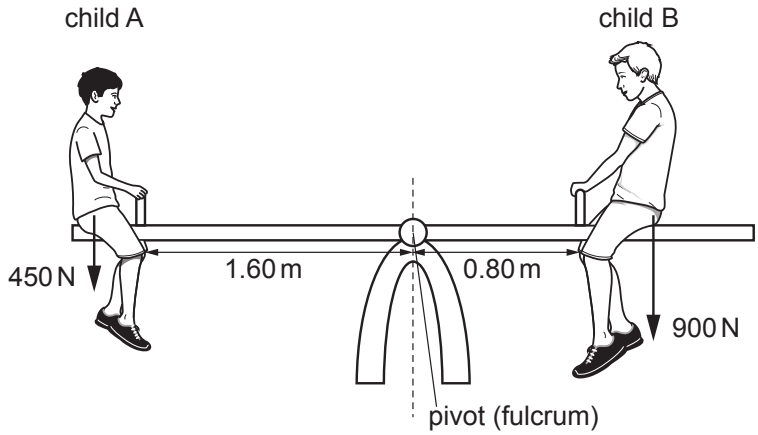


Fig. 3.1

(a) Child B moves 0.050 m further away from the pivot.

(i) Explain why the seesaw rotates clockwise.

(ii) Child A puts on a backpack and the seesaw now balances.

Calculate the mass of the backpack.

（2024 夏季 0625/43 第3题(a)）

三. 同时检查合力和合力矩

知识点 物体处于平衡状态时，所受合力为_____，合力矩为_____。
合力为零表示各方向的力相互抵消；合力矩为零表示顺时针力矩之和等于逆时针力矩之和。
力矩等于力与到支点的垂直距离的乘积，单位为 N m。

答案：零；零

怎么认 题目出现物体受多个力并问是否平衡时，先查合力是否为零，再查合力矩是否为零。

例题 3 **(c)** The block shown in Fig. 3.1 is in equilibrium.

State the **two** different conditions that apply when an object is in equilibrium.

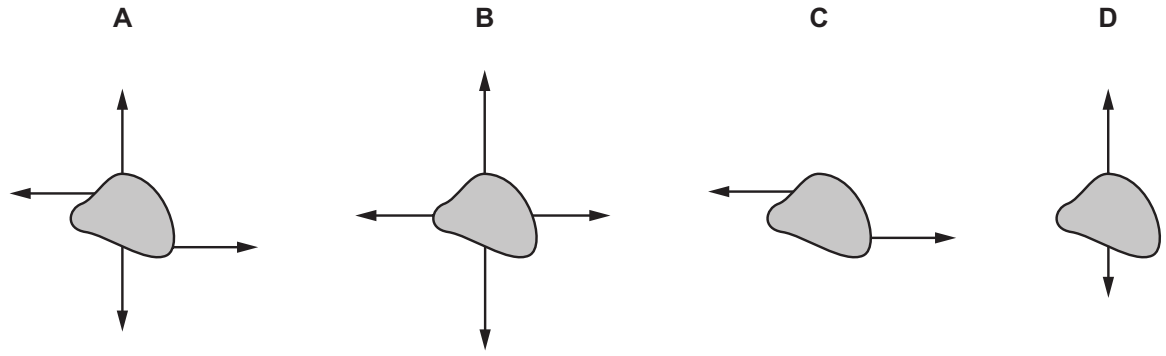
（2024 冬季 0625/41 第3题(c)）

解：物体处于平衡状态，故各方向的力相互抵消，合力为 0。
顺时针力矩之和等于逆时针力矩之和，故合力矩为 0。
答：合力为零；合力矩为零。

9. Forces are applied to four identical objects.

The length of each arrow indicates the magnitude of the force.

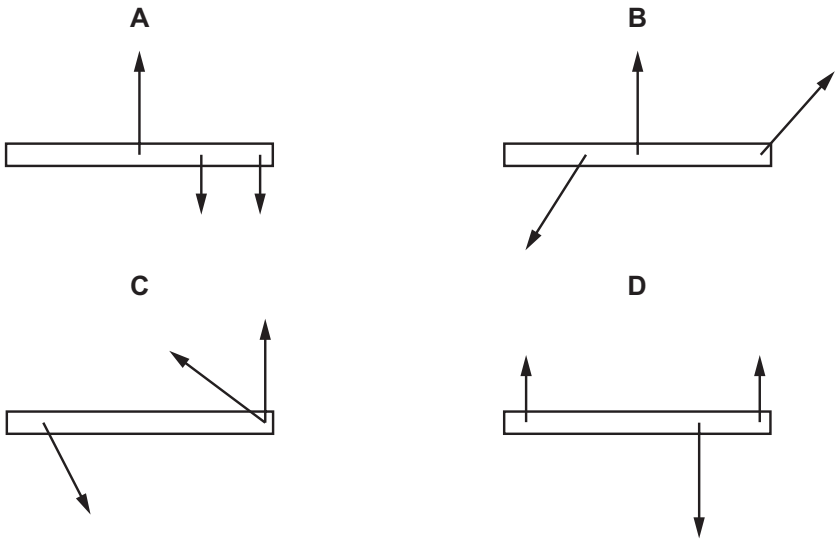
Which object is in equilibrium?



（2023 冬季 0625/21 第6题）

10. Each diagram shows three forces on a beam.

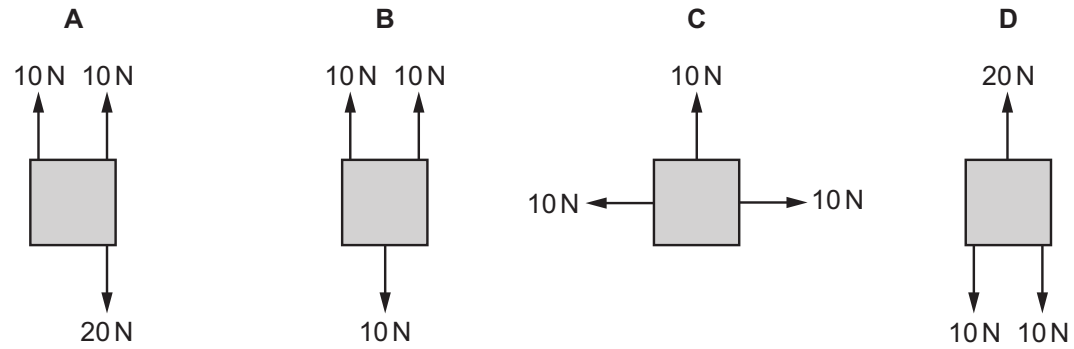
In which situation is it possible for the three forces shown to be in equilibrium?



（2024 夏季 0625/22 第5题）

11. The diagrams show four identical objects. Each object is acted on by only the forces shown.

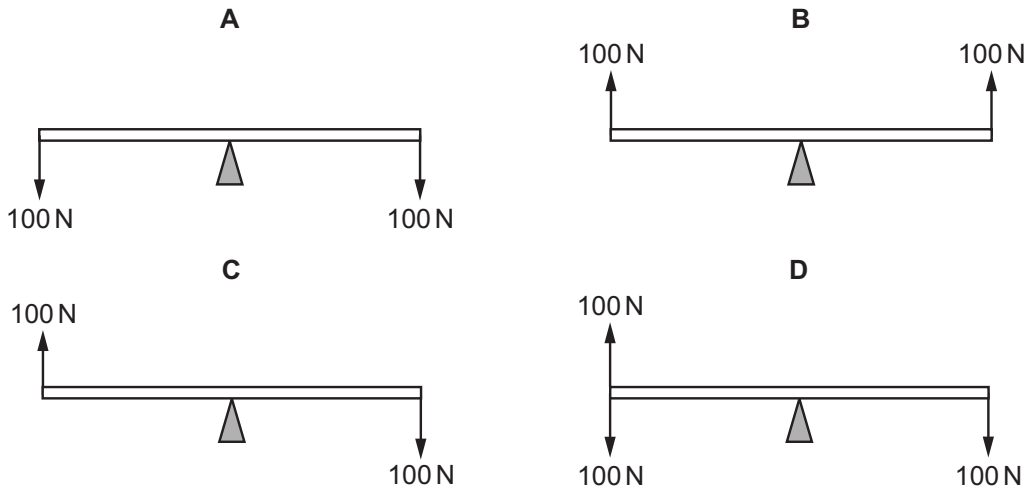
Which diagram shows an object in equilibrium?



（2023 冬季 0625/12 第6题）

12. A uniform rod rests on a pivot at its centre. The rod is not attached to the pivot. Forces are then applied to the rod in four different ways, as shown. The weight of the rod can be ignored.

Which diagram shows the rod in equilibrium?



（2023 冬季 0625/13 第6题）

1.5.3 重心

题型 1：找重心先让物体平衡（考频★★★☆☆）

知识点 重心是物体全部_____可视为集中作用的位置；在均匀重力场中，重心与质心重合。物体仅受重力和支承力并保持平衡时，重力作用线通过支承点；均匀规则物体的重心位于_____。重心位置用长度表示，常用单位为 cm 或 m。

答案：重量；几何中心

怎么认 题目出现直尺、支点并要求确定重心或质心位置时，先移去载荷，使直尺在支点上平衡。

一. 重力作用线过平衡点

例题 1 A student investigates the balancing of a metre ruler.

Fig. 1.1 shows the set-up.

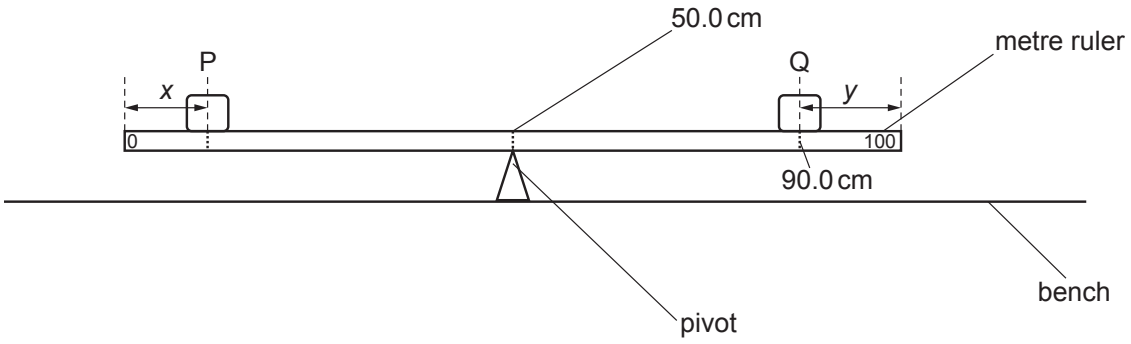


Fig. 1.1

(e) Using apparatus from Fig. 1.1, explain briefly how you would determine the position of the centre of mass of the ruler.

（2023 夏季 0625/61 第1题(e)）

解：移去直尺上的载荷 P、Q，把直尺放在支点上并移动直尺，直至直尺水平平衡。
平衡时重力作用线通过支点，在均匀重力场中，支点对应的刻度就是直尺的质心位置。
答：使空直尺在支点上平衡，读出支点对应的刻度。

针对练习

1. A student determines the weight of a metre ruler using a balancing method.

Fig. 1.1 shows the set-up.

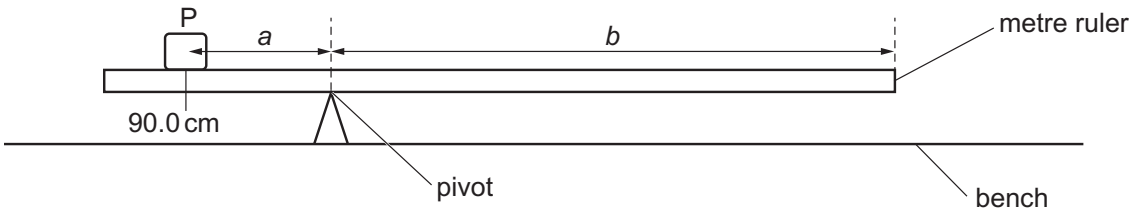


Fig. 1.1

(f) Using only the apparatus provided for the experiment, explain briefly how you would determine the position of the centre of mass of the metre ruler.

（2023 冬季 0625/61 第1题(f)）

2. Fig. 2.1 shows a balanced, uniform metre ruler made of wood.

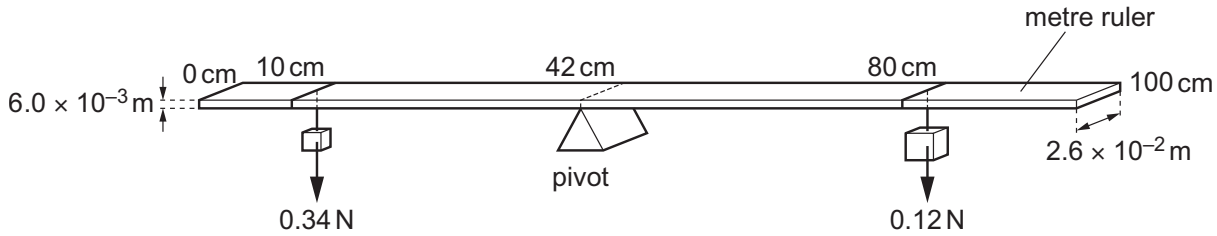


Fig. 2.1

The width of the metre ruler is 2.6×10^{-2} m and the thickness of the ruler is 6.0×10^{-3} m.

(b) On Fig. 2.1, mark the position of the centre of gravity of the metre ruler with a point labelled X. Label the distance of X from the 0 cm end of the ruler.

（2025 夏季 0625/42 第2题(b)）

3. What is the point at which the weight of an object appears to act?

A the centre of gravity of the object

B the density of the object

C the moment of a force about a point

D the pressure on the object due to its depth

（2024 冬季 0625/13 第6题）

4. A radio transmitter is a very tall, thin cylinder. It is prevented from falling over by wires which have one end fixed to the transmitter and the other end fixed in the ground. The ends of the wires in the ground are a long distance from the transmitter.

Fig. 4.1 shows the transmitter and two of the wires.

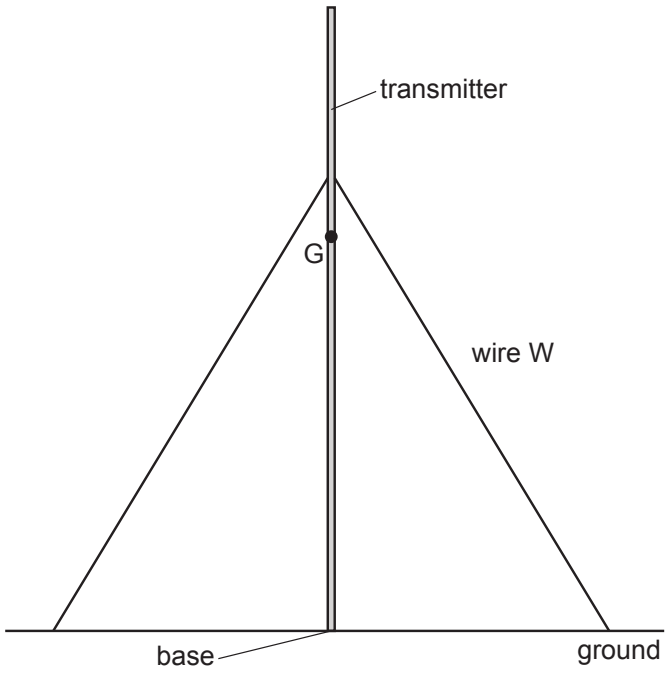


Fig. 4.1

(a) The centre of gravity G is shown on Fig. 4.1.

(i) State what is meant by centre of gravity.

(ii) Explain why the radio transmitter without the wires is a very unstable structure.

（2023 冬季 0625/41 第4题(a)）

二. 两次悬挂画铅垂线

知识点 重心是物体所受全部_____可视为集中作用的点。

不规则平面薄板从一点自由悬挂并静止时，重心在悬挂点的_____；换另一悬挂点重复画铅垂线，两线的_____就是重心。

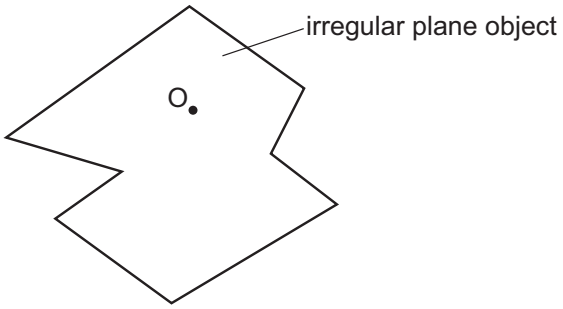
上述关系要求薄板能绕悬挂点自由转动并达到平衡；重心本身没有单位，表示其位置的长度可用 m 或 cm。

答案：重力；竖直下方；交点

怎么认 题目出现不规则薄板自由悬挂或求重心位置时，先过悬挂点画铅垂线，再换一点重复。

例题 2 An irregular plane object is suspended freely from point O.

The object is displaced and then released. It swings a few times, and comes to rest as shown.



Where is the centre of gravity of the object?

A horizontally to the left of O

B horizontally to the right of O

C vertically above O

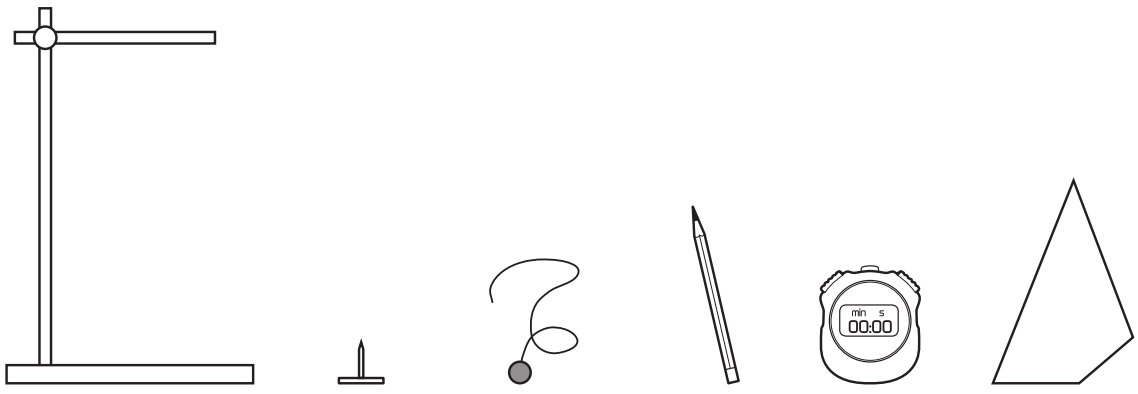
D vertically below O

（2024 春季 0625/12 第5题）

解：物体静止时，重力对悬挂点 O 的力矩为零，故重力作用线通过 O。
重力竖直向下，重心在 O 的竖直下方。
故选 D。

针对练习

5. A student determines the position of the centre of gravity of a piece of card. The diagram shows the equipment that is available. The equipment is not drawn to scale.



clamp and stand　pin　weight on a thin string　pencil　stop-watch　card

Which piece of equipment is **not** needed?

A pencil

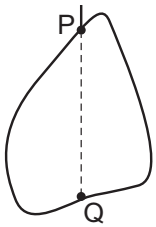
B pin

C weight on a thin string

D stop-watch

（2024 夏季 0625/11 第5题）

6. An irregularly shaped metal plate is freely suspended from a point P and is in equilibrium, as shown. Point Q is vertically below P.



Which statement about the position of the centre of gravity of the metal plate is correct?

A It is at P.

B It is at Q.

C It is halfway between P and Q.

D Further investigation is needed to determine its position.

（2023 夏季 0625/11 第9题）

题型 2：判断稳定先看重心投影（考频★★☆☆☆）

知识点 重心是物体所受重力的等效作用点；重心相对参考面的高度是长度，单位为 m。

在底面条件相同时，重心越_____，物体通常越稳定；在重心高度相同时，底面越_____，物体通常越稳定。

物体倾斜时，重心的竖直投影越过底面边缘，物体就会倾倒。

答案：低；宽

怎么认 题目出现物体形状、重心标记或较重部分的位置，并问稳定性时，先比较重心高低和底面宽窄。

例题 1 Fig. 2.1 shows a ship loaded with containers.

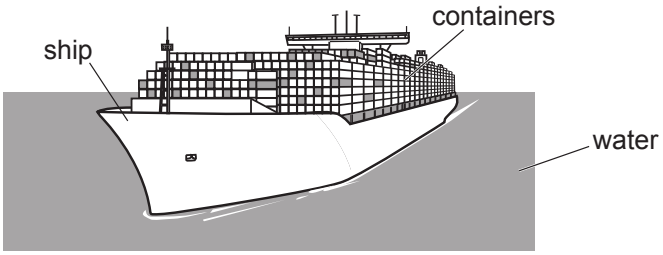


Fig. 2.1

(b) The containers with the greatest mass are loaded near the bottom of the ship.

State and explain the effect on the stability of the ship of loading the containers in this way.

（2023 春季 0625/42 第2题(b)）

解：质量最大的集装箱装在船的底部，使整艘船的重心降低。

重心越低，船倾斜时重心的竖直投影越不容易越过支承范围的边缘。

答：船的稳定性提高。

针对练习

1. Fig. 3.1 shows two solid shapes, a cylinder and a cone, which are made from the same material.

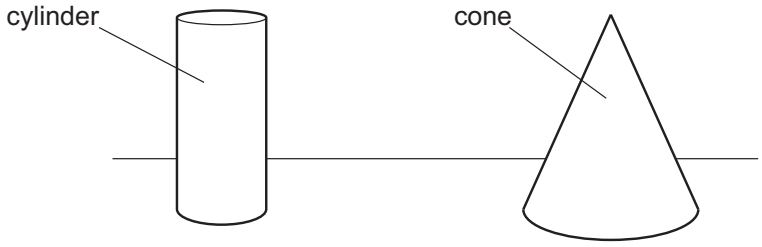


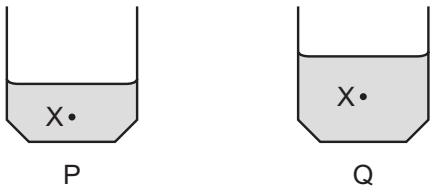
Fig. 3.1

(a) State and explain which shape is the more stable.

（2024 夏季 0625/32 第3题(a)）

2. Two identical containers, P and Q, are partly filled with different quantities of sand.

The position of the centre of gravity for each container is labelled X.



Which container is more stable and what is the reason why it is more stable?

A P is more stable because it has a lower centre of gravity.

B P is more stable because it has a smaller mass.

C Q is more stable because it has a greater depth of sand.

D Q is more stable because it has a higher centre of gravity.

（2024 冬季 0625/11 第7题）

3. A child has four blocks of wood in the shapes of the letters A, M, T and X.

The blocks have equal heights and thicknesses. At their widest parts, their widths are equal.

The child stands the four blocks the right way up on a flat table.

Which block is most likely to fall over when the block is slightly knocked?

A letter A

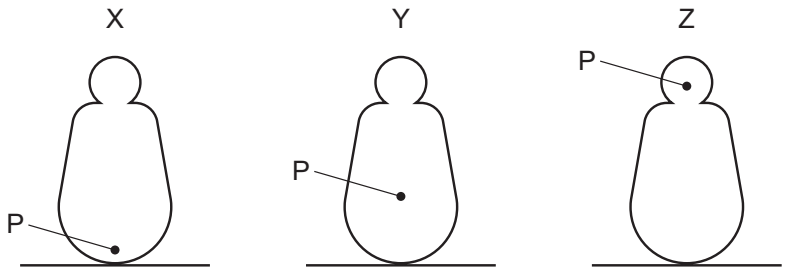
B letter M

C letter T

D letter X

（2025 冬季 0625/13 第7题）

4. Three children's toys, X, Y and Z, are the same size and shape. They have weights at different positions inside so that the position of the centre of gravity of each toy is different. Each toy's centre of gravity is marked P.



Which toy is the most stable and which toy is the least stable when balanced in the positions shown?

	most stable	least stable
A	X	Y
B	X	Z
C	Y	X
D	Y	Z

（2023 夏季 0625/12 第9题）

1.6 动量

题型 1：动量题先定方向再写 p=mv（考频★★★☆☆）

知识点 动量 p 定义为质量 m 与速度 v 的乘积，即 $p = mv$；动量方向与速度方向_____。
在一维运动中，顺正方向的速度取正，反方向的速度取负；静止物体的动量为_____。
计算时质量须化为_____，速度单位为 m/s，动量单位为 kg m/s。

答案：相同；零；千克（kg）

怎么认 题目出现物体的质量、速度及所求动量时，先规定正方向并把质量化为 kg，再写 $p = mv$。

一. 质量乘有向速度

例题 1 An object of mass 4.0 kg is moving with a velocity of 3.0 m/s in a straight line.

What is the momentum of the object?

A 0.75 kg m/s **B** 1.3 kg m/s **C** 12 kg m/s **D** 24 kg m/s

（2025 春季 0625/22 第6题）

解：取物体运动方向为正。
由 $p = mv$ 得
$p = 4.0 \times 3.0 = 12$ kg m/s。
故选 C。

针对练习

1. Fig. 2.1 shows a golfer about to hit a golf ball with a golf club. The initial momentum of the golf ball is zero.



Fig. 2.1

(a) Define momentum.

（2024 冬季 0625/42 第2题(a)）

2. Fig. 3.1 shows a boy throwing a ball at an object in a fairground.

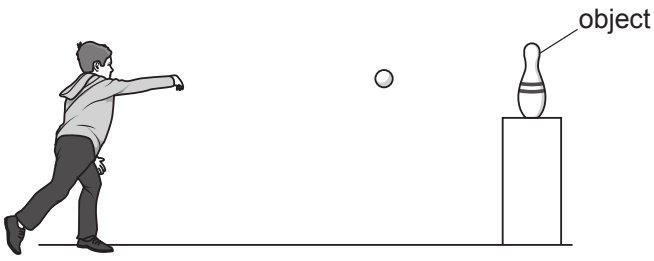


Fig. 3.1

The ball has a mass of 190 g and travels horizontally with a constant speed of 6.9 m/s.

(a) Calculate the momentum of the ball.

（2023 冬季 0625/43 第3题(a)）

3. Which statement is **not** correct?

A the momentum of a system is conserved in all interactions

B impulse = change of momentum

C force acting = change of momentum × time

D momentum = mass × velocity

（2025 夏季 0625/21 第7题）

二. 末动量减初动量

知识点 物体的动量等于_____，$p = mv$，方向与速度方向相同，单位为 $\mathrm{kg\ m\ s^{-1}}$。

选定正方向后，正向速度取正，反向速度取负；$\Delta p = p_{末} - p_{初}$，即_____。

合力恒定时，冲量等于_____，并有 $F\Delta t = \Delta p$；冲量单位为 N s。

合力等于单位时间内的动量变化量，即 $F = \Delta\frac{p}{\Delta}t$，力的单位为 N。

答案：质量与速度的乘积；末动量减初动量；力与作用时间的乘积

怎么认 题目出现停止、反弹或反向运动并求动量变化时，先定正方向，再写 $\Delta p = p_{末} - p_{初}$。

例题 2 The momentum of a body is changed by a force acting on it for a period of time.

Which action increases the change in momentum?

A doubling the force and halving the time

B doubling the force for the same time

C halving both the force and the time

D halving the force and doubling the time

（2023 春季 0625/22 第9题）

解： 由冲量与动量变化量的关系，原来的动量变化量为

$\Delta p = F\Delta t$

力加倍且作用时间不变时，

$\Delta p' = 2F\Delta t = 2\Delta p$

动量变化量增大，故选 B。

针对练习

4. Which equation gives the momentum change of an object?

A momentum change = $\frac{\text{force}}{\text{area}}$

B momentum change = force × distance

C momentum change = force × $\frac{\text{distance}}{\text{time}}$

D momentum change = force × time

（2024 冬季 0625/21 第7题）

5. A cricket ball is travelling at a speed of 25 m/s horizontally through the air. The mass of the ball is 0.14 kg.

A player catches the ball and the ball comes to rest.

(a) Calculate the change in momentum of the ball during the catch.

（2025 冬季 0625/43 第2题(a)）

6. A ball of mass *m* falls vertically and hits a hard surface.

Its speed on hitting the surface is v_1.

It rebounds vertically upwards with speed v_2.

What is the change in momentum of the ball?

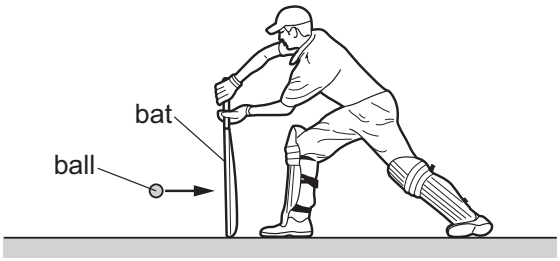
A mv_1 **B** mv_2 **C** $m(v_1 + v_2)$ **D** $m(v_2 - v_1)$

（2024 夏季 0625/21 第6题）

7. A cricket ball of mass 0.15 kg is moving at a speed of 30 m/s.

The diagram shows a batsman holding a bat stationary as the ball hits the bat and bounces back at the same speed in the opposite direction.

The ball is in contact with the bat for 1.0×10^{-3} s.



The table shows the change in momentum of the ball and the magnitude of the force applied to the ball.

Which row is correct?

	change of momentum / kg m/s	force applied to ball / N
A	4.5	4500
B	4.5	9000
C	9.0	4500
D	9.0	9000

（2025 夏季 0625/22 第7题）

题型 2：受力时间题先写 FΔt=Δp（考频★★★★☆）

知识点 冲量等于_____与该力作用时间的乘积，记为 $J = F\Delta t$，其中 F 为恒力或这段时间内的平均力。

合力的冲量等于物体的_____；质量不变时，$F\Delta t = \Delta p = m(v-u)$。

冲量的单位为_____，与动量单位 kg m s^{-1} 等价。

答案：力；动量的变化量；N s

怎么认 题目出现力和作用时间，并求冲量或速度变化时，先写 $F\Delta t = \Delta p$。

一. 力乘时间求冲量

例题 1 **(a)** Define impulse.

（2024 春季 0625/42 第2题(a)）

解：由冲量的定义，冲量等于力与该力作用时间的乘积。

答：力与该力作用时间的乘积。

针对练习

1. A resultant force of 2.0 N acts on an object of mass 3.0 kg for 6.0 s.

What is the change in velocity of the object?

A 0.25 m/s **B** 1.0 m/s **C** 4.0 m/s **D** 36 m/s

（2023 夏季 0625/22 第9题）

2. An object of mass 1.2 kg is moving with a velocity of 2.0 m/s when it is acted on by a force of 4.0 N. The velocity of the object increases to 5.0 m/s in the same direction.

For which period of time does the force act on the object?

A 0.90 s **B** 1.1 s **C** 1.5 s **D** 3.6 s

（2023 夏季 0625/21 第9题）

3. A ball is at rest on the ground. A boy kicks the ball. The boy's boot is in contact with the ball for a time of 0.040 s.

The average force on the ball is 200 N. The ball leaves the boy's boot with a speed of 20 m/s.

Which row gives the impulse of the boot on the ball and the average acceleration of the ball during the time of 0.040 s?

	impulse on ball / Ns	average acceleration of ball / m/s^2
A	8	0.8
B	8	500
C	5000	0.8
D	5000	500

（2025 冬季 0625/23 第8题）

4. A resultant force *F* accelerates a car of mass *m* along a straight horizontal road from rest to a speed *v* in time *t*, giving it momentum *p*.

Which pair of relationships for this situation is correct?

A $pt = mv$ and $F = pt$

B $p = mv$ and $F = pt$

C $p = mv$ and $Ft = p$

D $p = mvt$ and $Ft = v$

（2023 冬季 0625/22 第7题）

二. 由冲量更新末动量

知识点 动量等于质量与速度的乘积：$p = mv$；冲量等于物体_____的变化量：$J = F\Delta t = \Delta p$。冲量是_____量。规定正方向后，同向取正、反向取负，且$p_{末} = p_{初} + J$。
式中F为恒定合力或该段时间内的平均合力，Δt为作用时间；冲量的单位是N s，与kg m s^{-1}等价。

答案：动量；矢

怎么认 题目出现冲量或力与作用时间，并要求碰撞后的动量或速度时，先定正方向，再写$p_{末} = p_{初} + J$。

例题 2 An object has a mass of 20 kg.

Its velocity changes from 6 m/s to 10 m/s.

Which impulse has acted on the object?

A 80 Ns **B** 120 Ns **C** 200 Ns **D** 320 Ns

（2024 冬季 0625/23 第7题）

解： 由冲量等于动量变化量，取速度方向为正，得
$J = \Delta p = m(v - u)$

$J = 20 \times (10 - 6) = 80\ \text{N s}$

故选 A。

针对练习

5. A ball of mass 0.25 kg hits a wall at a speed of 16 m/s. It then rebounds back along its original path at a speed of 12 m/s.

What is the impulse experienced by the ball during its impact with the wall?

A 1.0 N s **B** 3.0 N s **C** 4.0 N s **D** 7.0 N s

（2023 夏季 0625/23 第9题）

6. A tennis ball with momentum 2.3 kg m/s is struck by a tennis racket.

The racket causes the direction of motion of the ball to reverse.

The racket exerts an average force of 1500 N during the impact with the ball. The racket and ball are in contact with each other for a time of 0.0024 s.

What is the magnitude of the momentum of the ball as it leaves the tennis racket?

A 1.3 kg m/s **B** 3.6 kg m/s **C** 5.9 kg m/s **D** 8.6 kg m/s

（2025 春季 0625/22 第8题）

7. A sphere X collides head on with a second identical sphere Y which is stationary.

The mass of each sphere is 0.15 kg.

Sphere X is travelling at a velocity of 2.0 m/s before the collision and produces an impulse of 0.21 N s on sphere Y.

What is the velocity of sphere X after collision?

A 0.60 m/s in the opposite direction to Y

B 0.60 m/s in the same direction as Y

C 1.4 m/s in the opposite direction to Y

D 1.4 m/s in the same direction as Y

（2023 冬季 0625/21 第7题）

8. **(b)** A test car crashes into a barrier to test the safety features. The test car has a total mass of 950 kg. It is moving with constant velocity from time $t = 0$ for 4.0 s. At $t = 4.0$ s, the car hits the barrier.

Fig. 1.1 shows the car as it hits the barrier.

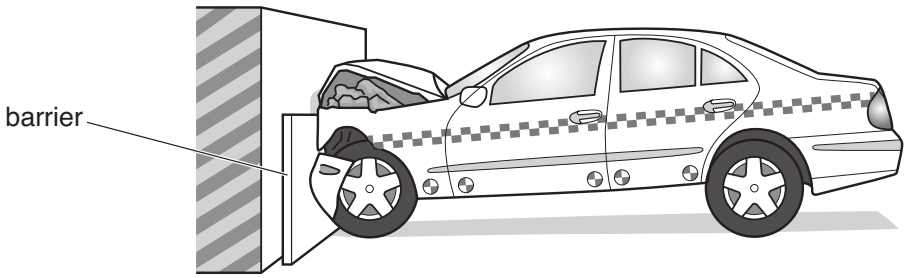


Fig. 1.1

(i) During the test crash, the resultant force acting on the car is 27 000 N. The car takes 1.5 s to come to rest. The deceleration is uniform.

Calculate the initial velocity of the car.

(ii) On Fig. 1.2, sketch a speed–time graph to show the motion of the car from time $t = 0$ until the car becomes stationary.

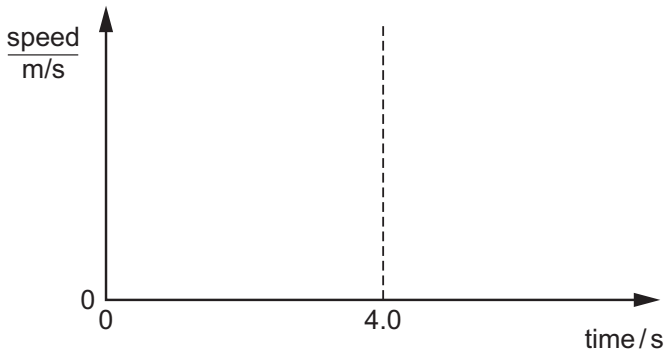


Fig. 1.2

（2024 冬季 0625/43 第1题(b)）

三. 动量变化除时间求力

知识点 冲量等于力与力作用时间的乘积，也等于动量的变化，关系为 _____。

平均合力等于单位时间内动量的变化，即 _____；该关系适用于所取时间内的平均合力。

动量有方向，计算 $\Delta p = p_2 - p_1$ 时须先规定正方向；力的方向与 Δp 的方向相同。

F 的单位是 N，Δp 的单位是 kg m s^{-1}，Δt 的单位是 s；质量流问题中，力的大小等于单位时间内排出物质的动量变化。

答案：$F\Delta t = \Delta p$；$F = \Delta \frac{p}{\Delta t}$

怎么认 题目出现动量变化和受力时间，或质量流率与排出速度时，先写 $F\Delta t = \Delta p$。

例题 3 **(c)** A different train is travelling with a momentum of 0.26 kg m / s.

The train slows down and stops after 2.1 s.

Calculate the average force acting on the train during this time.

（2025 夏季 0625/42 第3题(c)）

解：取列车原运动方向为正，由冲量等于动量变化得

$F\Delta t = \Delta p$

$F = \frac{p_2 - p_1}{\Delta t}$

$F = \frac{0-0.26}{2.1} \approx -0.12\ \mathrm{N}$

负号表示力的方向与列车原运动方向相反。

答：平均力为 $0.12\ \mathrm{N}$，方向与列车原运动方向相反。

针对练习

9. The momentum of a car changes from 10 000 kg m / s to 15 000 kg m / s in a time of 8.0 s.

What is the resultant force acting on the car?

A 630 N **B** 3100 N **C** 40 000 N **D** 200 000 N

（2025 冬季 0625/21 第7题）

10. A cricket ball is travelling at a speed of 25 m / s horizontally through the air. The mass of the ball is 0.14 kg.

A player catches the ball and the ball comes to rest.

(b) The player's hands are in contact with the moving ball for 9.7 ms.

Calculate the horizontal force exerted by her hands to bring the ball to rest.

（2025 冬季 0625/43 第2题(b)）

11. A girl holds a rubber ball out of a window of a tall building. The mass of the ball is 0.20 kg. The ball is at rest 10 m above a concrete path.

(b) The girl releases the ball and it falls towards the path. The ball strikes the path and bounces vertically upwards.

Fig. 1.1 shows the ball falling towards the path.

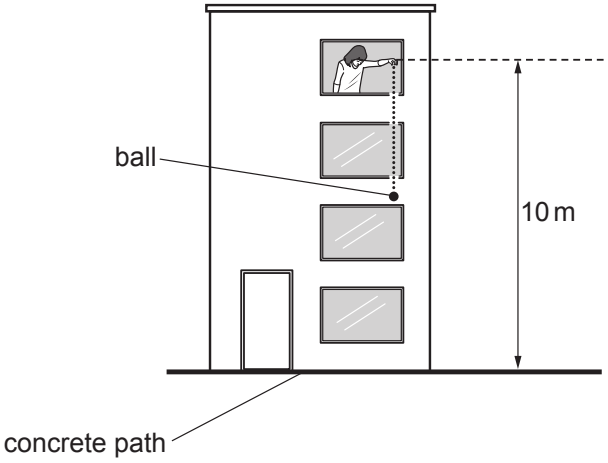


Fig. 1.1

The speed of the ball immediately **before** it strikes the path is 14 m / s.

The speed of the ball immediately **after** it strikes the path is 12 m / s.

(i) Calculate the kinetic energy of the ball immediately **after** it strikes the concrete path.

(ii) Show that the change in momentum of the ball when it bounces off the path is 5.2 kg m / s.

(iii) The ball is in contact with the path for 0.25 s.

Calculate the average resultant force on the ball when it is in contact with the path.

（2023 冬季 0625/41 第1题(b)）

12. **(b)** Fig. 2.1 shows a rocket and its exhaust gases.

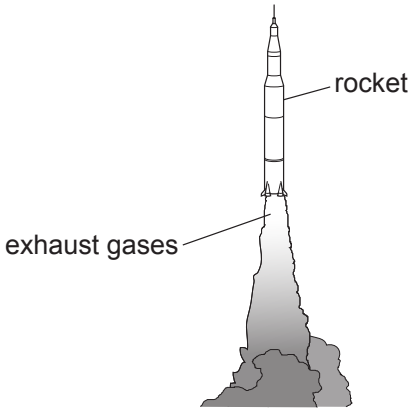


Fig. 2.1

The exhaust gases are emitted from the rocket with a velocity of 1400 m/s and at a rate of 2800 kg/s.

(i) Show that the force exerted on the rocket by the exhaust gases is 3900 kN.

State the equation you use.

(ii) Calculate the maximum mass that this force can lift from the ground. Ignore air resistance.

（2024 春季 0625/42 第2题(b)）

四. 同样 Δp 用更长时间减力

知识点 动量 p 等于质量 m 与速度 v 的乘积，$p = mv$；冲量 I 等于力与作用时间的乘积，也等于物体的_____，$I = F\Delta t = \Delta p$。

其中 F 为作用时间内的平均合力，Δt 为力的作用时间。

物体由相同初态变到相同末态时，Δp 相同；由 $F = \Delta\frac{p}{\Delta}t$ 可知，作用时间增大，平均冲击力_____。

动量单位为 kg m s^{-1}，冲量单位为 N s。

答案：动量变化量；减小

怎么认 题目出现缓冲垫、气囊、屈膝或接球时手后移时，先判断动量变化是否相同，再比较作用时间。

例题 4 A student catches a cricket ball. The speed of the ball immediately before it is caught is 18 m/s. The mass of the cricket ball is 160 g.

(c) As the student catches the ball, she moves her hands backwards.

Explain the effect of this action on the student's hands.

（2023 夏季 0625/42 第2题(c)）

解：接球前后球由运动变为静止，与手不后移相比，Δp 相同。

手向后移动使球停止所需的时间 Δt 增大。

由 $F\Delta t = \Delta p$ 得

$F = \Delta\frac{p}{\Delta}t$。

∵ Δp 相同而 Δt 增大，∴手对球的平均力减小，球对手的平均力也减小。

答：手受到的冲击力减小，受伤程度降低。

针对练习

13. A gymnast jumps down from a high piece of apparatus.

She gradually bends her knees as she lands.

Which effect does this have?

A She will have a smaller change of momentum as she lands.

B She will lose less kinetic energy as she lands.

C She will exert a smaller impulse on the ground as she lands.

D She will experience a smaller force from the ground as she lands.

（2024 夏季 0625/22 第6题）

14. Fig. 3.1 shows two children balanced on a seesaw. A seesaw is a length of wood which rotates about a central pivot.

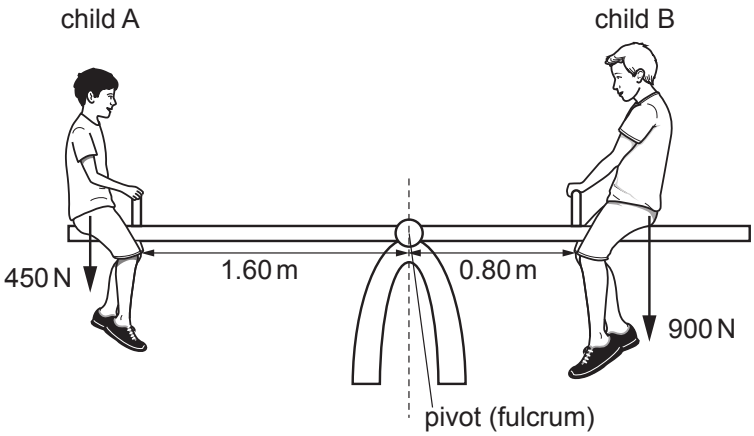


Fig. 3.1

(b) The concrete floor under the seesaw is replaced with a rubber floor. A child falls from the seesaw and experiences an impulse when they hit the floor.

(i) Define impulse.

(ii) Explain how the rubber floor reduces injury to the child.
Use ideas about impulse, force, momentum and time in your answer.

（2024 夏季 0625/43 第3题(b)）

题型 3：碰撞前后先守恒总动量（考频★★★☆☆）

知识点 动量等于物体质量与速度的乘积，$p = mv$；动量方向与速度方向相同，单位为 $\mathrm{kg\ m\ s^{-1}}$。

碰撞系统在所研究方向不受外力或外力合力可忽略时，碰撞前后的_____守恒。

一维碰撞中，各物体速度按规定的正方向取正负；若碰后粘连，则两物体具有_____，总动量为 $(m_1 + m_2)v$。

答案：总动量；共同速度

怎么认 题目出现两物体碰撞并给出碰撞前后质量、速度时，先规定正方向，将各物体动量带符号相加。

一. 碰前总动量等于碰后

例题 1 Trolley A and trolley B are on a horizontal, frictionless bench. Trolley A moves to the right with a constant velocity u = 0.44 m/s. Trolley B is stationary.

Fig. 2.1 shows trolley A before it collides with trolley B.

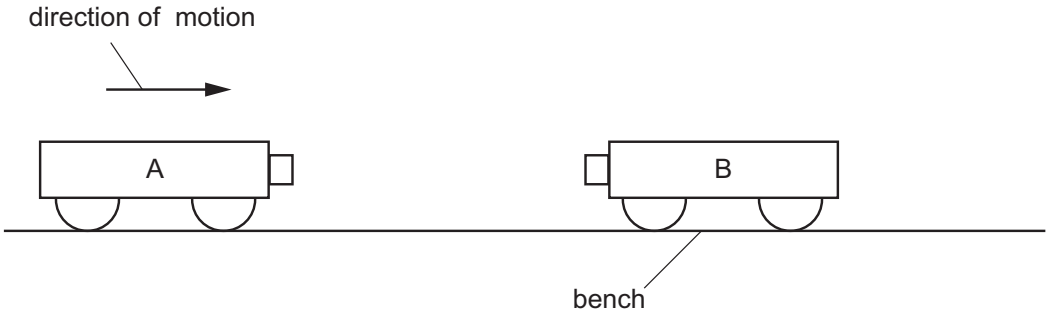


Fig. 2.1 (not drawn to scale)

(b) After the collision, the two trolleys are joined together and travel with a constant velocity v = 0.18 m/s to the right. The mass of trolley A is 0.75 kg.

Calculate the mass of trolley B.

（2025 春季 0625/42 第2题(b)）

解：取向右为正，由动量守恒得

$0.75 \times 0.44 + m_B \times 0 = (0.75 + m_B) \times 0.18$

$0.33 = 0.135 + 0.18 m_B$

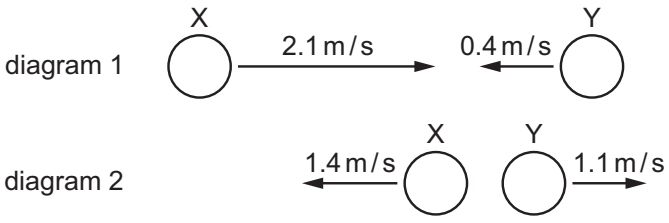
$m_B = \frac{0.33-0.135}{0.18} = 1.083\ \text{kg} \approx 1.1\ \text{kg}$

答：手推车 B 的质量为 1.1 kg。

针对练习

1. Diagram 1 shows a ball X of mass 0.15 kg travelling horizontally with a velocity of 2.1 m/s towards ball Y travelling at 0.4 m/s in the opposite direction.

Diagram 2 shows the velocities of the balls immediately after they collide.



What is the mass of ball Y?

A 0.15 kg **B** 0.19 kg **C** 0.35 kg **D** 0.79 kg

（2025 冬季 0625/22 第6题）

2. A small ball of mass 0.10 kg travels horizontally at a speed of 600 m / s. It strikes a stationary wooden block of mass 1.9 kg resting on a frictionless horizontal surface.

The ball stays in the block.

What is the speed of the ball and the block immediately after the impact?

A 30 m / s **B** 32 m / s **C** 60 m / s **D** 130 m / s

（2024 夏季 0625/23 第7题）

3. **(b)** Fig. 3.1 shows two toy trains, A and B, on a track.

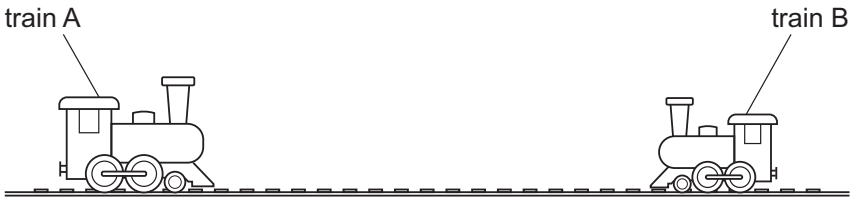


Fig. 3.1

The mass of train A is 0.45 kg and the mass of train B is 0.21 kg. The trains do **not** have motors.

Train A travels towards train B and they collide.

Immediately before the collision:

- the velocity of train A is 0.34 m / s to the right
- the velocity of train B is 0.12 m / s to the left.

The trains stick together when they collide.

Calculate the velocity of the trains immediately after the collision.

（2025 夏季 0625/42 第3题(b)）

4. Fig. 3.1 shows a boy throwing a ball at an object in a fairground.

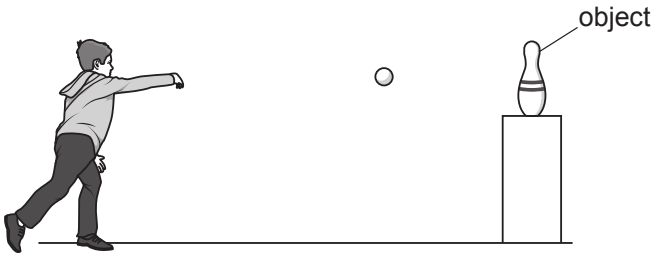


Fig. 3.1

The ball has a mass of 190 g and travels horizontally with a constant speed of 6.9 m / s.

(b) After hitting the object, the ball bounces back along the same straight path with a speed of 1.5 m / s. The object has a mass of 1.8 kg.

Calculate the speed of the object after it is hit by the ball.

（2023 冬季 0625/43 第3题(b)）

二. 初总动量为零时反向等量

知识点 动量等于质量与速度的乘积，$p = mv$，单位为 kg m s^{-1}；动量方向与速度方向相同。

冲量等于力与力作用时间的乘积，$I = F\Delta t = \Delta(mv)$，单位为 N s。

系统所受合外力为零时，系统的总动量_____；列式时先规定正方向，反向速度取负值。

静止系统分离或反冲时，初总动量为零，两部分的动量大小_____、方向_____。

质量为 m、速率为 v 的物体，其动能为 $E_k = \frac{1}{2}mv^2$，单位为 J。

答案：守恒；相等；相反

怎么认 题目出现静止物体被弹开或气体向后喷出时，先规定正方向并令分离前后总动量均为零。

例题 2 Fig. 2.1 shows a space vehicle which consists of a capsule and a nose cone.

The space vehicle is moving at a velocity of 7800 m/s. The mass of the space vehicle is 840 kg.

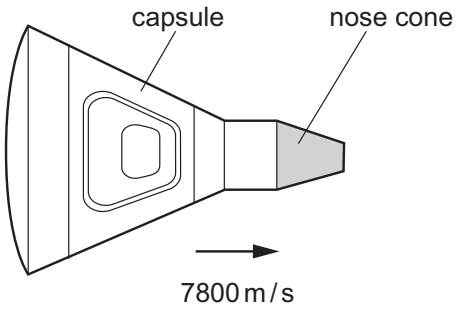


Fig. 2.1

(b) The capsule ejects the nose cone, as shown in Fig. 2.2.

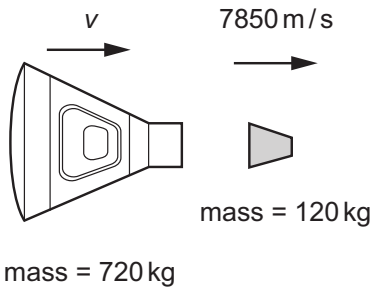


Fig. 2.2 (not to scale)

Determine the velocity *v* of the capsule after the nose cone is ejected. Give your answer to 3 significant figures.

（2025 夏季 0625/43 第2题(b)）

解：取向右为正，由动量守恒得

$840 \times 7800 = 720v + 120 \times 7850$

$v = \frac{840\times7800-120\times7850}{720}$

$v = 7791.67\ \mathrm{m/s} \approx 7790\ \mathrm{m/s}$

答：胶囊的速度为 7790 m/s，方向向右。

5. Fig. 2.1 shows two identical trolleys, P and Q, held at rest on a frictionless horizontal surface. A load is fixed to trolley P.

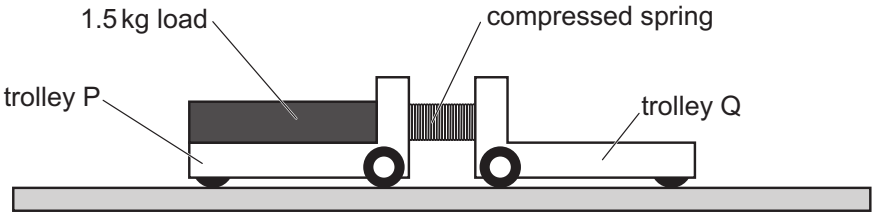


Fig. 2.1

There is a compressed spring between trolley P and trolley Q.

The trolleys are released. As the spring expands, it pushes the trolleys apart.

Trolley Q moves to the right at a constant speed of 0.36 m / s.

The mass of each trolley is 1.2 kg. The mass of the load on trolley P is 1.5 kg.

The spring has negligible mass.

(a) Calculate:

(i) the speed at which trolley P moves to the left

(ii) the kinetic energy of trolley Q when it moves at 0.36 m / s.

（2024 夏季 0625/41 第2题(a)）

6. **(a)** A balloon of mass 15 g is glued to a straw. The straw is threaded onto a horizontal string, as shown in Fig. 3.1.
The balloon is filled with air and then the air is released.

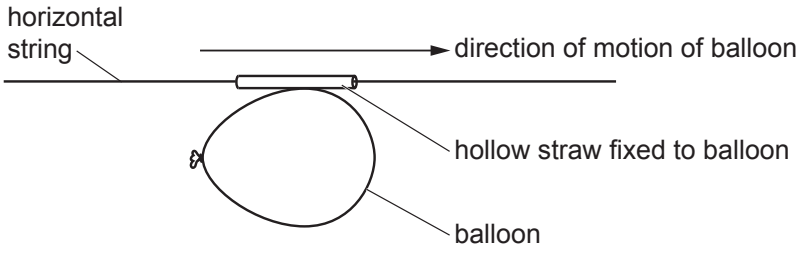


Fig. 3.1

As the air leaves the balloon, the balloon experiences a force.
The balloon accelerates from rest until it reaches a constant speed. It then travels 0.67 m in 0.18 s at this constant speed.

(i) Explain in words what is meant by the term impulse.

(ii) Calculate the resultant impulse on the balloon while it is accelerating.

(iii) Explain how momentum is conserved as the balloon accelerates.

（2023 冬季 0625/42 第3题(a)）

1.7.1 能量

题型 1：能量过程先盯住能量库（考频★★★★☆）

知识点 能量可储存在物体或系统的不同能量库中，能量的单位是焦耳（J）。

运动物体有_____能库；位置升高的物体有重力势能库；发生弹性形变的物体有_____能库。

电池和燃料有_____能库；此外还有内能库、静电能库和核能库。

答案：动；弹性势；化学

怎么认 题目出现电池、运动、高低位置、弹簧形变或温度变化时，先圈定对象，再按状态判断能量库。

一. 按对象和状态认能量库

例题 1 Fig. 4.1 shows a student using a battery-powered device.

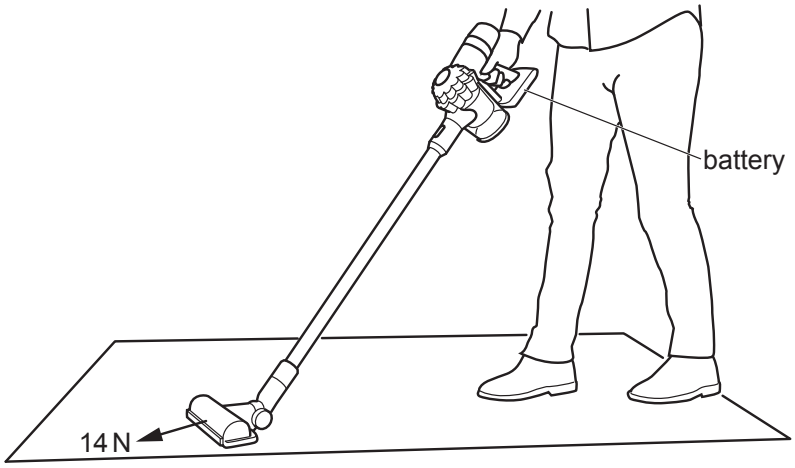


Fig. 4.1

(a) State the energy store in the battery.

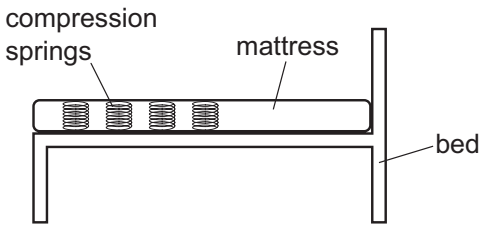
（2024 春季 0625/32 第4题(a)）

解：电池中的物质能够通过化学反应供能，储存的是化学能。

答：化学能。

针对练习

1. A mattress placed on a bed contains many compression springs.



Which energy store of the mattress **increases** when a person lies on the bed?

A gravitational potential

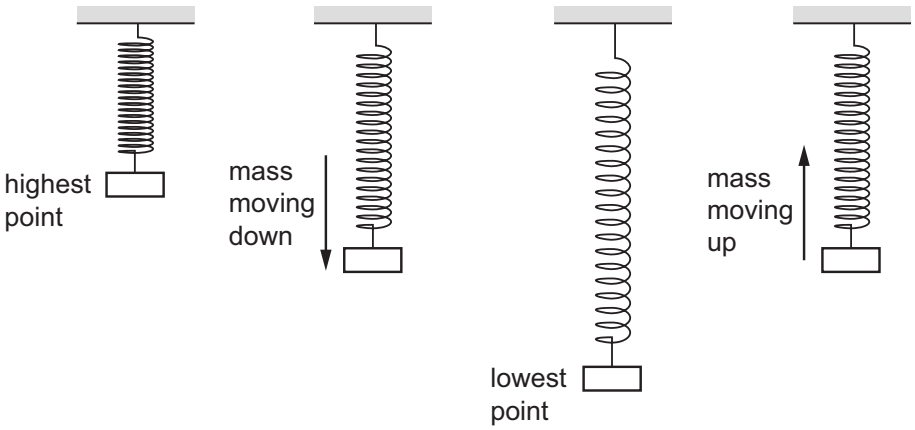
B chemical

C elastic

D kinetic

（2025 夏季 0625/11 第7题）

2. A mass bounces up and down on a steel spring. The diagram shows the mass and the spring at different points during the motion.



At which point is the least energy in the gravitational potential store of the mass and at which point is the most energy in the elastic store of the spring?

	least energy in gravitational potential store of the mass	most energy in the elastic store of the spring
A	mass moving down	mass moving up
B	mass moving down	lowest point
C	lowest point	mass moving up
D	lowest point	lowest point

（2023 冬季 0625/13 第8题）

3. Which row about the change of energy in the energy store must be correct?

	process	energy store	change of energy in store
A	water pumped up to a high-altitude dam	gravitational potential energy of water	increases
B	water pumped up to a high-altitude dam	kinetic energy of water	decreases
C	air passes through a wind turbine	gravitational potential energy of air	increases
D	air passes through a wind turbine	kinetic energy of air	increases

（2023 夏季 0625/21 第10题）

二. 沿过程写库的增减

知识点 能量可储存在动能库、重力势能库、化学能库、弹性势能库和内能库等；能量转移时，一个能量库减少，另一个能量库增加。

能量可通过机械功、电功、加热或波传递；在封闭系统内，总能量_____。

物体下落时，重力势能库中的能量减少，动能库中的能量增加，能量通过_____转移；物体受阻力而停下时，动能转移到内能库。

能量的单位是_____，符号为 J。

答案：保持不变；机械功；焦耳

怎么认 题目出现下落、上坡、制动、碰撞或装置运行时，先按事件先后写出减少和增加的能量库。

例题 2 A ball is falling towards the ground.

Which transfer between energy stores is taking place?

A elastic energy to kinetic energy

B gravitational potential energy to elastic energy

C gravitational potential energy to kinetic energy

D kinetic energy to gravitational potential energy

（2024 春季 0625/22 第3题）

解：球下落时高度减小，重力势能库中的能量减少；球的速率增大，动能库中的能量增加。故能量由重力势能库转移到动能库。故选 C。

针对练习

4. Which device transfers energy from a chemical energy store to a kinetic energy store?

A an a.c. generator

B a battery-powered torch

C a car engine

D a wind-up mechanical clock

（2025 冬季 0625/23 第9题）

5. A student drops a heavy ball from a vertical height of 1.8 m above the ground. The ball then falls to the ground. It does **not** bounce after hitting the ground.

(a) Describe the transfers of energy of the ball between stores from when the ball begins to fall to when it reaches the ground.

（2024 夏季 0625/42 第3题(a)）

6. Fig. 3.1 shows a side view of part of a concrete track at a skateboard park.

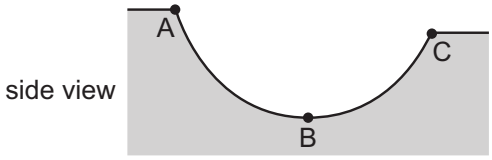


Fig. 3.1

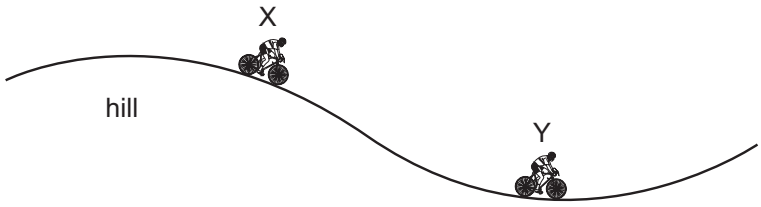
(a) A skateboarder is initially at rest at point A. The skateboarder then travels through point B and comes to rest at point C.

Describe the transfer of energy as the skateboarder travels from A to B to C along the concrete track.

（2025 夏季 0625/41 第3题(a)）

7. A cyclist travels down a hill from rest at point X without pedalling.

The cyclist applies his brakes and the cycle stops at point Y.



Which energy transfers have taken place between X and Y?

A gravitational potential → kinetic → internal (thermal)

B gravitational potential → internal (thermal) → kinetic

C kinetic → gravitational potential → internal (thermal)

D kinetic → internal (thermal) → gravitational potential

（2023 冬季 0625/21 第8题）

三. 总能量前后必须相等

知识点 能量守恒定律：能量不能被_____，也不能被_____，只能在能量库之间转移。
在任何能量转移过程中，转移前后的总能量_____，能量的单位为焦耳（J）。
输入能量等于有用输出能量与耗散能量之和。

答案：创造；消灭；保持不变

怎么认 题目要求表述能量守恒定律时，先写能量不能被创造或消灭，再写能量只能转移。

例题 3 **(a)** State the principle of conservation of energy.

（2023 春季 0625/42 第3题(a)）

解：答：能量不能被创造或消灭，只能从一个能量库转移到另一个能量库。

题型 2：机械能计算先选 Ek 或 ΔEp（考频★★★★☆）

知识点 物体由于运动而具有的能量称为动能，质量为 m、速率为 v 时，$E_k =$ _____。
质量不变时，动能与速率的_____成正比；速率变为原来的 n 倍，动能变为原来的 n^2 倍。
计算时质量用 kg，速率用 m/s，动能的单位是 J。

答案：$\frac{1}{2}mv^2$；平方

怎么认 题目出现质量和速率，或同一物体速率改变并求动能时，先写 $E_k = \frac{1}{2}mv^2$。

一. 动能用二分之一 mv 方

例题 1 A car is travelling at a speed of 8.0 m/s.

The kinetic energy stored in the car is 32 000 J.

What is the kinetic energy stored in the car when its speed increases to 16 m/s?

A 16 000 J　　**B** 32 000 J　　**C** 64 000 J　　**D** 130 000 J

（2025 春季 0625/22 第9题）

解：设原动能为 E_1，速率增大后的动能为 E_2。同一辆车质量不变，得
$\frac{E_2}{E_1} = \left(\frac{16}{8.0}\right)^2 = 4$
$E_2 = 4 \times 32000 \text{ J} = 128000 \text{ J} \approx 1.3 \times 10^5 \text{ J}$
故选 D。

针对练习

1. A train travels with a constant velocity of 56 m/s on a horizontal track. The mass of the train is 440 000 kg.

(b) Calculate the kinetic energy stored in the moving train.

（2025 冬季 0625/41 第1题(b)）

2. A student catches a cricket ball. The speed of the ball immediately before it is caught is 18 m/s. The mass of the cricket ball is 160 g.

(a) Calculate the kinetic energy stored in the cricket ball immediately before it is caught.

（2023 夏季 0625/42 第2题(a)）

3. The mass of air hitting the blades of a wind turbine each second is 1.5×10^4 kg.

The speed of the air is 4.0 m / s.

The density of air is 1.2 kg / m^3.



Which row gives the volume of the air hitting the blades each second and the kinetic energy of the air hitting the blades each second?

	volume of air each second / m^3	kinetic energy each second / J
A	13 000	72 000
B	13 000	120 000
C	18 000	72 000
D	18 000	120 000

（2023 冬季 0625/23 第4题）

二. 势能变化用 mgΔh

知识点 物体在近地面且重力场强 g 可视为恒定时，重力势能的变化为 $\Delta E_p = mg\Delta h$，其中 Δh 表示_____。

高度变化只取竖直高度差，斜面路程不代入；规定竖直向上为正，上升时 ΔE_p 为_____，下降时 ΔE_p 为_____。

m 的单位为 kg，g 的单位为 N/kg，Δh 的单位为 m，ΔE_p 的单位为 J。

答案：竖直高度变化量；正；负

怎么认 题目出现质量或重力及竖直高度变化，且求重力势能变化时，先写 $\Delta E_p = mg\Delta h$。

例题 2

The equation used to find the change in gravitational potential energy of an object can be written as

$$\Delta E_P = Y \quad Z \quad \Delta h$$

where ΔE_P is the change in gravitational energy and Δh is the change in height.

Which row gives the quantities *Y* and *Z*?

	Y	*Z*
A	mass	gravitational field strength
B	gravitational field strength	density
C	density	speed
D	speed	mass

（2023 春季 0625/22 第10题）

解： 由重力势能的变化关系得
$\Delta E_p = mg\Delta h$
与 $\Delta E_p = Y \times Z \times \Delta h$ 对照得
$Y = m$
$Z = g$
故 Y 为质量，Z 为重力场强。故选 A。

针对练习

4. A rock of weight 50 N falls a vertical distance of 7.0 m from rest.

What is the change in the gravitational potential energy store of the rock?

A decrease of 7.1 J

B decrease of 350 J

C increase of 7.1 J

D increase of 350 J

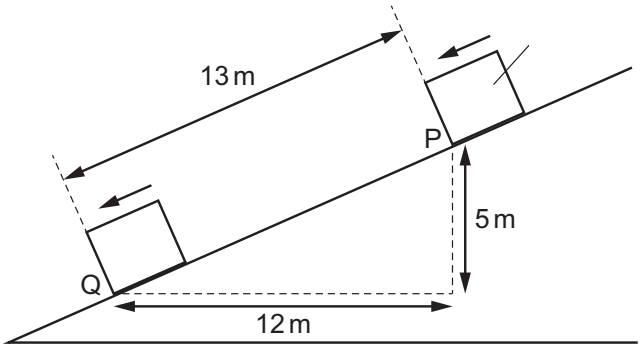
（2023 夏季 0625/11 第11题）

5. A girl holds a rubber ball out of a window of a tall building. The mass of the ball is 0.20 kg. The ball is at rest 10 m above a concrete path.

(a) Calculate the gravitational potential energy of the ball relative to the concrete path.

（2023 冬季 0625/41 第1题(a)）

6. A box of mass 2.0 kg slides down a slope. The gravitational field strength is 9.8 N / kg.



What is the decrease in the gravitational potential energy stored as the box moves from P to Q?

A 9.8 J **B** 98 J **C** 240 J **D** 250 J

（2024 冬季 0625/23 第9题）

7. **(a)** Fig. 1.1 shows a helicopter which is stationary at a height of 1500 m above the ground.

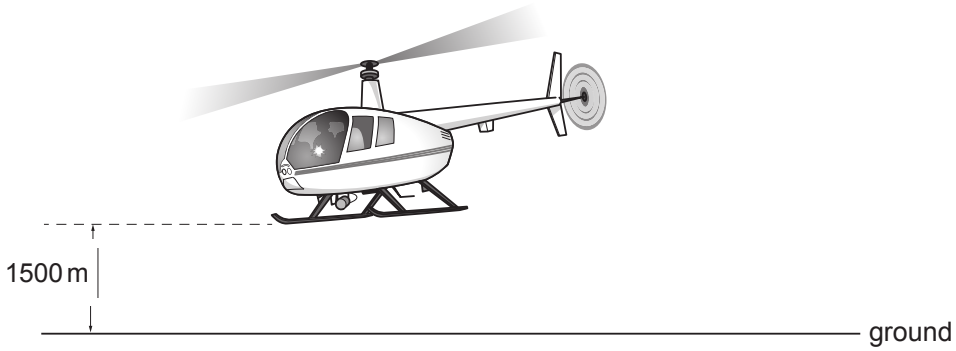


Fig. 1.1 (not to scale)

(i) State the **two** conditions necessary for the helicopter to remain in equilibrium.

(ii) The mass of the helicopter is 3200 kg.

Calculate the change in the gravitational potential energy of the helicopter as it rises from the ground to 1500 m.

（2023 夏季 0625/42 第1题(a)）

三. 无耗散时令机械能相等

知识点 质量为 m 的物体以速率 v 运动时，动能为 $E_k = \frac{1}{2}mv^2$；m 的单位为 kg，v 的单位为 m/s，能量单位为 J。

物体下降高度 Δh 时，重力势能的减少量为 $mg\Delta h$；Δh 的单位为 m，取 $g = 9.8\text{m/s}^2$。

空气阻力等耗散作用可忽略时，机械能_____；减少的重力势能等于增加的_____。

物体由静止下落 Δh 时，$mg\Delta h = \frac{1}{2}mv^2$，故 $v =$ _____。

答案：守恒；动能；$\sqrt{2g\Delta h}$

怎么认 题目出现物体下落或竖直上抛，且阻力可忽略时，先令减少的能量等于增加的能量。

例题 3 A stone is dropped from a tall tower and falls a distance of 50 m to the ground.

The stone has a mass of 3.0 kg.

At which speed does the stone hit the ground?

A 17 m/s **B** 31 m/s **C** 54 m/s **D** 150 m/s

（2024 夏季 0625/21 第7题）

解：石块由静止下落，减少的重力势能转化为动能，

$mgh = \frac{1}{2}mv^2$

$v = \sqrt{2gh}$

$v = \sqrt{2 \times 9.8 \times 50} \approx 31\ \mathrm{m/s}$

故选 B。

针对练习

8. A stone is thrown vertically upwards at a speed of 5.0 m/s.

All of the energy initially in the kinetic store of the stone is transferred to its gravitational potential store when the stone reaches its maximum height.

Which equation gives the maximum height *h* reached by the stone?

A $h = \dfrac{9.8}{2 \times 5.0^2}$

B $h = \dfrac{5.0^2 \times 2}{9.8}$

C $h = \dfrac{5.0^2}{2 \times 9.8}$

D $h = \dfrac{2 \times 9.8}{5.0^2}$

（2025 夏季 0625/22 第8题）

9. A student drops a heavy ball from a vertical height of 1.8 m above the ground. The ball then falls to the ground. It does **not** bounce after hitting the ground.

(b) Calculate the maximum speed of the ball. Ignore air resistance.

Show your working.

（2024 夏季 0625/42 第3题(b)）

10. A stone is dropped from a bridge which is 22 m above a river.

What is the speed of the stone when it hits the water?

A 15 m/s **B** 21 m/s **C** 220 m/s **D** 430 m/s

（2025 夏季 0625/23 第9题）

11. **(a)** A hard ball is dropped vertically downwards.

Fig. 1.1 shows the speed–time graph for the ball from when it is dropped until it hits the ground.

Air resistance is ignored.

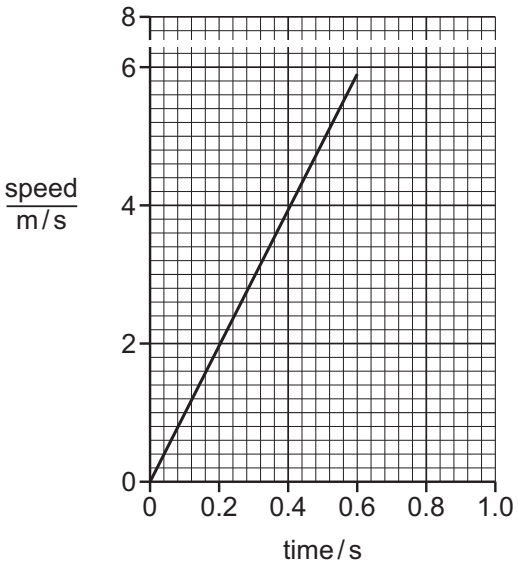


Fig. 1.1

(i) Describe the motion of the ball in Fig. 1.1.

(ii) Show that the distance travelled by the ball is 1.8 m.

(iii) The mass of the ball is 0.54 kg. Calculate the gravitational potential energy stored in the ball immediately before it is dropped.

(iv) Determine the kinetic energy of the ball when it has fallen half way to the ground.

（2025 冬季 0625/43 第1题(a)）

四. 有阻力先扣耗散能量

知识点 质量为 m、速率为 v 的物体，其动能为 $E_k =$ _____；m 用 kg，v 用 m/s，E_k 用 J。

物体升高 Δh 时，重力势能增加量为 $\Delta E_p =$ _____；g 用 N/kg，Δh 用 m。

有阻力时，输入或减少的能量等于有用机械能变化与克服阻力所转移的能量之和。阻力恒定且与位移反向时，耗散能量为 $E_d =$ _____，单位为 J。

能量守恒包括转移到周围环境的内能；这部分能量不能再计入物体的动能或重力势能。

答案：$\frac{1}{2}mv^2$；$mg\Delta h$；Fd

怎么认 题目出现高度变化、阻力功和所求动能或速率时，先列机械能变化与耗散能量的守恒关系。

例题 4 Fig. 3.1 shows an archer aiming an arrow at a target.

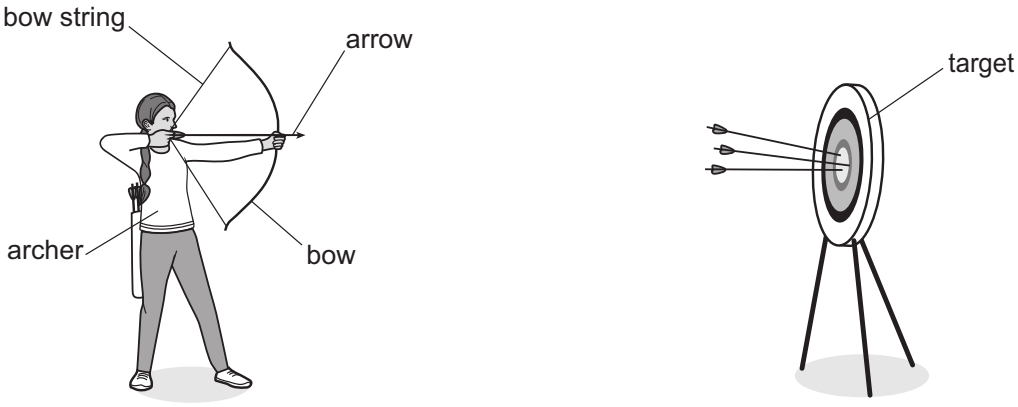


Fig. 3.1

(a) The archer pulls back on the bow string, doing a total of 110 J of work. Her hand moves a distance of 0.45 m. The bow is bent and stores energy.

Show that the average force applied by the archer in pulling the string back is approximately 240 N.

(b) The archer releases the bow string. All the energy in **(a)** is transferred to the arrow.

The arrow moves off at an initial speed v. The mass of the arrow is 0.030 kg.

(i) Calculate the initial speed v of the arrow.

(ii) Explain why the speed of the arrow as it hits the target is less than the value in **(b)(i)**.

（2025 夏季 0625/43 第3题(b)）

解： 弓储存的 110 J 能量全部转化为箭的动能，故

$110 = \frac{1}{2}mv^2$

$110 = \frac{1}{2} \times 0.030 \times v^2$

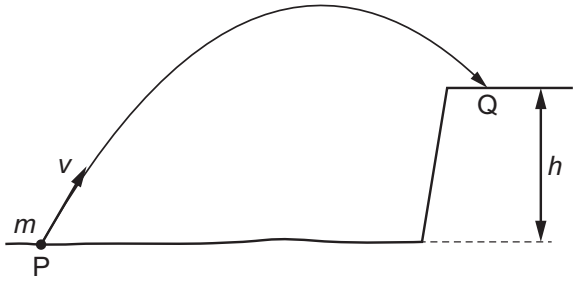
$v = \sqrt{\frac{2\times110}{0.030}} = 85.6\ \text{m/s} \approx 86\ \text{m/s}$

箭飞行时克服空气阻力做功，部分机械能转移为周围环境的内能，所以击中靶时的动能减小，速率小于初始速率。

答：初始速率为 86 m/s；空气阻力使部分机械能转移为周围环境的内能。

12. The diagram shows an object of mass m being projected with speed v from a point P to a point Q on top of a cliff height h.

The object does work W against air resistance as it travels from P to Q.



What is the kinetic energy of the object when it reaches point Q?

A $\frac{1}{2}mv^2 + mgh + W$

B $\frac{1}{2}mv^2 + mgh - W$

C $\frac{1}{2}mv^2 - mgh + W$

D $\frac{1}{2}mv^2 - mgh - W$

（2024 冬季 0625/21 第9题）

13. A stone has a gravitational energy store equal to 46 J.

When the stone falls in air, it does 21 J of work against air resistance.

What is the gain in kinetic energy stored in the stone during this fall?

A 21 J **B** 25 J **C** 46 J **D** 67 J

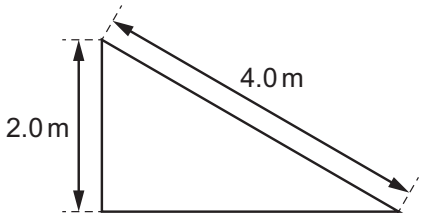
（2025 冬季 0625/12 第8题）

14. A box is initially at rest at the top of a rough slope.

The box slides down the slope.

The weight of the box is 20 N.

The slope is 4.0 m long and 2.0 m high.



The box does 10 J of work against friction as it slides down the slope.

What is the speed of the box as it reaches the bottom of the slope?

A 5.4 m/s **B** 6.3 m/s **C** 7.1 m/s **D** 9.5 m/s

（2023 冬季 0625/22 第9题）

题型 3：效率题先找有用输出（考频★★★☆☆）

知识点 效率表示输入能量中转化为有用输出的比例，$\eta =$ ____。

若用功率计算，则 $\eta = \frac{\text{有用功率输出}}{\text{总输入功率}}$；写成百分率时乘 100%。

效率没有单位，实际装置满足 $0 \le \eta \le 1$，即 $0\% \le \eta \le$ ____。

答案：有用能量输出；总能量输入；100%

怎么认 题目出现有用输出与总输入的能量或功率时，先用有用输出除以总输入。

一. 有用输出除总输入

例题 1 Four students determine the efficiency of four different electrical devices. The teacher knows that one student has made a mistake in the calculation.

Which value for efficiency is **not** correct?

A 12%　　**B** 36%　　**C** 78%　　**D** 102%

（2025 春季 0625/22 第12题）

解：效率为有用输出与总输入之比，故 $0\% \le \eta \le 100\%$。

$102\% > 100\%$

故选 D。

针对练习

1. A machine is very efficient.

What does this mean?

A It produces a large amount of power.

B It uses very little energy.

C It wastes very little energy.

D It works very quickly.

（2025 冬季 0625/21 第8题）

2. **(b)** A wind turbine is used to generate electricity.
The useful output from the turbine in 1.0 s is 6000 J. The kinetic energy of the wind hitting the turbine in 1.0 s is 11 000 J. The velocity of the wind hitting the turbine is 6.3 m / s.

(i) Show that the mass of air hitting the turbine each second is approximately 550 kg.

(ii) Calculate the efficiency of the turbines. You may assume that all the kinetic energy stored in the wind is transferred to the turbine.

（2024 冬季 0625/42 第3题(b)）

3. Fig. 2.1 shows solar-powered traffic warning lights.

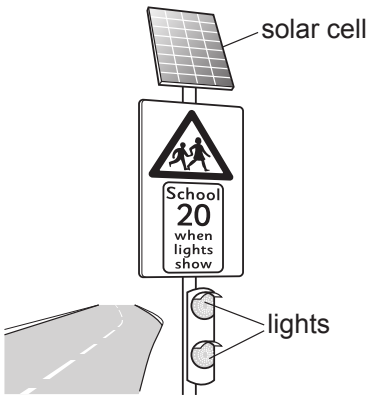


Fig. 2.1

The energy from the solar cell is stored in a battery.

(c) The efficiency of the solar cell is 22%. The power supplied to the lights by the cell is 15 W.

(i) State what is meant by 22% efficiency.

(ii) Calculate the solar power input to the solar cell.

（2024 夏季 0625/43 第2题(c)）

4. A student investigates the efficiency of a filament lamp. Fig. 4.1 shows the filament lamp with its glass bulb immersed in water in a beaker.

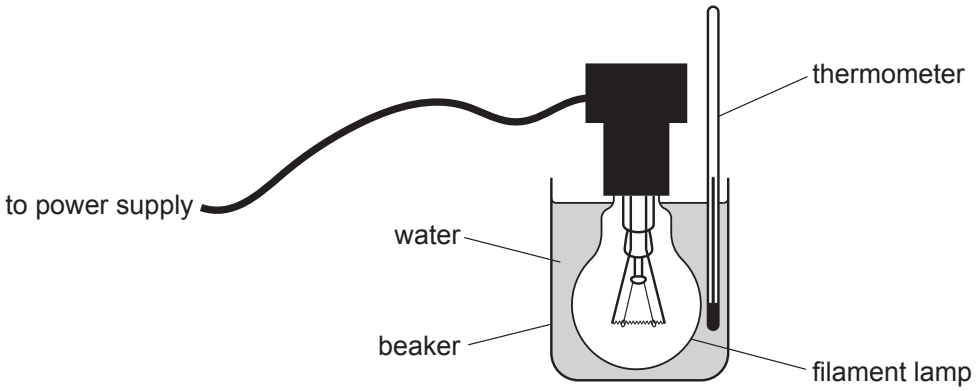


Fig. 4.1

The reading on the thermometer in the water is 19.0 °C.

Only the glass of the lamp is in contact with the water and the electrical connections are completely insulated.

The lamp is switched on.

At the end of the experiment, the temperature of the water is 21.5 °C.

(a) The mass of the water in the beaker is 600 g and the specific heat capacity of water is 4200 J / (kg °C).

(i) Show that the increase in the internal energy of the water is 6300 J.

(ii) In the experiment, the lamp is switched on for 500 s. The power supplied to the filament lamp is 13 W. The useful energy from the lamp is transferred as light. The energy that increases the temperature of the water is wasted energy.

Determine the maximum possible efficiency of the filament lamp.

（2023 夏季 0625/41 第4题(a)）

二. 桑基线宽先核对总量

知识点 在同一能量转化过程中，能量守恒要求总输入等于_____；能量单位为 J，功率单位为 W。效率等于_____，也可用有用功率输出与总功率输入之比；效率没有单位，乘 100% 写成百分数。桑基图中主箭头表示输入，各分支表示有用输出和损耗；同一标度下，箭头宽度表示_____。

答案：有用输出与各项损耗之和；有用能量输出与总能量输入之比；能量或功率的大小

怎么认　题目出现桑基图、输入量和各分支输出时，先令有用输出与全部损耗之和等于输入。

例题 2　A student investigates the efficiency of a filament lamp. Fig. 4.1 shows the filament lamp with its glass bulb immersed in water in a beaker.

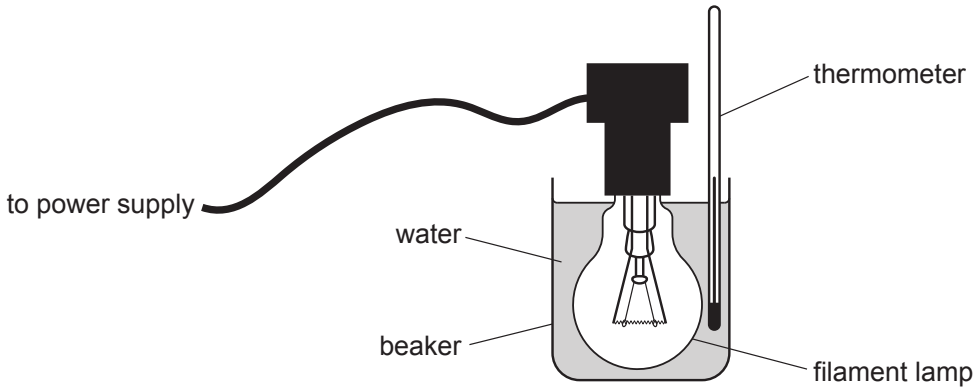


Fig. 4.1

The reading on the thermometer in the water is 19.0 °C.

Only the glass of the lamp is in contact with the water and the electrical connections are completely insulated.

The lamp is switched on.

At the end of the experiment, the temperature of the water is 21.5 °C.

(a) The mass of the water in the beaker is 600 g and the specific heat capacity of water is 4200 J/(kg °C).

(i) Show that the increase in the internal energy of the water is 6300 J.

(ii) In the experiment, the lamp is switched on for 500 s. The power supplied to the filament lamp is 13 W. The useful energy from the lamp is transferred as light. The energy that increases the temperature of the water is wasted energy.

Determine the maximum possible efficiency of the filament lamp.

(b) The efficiency of the lamp is less than the value determined in **(a)(ii)**.

Suggest **one** reason for this.

（2023 夏季 0625/41 第4题(b)）

解：输入能量一定，实际损耗能量等于水增加的内能与传递给其他物体的能量之和。
∵ 传递给烧杯和周围空气的能量未由水的温升计入，
∴ 实际损耗能量大于 6300 J，有用光能小于(a)(ii)所得值。
答：部分能量传递给烧杯或周围空气。

5. **(a)** Fig. 3.1 shows a Sankey diagram for the power transfer in a coal-fired power station.

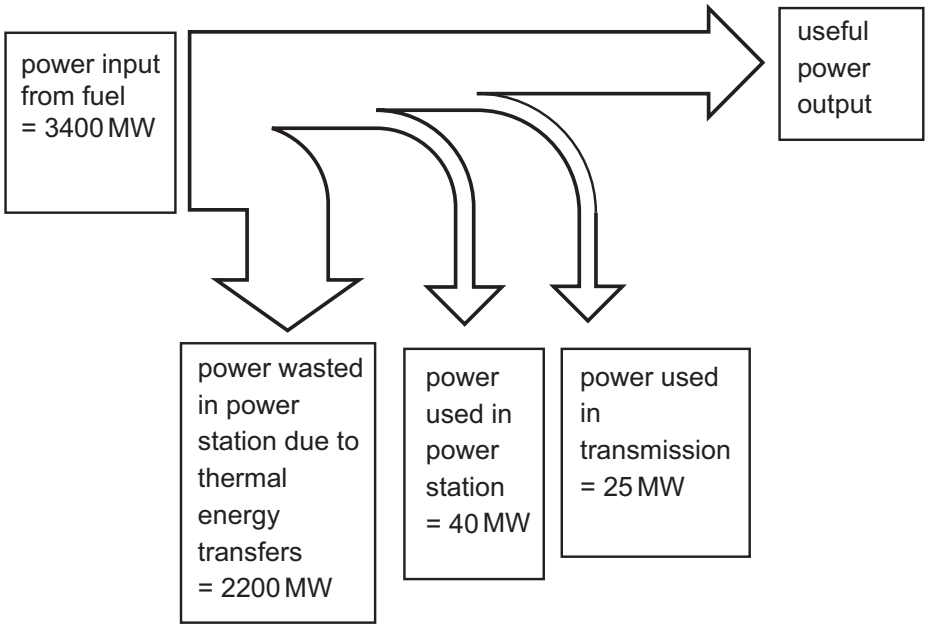


Fig. 3.1

(i) Show that the useful power output from the power station is approximately 1100 MW.

(ii) Calculate the efficiency of the power station.

（2025 冬季 0625/43 第3题(a)）

6. Fig. 4.1 shows a flow diagram for the energy transferred in a television.

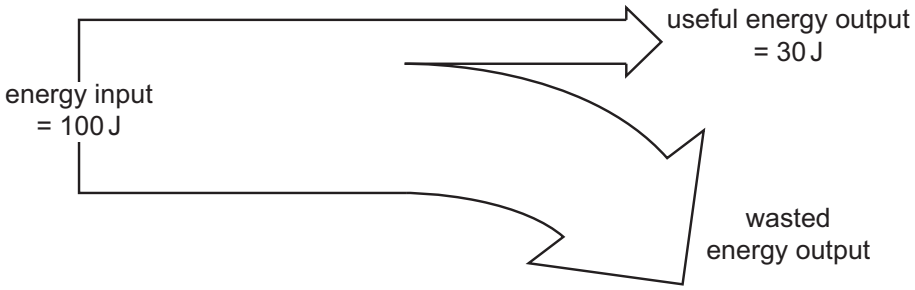


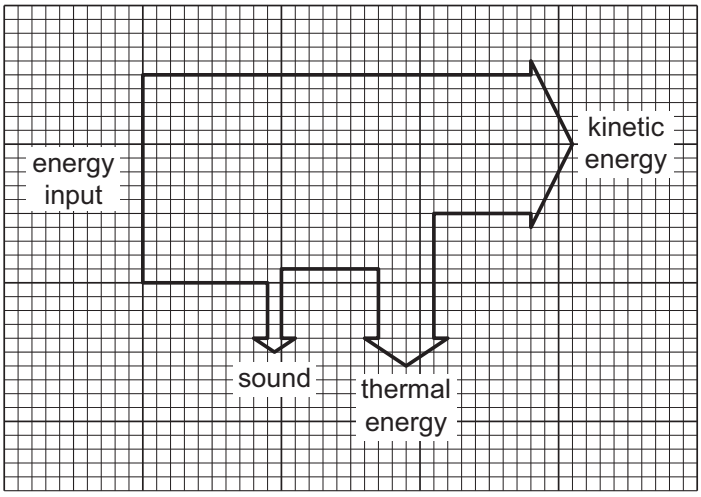
Fig. 4.1

(a) **(i)** State **two** ways in which **useful** energy is transferred from the television.

(ii) Determine the value of the wasted energy output from the television.

（2024 夏季 0625/32 第4题(a)）

7. The diagram shows a Sankey diagram for an electric drill.



scale: distance between two lines = 40 J

What is the total wasted energy shown by the diagram?

A 120 J **B** 200 J **C** 360 J **D** 560 J

（2024 冬季 0625/21 第10题）

8. **(b)** Fig. 2.1 shows the energy flow diagram for a car powered by a petrol engine.

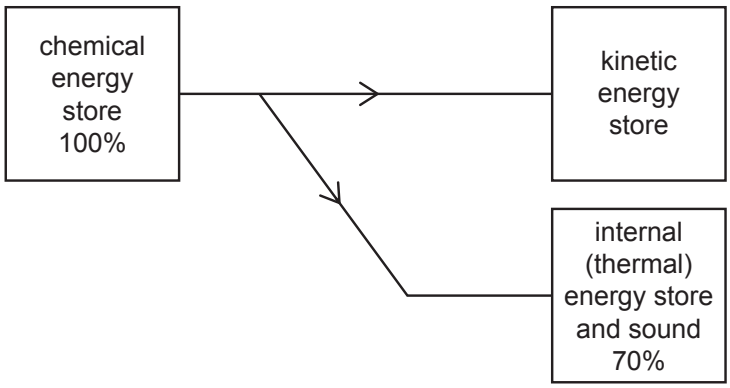


Fig. 2.1

(i) Using the information in Fig. 2.1, calculate the percentage of energy transferred from the chemical store to the kinetic store.

(ii) Fig. 2.2 shows the energy flow diagram for an electric car. The electric car is driven by an electric motor which is powered by a battery.

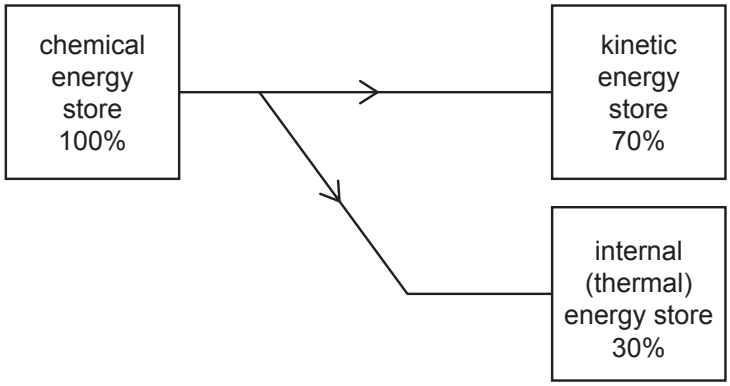


Fig. 2.2

Using the information in Fig. 2.1 and Fig. 2.2, state which car is more efficient. Give a reason for your answer.

（2023 冬季 0625/32 第2题(b)）

1.7.2 功

题型 1：先判断力是否沿位移做功（考频★★☆☆☆）

知识点 机械功等于通过力传递的_____；物体沿力的方向产生位移时，该力对物体做功。

力沿位移方向且大小不变时，$W = Fd = \Delta E$，其中 F 为力，d 为沿力方向移动的距离。

功和能量的单位都是_____，符号为_____。

答案：能量；焦耳；J

怎么认 题目出现力、沿力方向移动的距离与功中的任意两量时，先写 $W = Fd$。

例题 1 Which equation relates the work done *W* on an object by a force *F* when it moves a distance *d*?

A $d = WF$ **B** $d = \frac{F}{W}$ **C** $F = \frac{d}{W}$ **D** $F = \frac{W}{d}$

（2025 春季 0625/12 第10题）

解：由机械功的计算式得
$W = Fd$
两边同除以 d，得
$F = \frac{W}{d}$
故选 D。

针对练习

1. What needs to be known to calculate the work done by a force acting on an object?

	the size of the force	the distance the force moves the object	the time for which the force acts
A	✓	✓	✓
B	✓	✓	✗
C	✓	✗	✓
D	✓	✗	✗

key
✓ = needed
✗ = **not** needed

（2025 冬季 0625/11 第8题）

2. A woman pushes a mower across a lawn.

Which quantities does the woman use to calculate the work she does?

A distance, force and time

B distance and force only

C distance and time only

D force and time only

（2025 冬季 0625/13 第9题）

3. The work done *W* by a force is related to the magnitude *F* of the force and the distance *d* moved in the direction of the force.

Which equation for *W* is correct?

A $W = d \div F$ **B** $W = d + F$ **C** $W = F \div d$ **D** $W = F \times d$

（2025 夏季 0625/12 第8题）

4. Three situations are listed.

1 someone blowing air into a party balloon

2 a crane lifting a block of concrete

3 a pile of books at rest on a shelf

In which situations is work being done?

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

（2024 春季 0625/12 第6题）

题型 2：算功先取沿力方向的距离（考频★★★★☆）

知识点 机械功等于机械做功所转移的能量，$W = \Delta E$。

恒力与位移同向时，$W = Fd$，其中 d 为物体沿力方向移动的距离。

机械功的国际单位是_____，1 J = 1 N m；此时机械功等于_____与_____的乘积。

摩擦力使物体停止时，转移能量的大小也等于摩擦力与移动距离的乘积。

答案：焦耳（J）；力；沿力方向的距离

怎么认 题目出现力与物体沿力方向移动的距离，并求功或转移能量时，先用 $W = Fd$。

一. 同向力乘位移

例题 1 This question is about work, energy stores and energy transfers.

(a) Fig. 5.1 shows a child pulling a toy trolley across the floor.

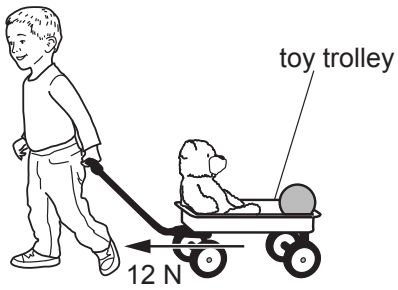


Fig. 5.1

The child pulls the toy trolley with a horizontal force of 12 N. The distance moved by the trolley is 5.0 m.

Calculate the mechanical work done on the toy trolley by the 12 N force.

（2023 春季 0625/32 第5题(a)）

解：拉力与位移同向，由 $W = Fd$ 得

$W = 12\ \text{N} \times 5.0\ \text{m}$

$W = 60\ \text{J}$

答：该力对玩具车做的机械功为 60 J。

针对练习

1. Fig. 3.1 shows an archer aiming an arrow at a target.

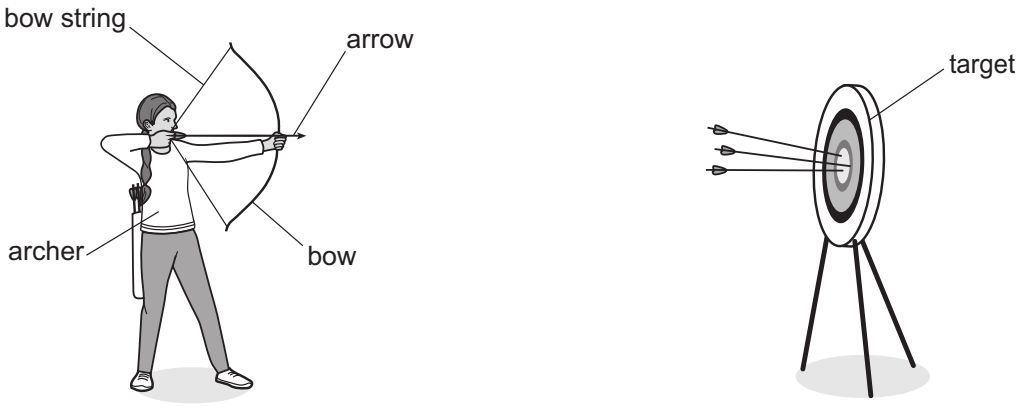


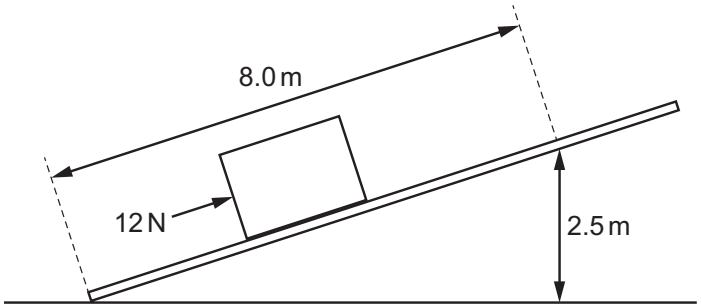
Fig. 3.1

(a) The archer pulls back on the bow string, doing a total of 110 J of work. Her hand moves a distance of 0.45 m. The bow is bent and stores energy.

Show that the average force applied by the archer in pulling the string back is approximately 240 N.

（2025 夏季 0625/43 第3题(a)）

2. The diagram shows a force of 12 N being used to push a box up a slope. The box is moved 8.0 m along the slope. This lifts the box through a vertical height of 2.5 m.



How much work is done pushing the box from the bottom to the top of the slope?

A 1.5 J **B** 4.8 J **C** 30 J **D** 96 J

（2024 冬季 0625/13 第8题）

3. A 500 N weight is raised through a height of 5 cm.

How much work is done by the force?

A 25 J **B** 100 J **C** 2500 J **D** 10 000 J

（2023 春季 0625/12 第11题）

4. A moving object is brought to rest by a frictional force of 30 N over a distance of 5.0 m.

The diagram shows the energy transferred between stores.



How much energy is transferred by this force and how is the energy transferred?

	energy transferred / J	how the energy is transferred
A	6.0	by electrical working
B	6.0	by mechanical working
C	150	by electrical working
D	150	by mechanical working

（2024 冬季 0625/11 第9题）

二. 提升只取竖直高度

知识点 机械功等于力与物体沿力方向移动距离的乘积，也是转移的能量，即 $W = Fd = \Delta E$，其中 d 是_____的距离。

物体竖直提升时，克服重力所做的功为 $W = Gh = mgh$，其中 h 是_____，斜面路程不代入 h。

功和能量的单位均为_____，符号为 J；以上关系适用于力与位移方向一致的情况。

答案：沿力方向移动；竖直高度；焦耳

怎么认 题目出现物体被提升、给出重量或质量及竖直高度时，先写 $W = Gh$ 或 $W = mgh$。

例题 2 A student has a battery-powered torch. Fig. 3.1 shows the torch.

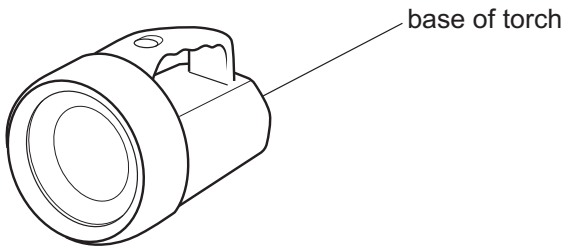


Fig. 3.1

(b) The weight of the torch is 8.5 N. The student lifts the torch a vertical distance of 0.80 m to place it on a shelf.

Calculate the work done on the torch by the student.

（2023 夏季 0625/32 第3题(b)）

解：提升时学生施加的力克服重力，沿力方向的距离为竖直高度。

由 $W = Fd$ 得

$W = 8.5 \times 0.80$

$W = 6.8$ J

答：学生对手电筒做功 6.8 J。

5. **(b)** The builder lifts another rock using a truck as shown in Fig. 2.2.

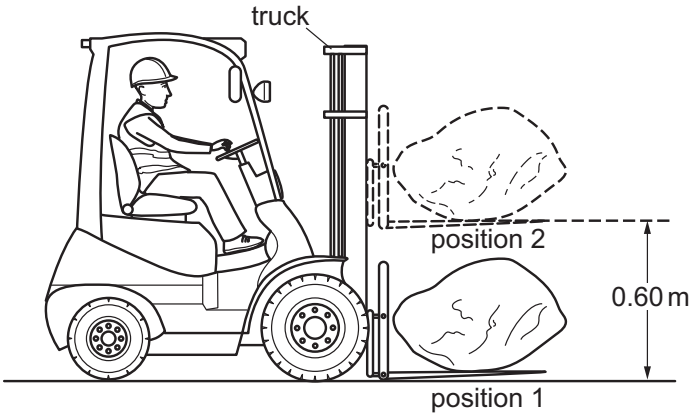


Fig. 2.2 (not to scale)

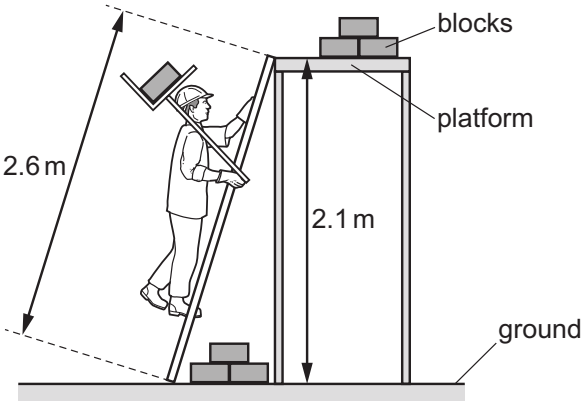
The truck lifts the rock through a vertical height of 0.60 m.

The weight of the rock is 4800 N.

Calculate the work done in lifting the rock.

（2025 冬季 0625/33 第2题(b)）

6. A builder lifts one concrete block from the ground onto a platform.



The weight of one block is 170 N.

What is the useful work done against gravity on one block?

A 360 J **B** 440 J **C** 360 W **D** 440 W

（2024 冬季 0625/12 第8题）

7. A student holds a pile of books. The mass of the books is 3.2 kg.

(b) The student carries the books from the bottom to the top of the stairs shown in Fig. 4.1.

The vertical height of the stairs is 4.5 m.

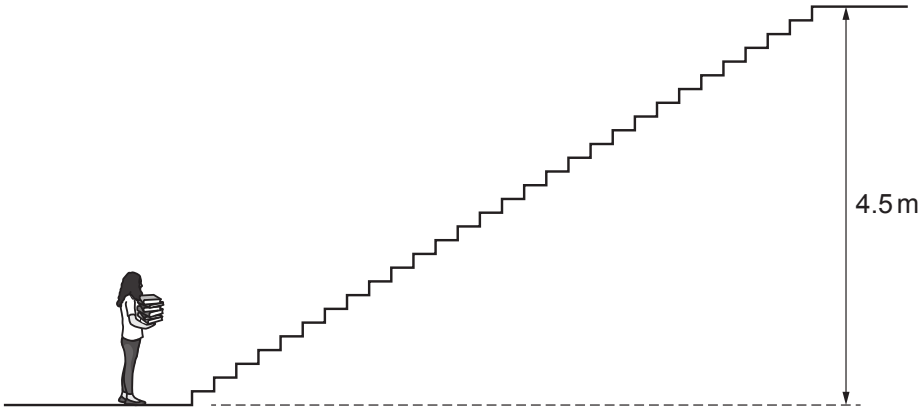


Fig. 4.1

(i) Show that the work done on the books when they are carried to the top of the stairs is approximately 140 J.

(ii) Determine the gravitational potential energy gained by the books.

Give a reason for your answer.

（2023 冬季 0625/32 第4题(b)）

8. Fig. 4.1 shows a student doing some repetitive ‘step-up’ exercises. In each ‘step-up’, the student steps up from the floor onto a box and then back down to the floor.

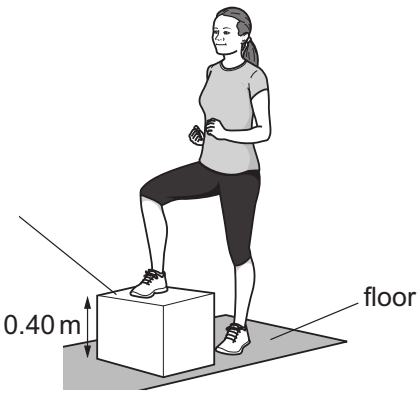


Fig. 4.1

(a) (i) The height of the box is 0.40 m. The weight of the student is 600 N.

Calculate the work done by the student in rising 0.40 m.

(ii) The chemical energy store in the student’s body decreases as she does ‘step-up’ exercises.

State the energy stores that increase as a result of energy transfers from the student’s chemical energy store.

（2025 冬季 0625/31 第4题(a)）

三. 多步题先求缺少的力

知识点 机械功等于力与物体沿_____通过的距离的乘积，也等于所转移的能量，$W = Fd = \Delta E$。若 F 或 d 未知，先由 $F = ma$、$E_k = \frac{1}{2}mv^2$、重力或其他受力关系求出；多个物体或多个过程的功应_____。

功和能量的单位都是_____，$1\ \mathrm{J} = 1\ \mathrm{N\ m}$。

答案：力的方向；分别求出后相加；焦耳（J）

怎么认 题目出现功、力和沿力方向距离中有未知量时，先由速率、动能或受力关系求出未知量。

例题 3

A girl is cycling along a straight horizontal road.

Fig. 1.1 shows the **directions** of the forces acting on the cyclist as she cycles in the direction of force C.

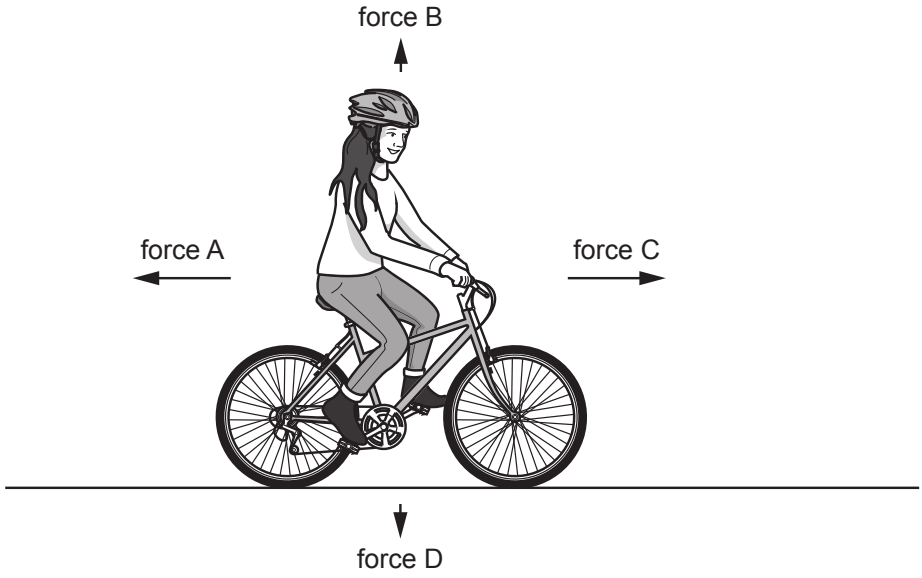


Fig. 1.1

(b) Another cyclist travels a distance of 250 m in a time of 21 s.

(i) Calculate the average speed of the cyclist.

(ii) The cyclist exerts a force of 36 N to move the cycle forwards.

Calculate the work done by this force when the cyclist travels 250 m. Include the unit.

（2024 夏季 0625/33 第1题(b)）

解：由平均速率等于总路程除以总时间，得

$v = \frac{250\ \mathrm{m}}{21\ \mathrm{s}}$

$= 11.9\ \mathrm{m/s} \approx 12\ \mathrm{m/s}$

力与位移同向，由 $W = Fd$ 得

$W = 36\ \mathrm{N} \times 250\ \mathrm{m}$

$= 9000\ \mathrm{J}$

答：（i）平均速率为 $12\ \mathrm{m/s}$；（ii）所做的功为 $9000\ \mathrm{J}$。

9. A person carries 20 tiles from the ground to the roof of a house. Each tile has a mass of 1.2 kg. The roof of the house is 15 m above the ground.

How much work does the person do against gravity on the tiles in carrying them to the roof?

A 37 J **B** 180 J **C** 360 J **D** 3500 J

（2025 夏季 0625/11 第9题）

10. A car accelerates uniformly in a straight line from rest at time $t = 0$. At $t = 3.2$ s, the speed of the car is 13.0 m/s.

(c) The car decelerates from 13.0 m/s to 0 m/s at a constant deceleration. The mass of the car is 1350 kg. The car travels 13 m in 2.0 s as it decelerates.

Show that the work done by the car as it decelerates is approximately 1.1×10^5 J.

（2023 冬季 0625/42 第1题(c)）

11. **(b)** Another bus travels at a speed of 8.9 m/s. The brakes apply a constant force and the bus stops in a distance of 23 m. This bus has a mass of 18 000 kg.

(i) Calculate the kinetic energy of the bus before the brakes are applied.

(ii) Calculate the force applied to stop the bus.

（2024 春季 0625/42 第1题(b)）

12. An electric motor lifts a load.
Fig. 4.1 shows the arrangement.

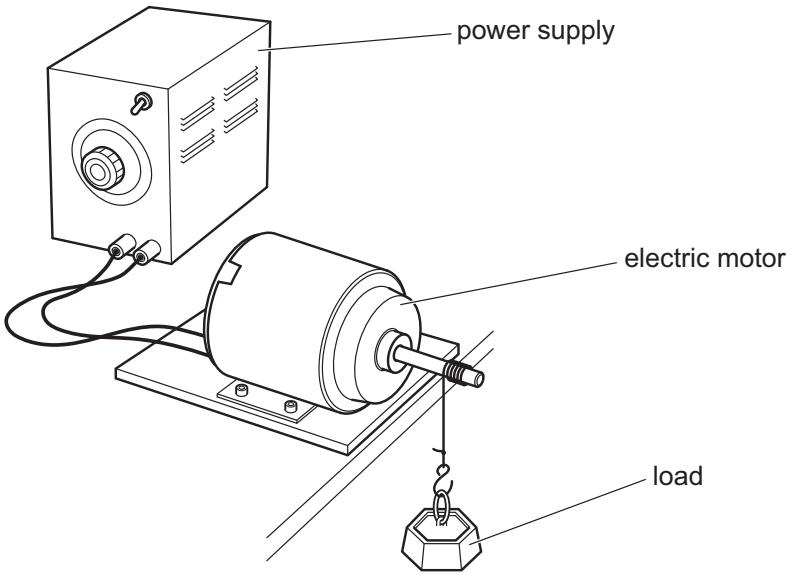


Fig. 4.1

(a) **(i)** The weight of the load is 15 N. The load is raised a vertical distance of 0.80 m.

Calculate the work done on the load.

(ii) Describe **one** way in which energy is wasted as the electric motor lifts the load.

（2025 夏季 0625/31 第4题(a)）

1.7.3 能源资源

题型 1：判断能源先追来源（考频★★★★☆）

知识点 可再生能源是在使用时间尺度内能由自然过程_____的能源资源，使用后不会逐渐耗尽。
不可再生能源的储量有限，消耗速度远大于自然补充速度；化石燃料和_____属于不可再生能源。
太阳能、风能、水能、潮汐能、波浪能、地热能和生物燃料属于_____能源。
燃烧化石燃料发电会造成空气污染；风能、核能和潮汐能发电时不造成空气污染。
可再生性是能源资源的分类，没有单位；判断时以使用时间尺度内能否自然补充为准。

答案：持续补充；核燃料；可再生

怎么认 题目出现能源名称并要求判断是否可再生时，先看它能否在使用时间尺度内由自然过程补充。

一. 看使用速度能否自然补充

例题 1 Which energy resource is non-renewable?

A geothermal

B natural gas

C solar

D wind

（2023 冬季 0625/11 第9题）

解：天然气是化石燃料，储量有限，使用后会逐渐耗尽，属于不可再生能源。
地热能、太阳能和风能能由自然过程持续补充。故选 B。

针对练习

1. Which energy resource is non-renewable?

A biofuel

B energy from the Sun

C nuclear fuel

D water behind a dam

（2024 冬季 0625/13 第9题）

2. **(a)** Energy stored in the water behind hydroelectric dams is an example of a renewable energy source.

(i) State what is meant by a renewable energy source.

(ii) State the name of **one other** renewable energy source.

（2024 冬季 0625/32 第4题(a)）

3. **(c)** State and explain whether each of the following methods of electrical power generation is renewable.

(i) power generation in a nuclear power station

(ii) power generation from waves in the sea

（2023 夏季 0625/43 第2题(c)）

4. **(a)** Table 5.1 shows whether some energy resources are renewable and whether they cause air pollution when being used to generate electrical power.

For each energy resource, complete Table 5.1 by writing **yes** or **no** in each space. The solar energy resource has been done for you.

Table 5.1

energy resource	is it renewable?	does it cause air pollution?
solar	yes	no
fossil fuels		
wind		
nuclear fuel		
tidal		

（2025 冬季 0625/33 第5题(a)）

二. 太阳来源先追能量链

知识点 能源资源的能量来源，是沿能量转化链追溯得到的最初来源。

风能、生物燃料、化石燃料、波浪能和水力发电中水的重力势能，最终主要来自_____。

地热能来自地球内部，核能来自核燃料，潮汐能来自天体间的_____作用，均不来自太阳辐射。

判断能源是否来自太阳，应追溯能量链的起点，不能依据发电过程中是否使用_____判断。

答案：太阳辐射；引力；水

怎么认 题目出现能源是否来自太阳或要求选出非太阳来源时，先沿能量链追溯其最初来源。

例题 2

(c) Radiation from the Sun is the main source of energy for most of our energy resources.

State **two** energy resources that are **not** due to radiation from the Sun.

（2023 春季 0625/42 第3题(c)）

解：地热能来自地球内部的热能，不由太阳辐射提供；核能来自核燃料，不由太阳辐射提供。

答：地热能、核能。

针对练习

5. **(b)** State **two** energy resources for which the Sun is **not** the main source.

（2023 夏季 0625/43 第2题(b)）

6. Many methods of generating electrical power involve the use of water.

(c) State **two** methods of generating electrical power for which the main source of energy is **not** the Sun.

（2023 冬季 0625/41 第5题(c)）

7. Three energy resources are listed.

1 geothermal

2 wind

3 nuclear fuel

Which resources get their energy from the Sun?

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

（2025 夏季 0625/22 第9题）

8. Useful energy is obtained from different energy resources.

Four examples of energy resources are listed.

- water waves
- geothermal
- wind
- water behind hydroelectric dams

How many of these energy resources depend on radiation from the Sun?

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

（2024 冬季 0625/23 第8题）

三. 按资源状态认能量库

知识点 能源资源的能量库由资源的状态和储能方式确定。

化石燃料和生物燃料储存_____，核燃料储存_____。

水坝后高处的水储存重力势能；运动的风、波浪和潮流具有_____。

水电站中，高处的水向下流动并推动涡轮机，涡轮机带动发电机产生电能。

答案：化学能；核能；动能

怎么认 题目出现燃料、高处的水或运动的风、波浪、潮流并问能量库时，先按资源状态判断。

例题 3

Fig. 3.1 represents a hydroelectric power station transmitting electrical energy to homes and factories far away.

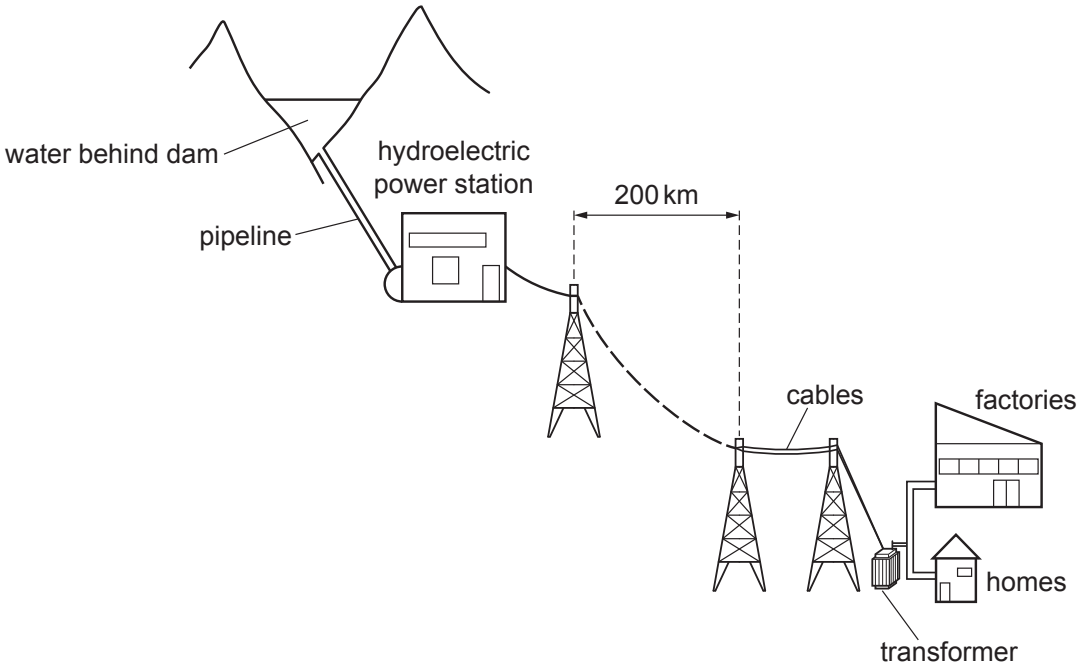


Fig. 3.1

(a) (i) State the energy store for the water behind the dam.

(ii) In the list of equipment, draw a ring around each item that a hydroelectric power station requires.

boiler **cooling tower** **generator** **solar cell** **turbine**

（2024 夏季 0625/33 第3题(a)）

解：(i) 水坝后的水处于高处，储存重力势能。
(ii) 水流推动涡轮机转动，涡轮机带动发电机产生电能。
答：(i) 重力势能；(ii) 发电机、涡轮机。

针对练习

9. In a small power station, biofuel is used to generate electricity.

Which energy store is reduced by this process?

A chemical

B kinetic

C nuclear

D thermal

（2023 冬季 0625/12 第9题）

10. Which energy resource stores kinetic energy?

A coal

B nuclear fission

C solar

D wind

（2025 冬季 0625/22 第8题）

11. Which energy resource does **not** contain a store of chemical energy?

A biofuel

B coal

C nuclear fuel

D oil

（2025 夏季 0625/11 第8题）

题型 2：发电流程先找涡轮和发电机（考频★★★★☆）

知识点 化石燃料和生物燃料储存化学能，核燃料在核裂变中释放核能；这些能量转化为热能，使水沸腾产生蒸汽。

蒸汽推动_____转动，涡轮带动_____，把机械能转化为电能。

燃料发电使用蒸汽过程；潮汐、水坝蓄水和风可使涡轮转动，不使用锅炉产生蒸汽。

能量的单位是焦耳（J），发电功率的单位是瓦特（W）。

答案：涡轮；发电机

怎么认 题目出现燃料、锅炉、蒸汽、涡轮或发电机时，先判定能量来源，再写蒸汽推动涡轮、涡轮带动发电机。

一. 燃料加热后带动涡轮

例题 1 Which energy resource requires a power station with a boiler to produce steam when generating electricity?

A coal

B tides

C water behind a dam

D wind

（2025 夏季 0625/12 第9题）

解：煤燃烧释放热能，锅炉用热能使水沸腾产生蒸汽。

蒸汽推动涡轮转动，涡轮带动发电机。因此所需能源为煤。

故选 A。

针对练习

1. Which statement about the use of nuclear fuel as an energy resource is correct?

A It obtains its energy from the Sun.

B It has **no** environmental impact.

C Nuclear power stations do **not** need turbines.

D The energy is released by nuclear fission.

（2024 冬季 0625/21 第8题）

2. A power station uses biofuels to generate electrical power.

(a) Describe how the power station generates electrical power from the chemical energy stored in biofuels.

（2025 春季 0625/32 第4题(a)）

二. 风轮直驱光伏直转

知识点 太阳能电池把太阳的_____转化为_____，不经过锅炉和涡轮。

风的动能使风轮叶片转动，叶片带动_____转动，从而产生电能。

答案：光能；电能；发电机

怎么认 题目出现太阳能电池或风轮发电图时，先判断是否经过涡轮和发电机。

例题 2 Fig. 3.1 shows a simplified diagram of a solar cell.

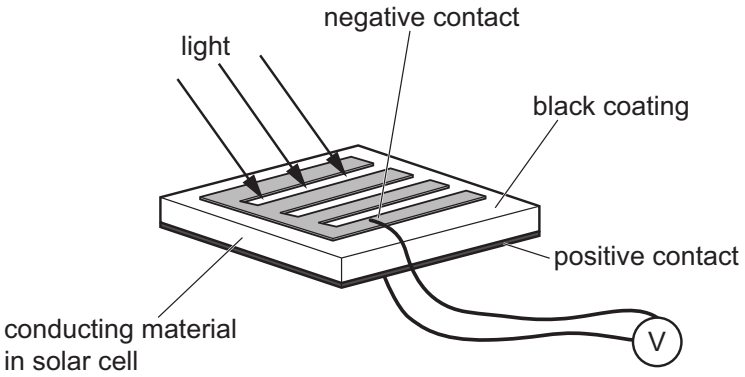


Fig. 3.1

(a) Describe the energy transfer in the solar cell.

（2025 冬季 0625/41 第3题(a)）

解：太阳发出的光属于电磁辐射，太阳能电池吸收光能并产生电能。

答：光能转化为电能。

3. Fig. 3.1 shows black solar panels installed on the roof of a house and a large rechargeable battery.

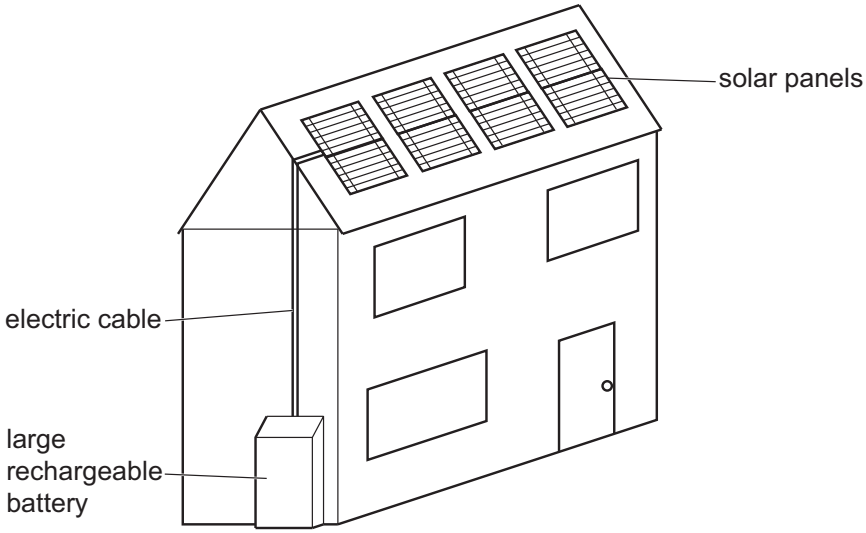


Fig. 3.1 (not to scale)

The solar panels produce electricity and give a maximum power output of 3.5 kW. The efficiency of the solar panels is 16%.

(d) Suggest **one** advantage of storing energy in the large rechargeable battery.

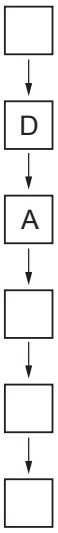
（2025 冬季 0625/42 第3题(d)）

4. Electricity is distributed from wind turbines to homes and industry.

(a) Statements A–F describe the main stages in the transfer of energy from the Sun to electrical energy in a wind turbine generator.
The statements A–F are **not** in the correct order.

A Air moves from regions of high pressure to regions of low pressure.
B The turbine blades turn a generator.
C Energy from the Sun heats the atmosphere unevenly.
D Uneven heating of the atmosphere produces regions of different atmospheric pressure.
E The generator produces electrical energy.
F Moving air turns the turbine blades.

Complete the flow chart to describe how a wind turbine uses energy from the Sun to generate electrical energy. Insert the missing letters in the empty boxes.



（2023 夏季 0625/31 第3题(a)）

5. **(c)** The lamp uses electrical energy that is generated by a wind turbine.
Fig. 4.2 shows a wind turbine.

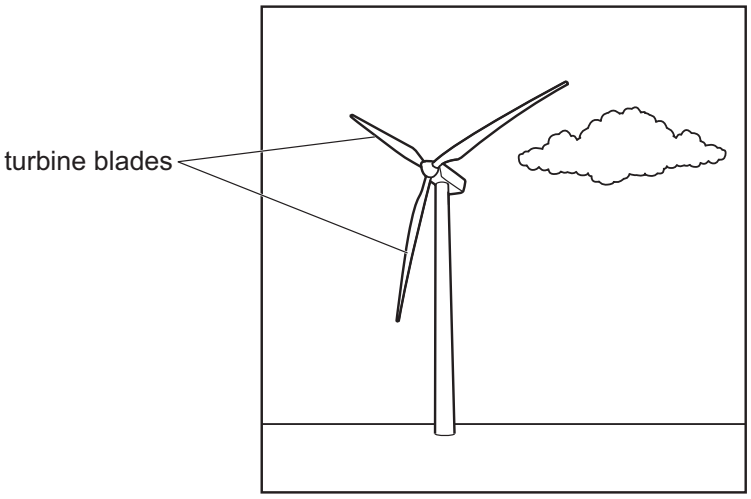


Fig. 4.2

Describe **three** energy transfers that take place when energy from the Sun causes electrical energy to be generated by the wind turbine.

（2024 冬季 0625/31 第4题(c)）

三. 水流或地热按设备串联

知识点 水波、潮汐和水坝后的水都储存能量，能量的单位是焦耳（J）。

水释放能量并流动时，水流推动_____转动，涡轮带动_____产生电能；水流能够到达设备是这一过程成立的条件。

利用地热资源时，地下热岩石加热水形成蒸汽，蒸汽推动涡轮，再由发电机产生电能。

答案：涡轮；发电机

怎么认 题目出现流水、潮汐、波浪或地热发电流程时，先写流体推动涡轮，再写涡轮带动发电机。

例题 3 Students are asked for examples of water being used to store energy.

Three examples are listed.

1 energy stored in water waves

2 energy stored in tides

3 energy stored in water behind dams

Which examples describe water being used to store energy?

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

（2024 冬季 0625/12 第9题）

解：水波、潮汐和水坝后的水均能储存能量，故 1、2、3 均正确。

故选 A。

针对练习

6. Many methods of generating electrical power involve the use of water.

(a) Describe **one** method of generating electrical power from energy stored in water.

（2023 冬季 0625/41 第5题(a)）

7. **(b)** Describe how useful energy may be obtained from geothermal resources.

（2025 冬季 0625/43 第3题(b)）

8. An electric motor lifts a load.
Fig. 4.1 shows the arrangement.

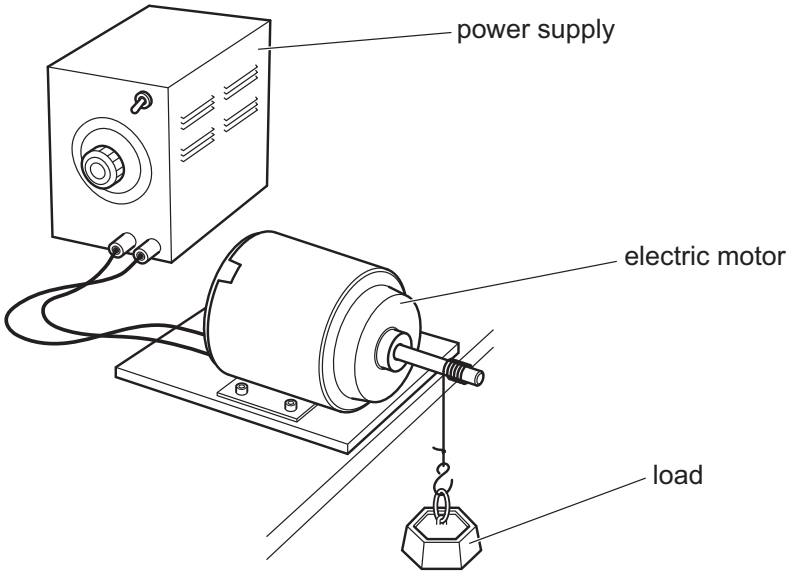


Fig. 4.1

(b) A hydroelectric power station generates electrical power using the energy stored in water behind a dam.

Describe how a hydroelectric power station generates electrical power.

（2025 夏季 0625/31 第4題(b)）

9. Fig. 4.1 shows a flow diagram for the energy transferred in a television.

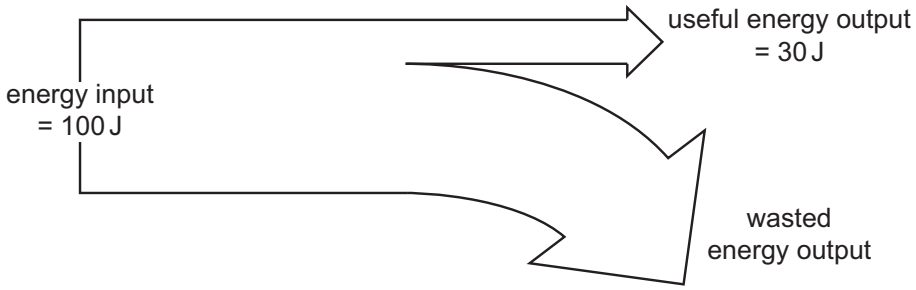


Fig. 4.1

(b) Fig. 4.2 represents a hydroelectric power station.

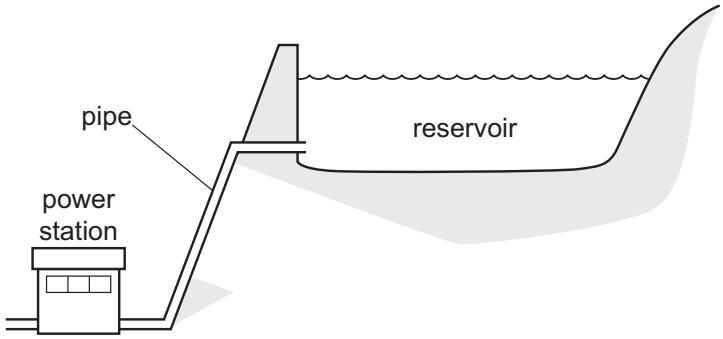


Fig. 4.2

(i) Describe how a hydroelectric power station generates electrical power.

(ii) Apart from cost, state **one** advantage and **one** disadvantage of generating electrical power using a hydroelectric power station compared to a coal-fired power station.

（2024 夏季 0625/32 第4题(b)）

题型 3：比较能源先分评价维度（考频★★★☆☆）

知识点 比较能源的环境影响，应分别考察单位能量产生的温室气体、空气污染物、废物以及生态和土地影响。

化石燃料燃烧会排放二氧化碳和空气污染物；风能、水能发电时不燃烧燃料，核能发电的大气污染较少，但会产生放射性废物。

可在自然过程中较快补充的能源称为_____能源；化石燃料和核燃料属于_____能源。

单位能量排放量常用 g/MJ 或 kg/kWh 表示，比较时应采用_____的发电量。

答案：可再生；不可再生；相同

怎么认 题目出现不同能源或发电站的环境优缺点时，先按排放、废物、生态土地和可再生性分别比较。

一. 先比排放和环境影响

例题 1 Which power station produces the greatest atmospheric pollution for each unit of energy generated?

A a gas fired power station

B a hydroelectric power station

C a nuclear power station

D a wind farm

（2023 春季 0625/12 第10题）

解：燃气发电站燃烧化石燃料，每产生单位能量会排放二氧化碳和其他空气污染物。
水力、核能和风力发电在运行时产生的大气污染均较少。
因此燃气发电站产生的大气污染最大。故选 A。

针对练习

1. Fig. 2.1 shows an electric tumble dryer used to dry wet clothes.

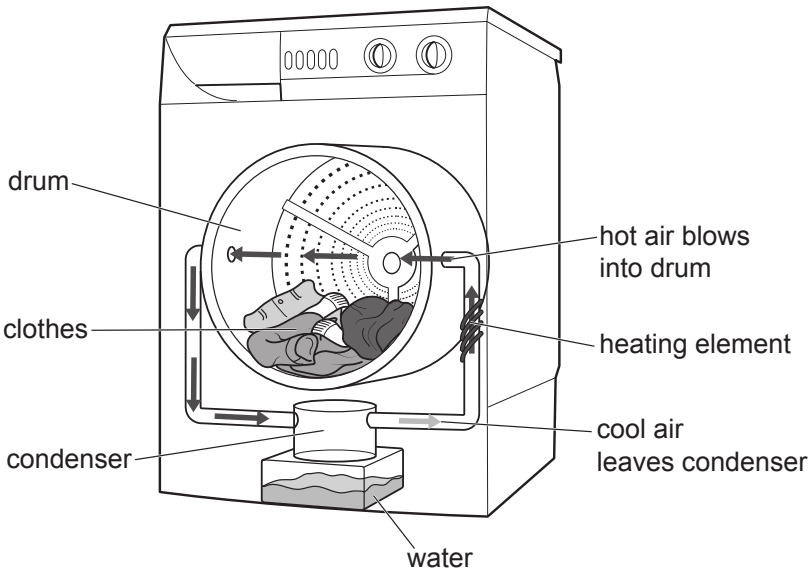


Fig. 2.1

(c) Suggest why using a clothesline to dry clothes in the open air is better for the environment than using an electric tumble dryer.

（2023 冬季 0625/42 第2题(c)）

2. The government of a country decides to reduce the amount of fossil fuel burned for generating electrical power.

(b) (i) Describe how a hydroelectric power station generates electrical power.

(ii) Hydroelectric power stations are expensive to build.

State **two** other disadvantages of using a hydroelectric power station to generate electrical power.

（2024 夏季 0625/31 第4题(b)）

3. Fig. 3.1 represents a hydroelectric power station transmitting electrical energy to homes and factories far away.

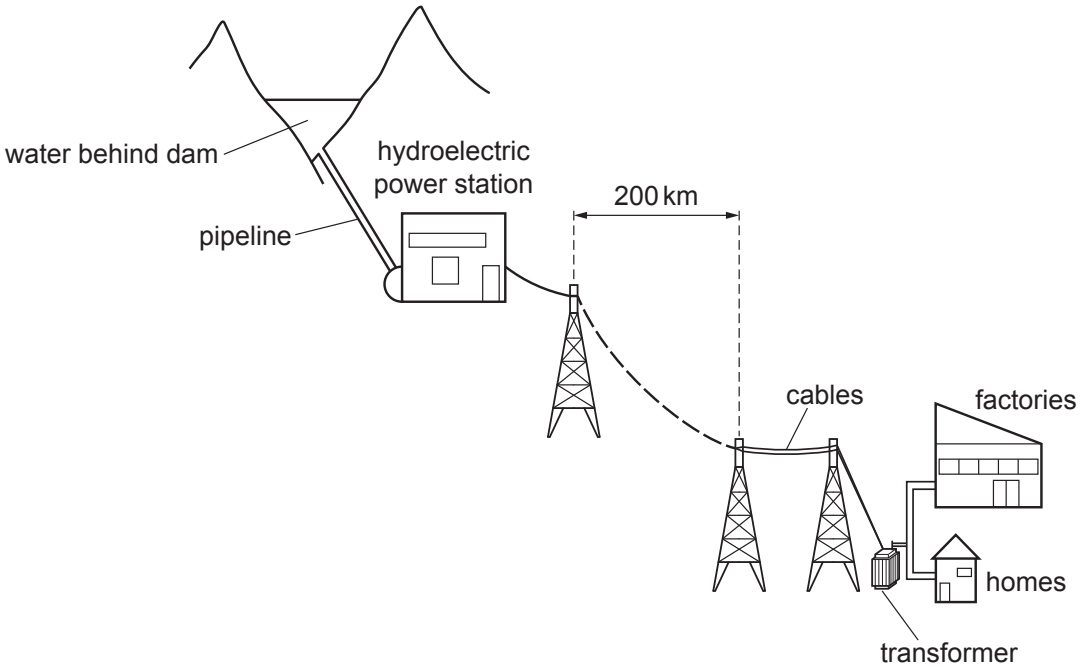


Fig. 3.1

(c) Hydroelectric power stations may replace coal-fired power stations.

State **two** advantages and **two** disadvantages of using hydroelectric power stations compared with coal-fired power stations. Do **not** include building or maintenance costs.

advantages

disadvantages

（2024 夏季 0625/33 第3题(c)）

4. A power station uses biofuels to generate electrical power.

(b) State **one** advantage and **one** disadvantage, apart from cost, of generating electrical power using biofuels compared with generating electrical power using fossil fuels.

（2025 春季 0625/32 第4题(b)）

二. 再比可靠性和可用条件

知识点 比较能源资源时，应按可靠性、可用条件和环境影响分别评价，结论取决于所比较的维度。

风能的输出随风速变化，不能保证按需发电，供能具有_____性；潮汐变化遵循规律，供能时间可以_____。

太阳能发电受光照条件限制；蓄电池储存电能后，可在无光照时维持用电设备工作。

答案：间歇；预测

怎么认 题目出现能源比较或百分比图时，先按可靠性、可用条件和环境影响分项判断。

例题 2 Which row describes an advantage and a disadvantage of wind turbines?

	advantage	disadvantage
A	no fuel needed	harmful gases released
B	variable supply	fuel needed
C	no harmful gases released	variable supply
D	constant supply	noisy

（2024 春季 0625/12 第7题）

解：风力发电由风的动能驱动，不需要燃料，运行时不释放有害气体；风速随时间变化，电力供应也会变化。故选 C。

针对练习

5. Fig. 2.1 shows solar-powered traffic warning lights.

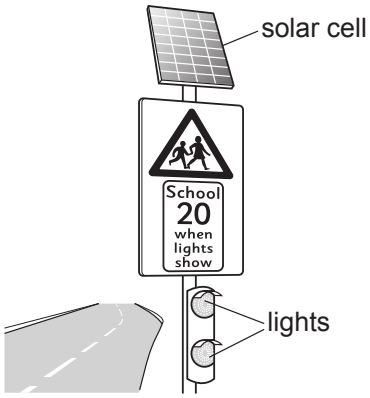


Fig. 2.1

The energy from the solar cell is stored in a battery.

(d) Suggest **two** advantages of using a solar cell to power the traffic warning lights in Fig. 2.1 compared to using mains electricity.

（2024 夏季 0625/43 第2题(d)）

6. **(c)** Tidal energy and wind energy are both renewable energy resources.
Suggest **one** reason why tidal energy is a more useful energy resource than wind energy.

Ignore the costs of construction and maintenance.

（2024 冬季 0625/42 第3题(c)）

1.7.4 功率

题型 1：先把功率认成能量速率（考频★★☆☆☆）

知识点 功率表示完成的功或转移能量的快慢，等于_____内完成的功或转移的能量。
$P = \frac{W}{t}$ 或 $P = \Delta\frac{E}{t}$，其中 t 为完成这些功或转移这些能量所用的时间。
功率的单位是_____，符号为 W；1 W = 1 J/s。完成相同的功时，所用时间越短，功率越_____。

答案：单位时间；瓦特；大

怎么认 题目出现功率单位，或相同功与不同用时，先用 $P=\frac{W}{t}$ 判断。

例题 1 What is the unit of power?

A joule

B newton

C volt

D watt

（2023 春季 0625/12 第12题）

解： 由功率的定义得

$P=\frac{W}{t}$

功率的单位为焦耳每秒，即瓦特。故选 D。

针对练习

1. Four electric motors do the same quantity of work when they lift a weight of 10 N through the same distance.

The times taken by each motor to lift the weight are shown.

What is the time taken by the motor which produces the most power?

A 1.5 s **B** 6.0 s **C** 15 s **D** 60 s

（2024 夏季 0625/13 第7题）

2. A microwave oven is rated at 900 watts.

Which statement correctly describes the meaning of this value?

A 900 joules are transferred every second.

B 900 amperes are transferred every second.

C 900 volts are transferred every second.

D 900 ohms are transferred every second.

（2023 冬季 0625/23 第10题）

3. A child runs up a set of stairs four times. The time taken for each run is recorded.

Which time is measured when the child's useful power is greatest?

A 10 s **B** 20 s **C** 30 s **D** 40 s

（2023 夏季 0625/21 第12题）

题型 2：功率换算先写 P=E/t（考频★★★★☆）

知识点 功率表示单位时间内完成的功或转移的能量，定义式为 _____ 或 _____。

式中 W 与 ΔE 必须对应同一时间 t；计算前把分钟、小时换算成 s，把 MJ 换算成 J。

功率的国际单位是 _____，1 W = 1 J/s。

答案：$P=\frac{W}{t}$；$P=\Delta\frac{E}{t}$；瓦特（W）

怎么认 题目出现功或能量、所用时间及所求功率时，先把时间化为 s，再写功率定义式。

一. 能量除时间求功率

例题 1 Fig. 4.1 shows a student using a battery-powered device.

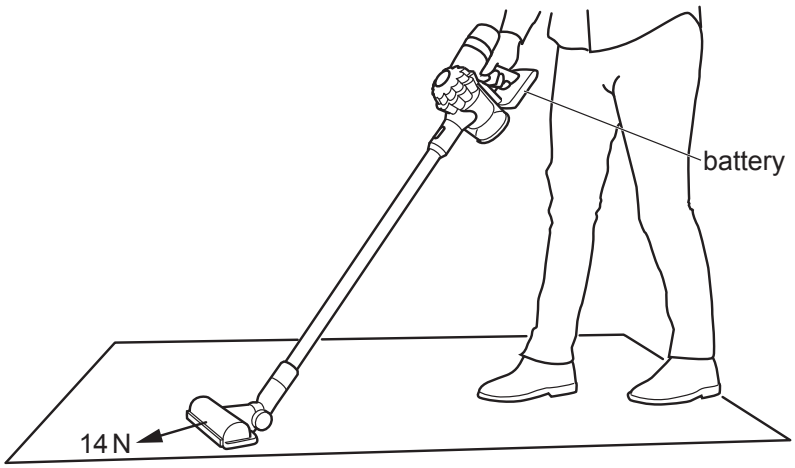


Fig. 4.1

(c) The student uses the device for a time of 30 s. The energy input to the device is 5400 J.

Calculate the power input to the device.

（2024 春季 0625/32 第4题(c)）

解：由功率等于能量转移量除以所用时间得

$P = \Delta\frac{E}{t}$

$P = 5400\frac{\text{J}}{30}\ \text{s} = 180\ \text{W}$

答：功率输入为 180 W。

针对练习

1. **(c)** The work done by the truck in lifting a different rock is 5800 J.

The truck lifts the rock in a time of 7.4 s.

Calculate the power of the truck in lifting the rock. Include the unit.

（2025 冬季 0625/33 第2题(c)）

2. A student uses an electric motor to lift a load. Fig. 4.1 shows the arrangement.

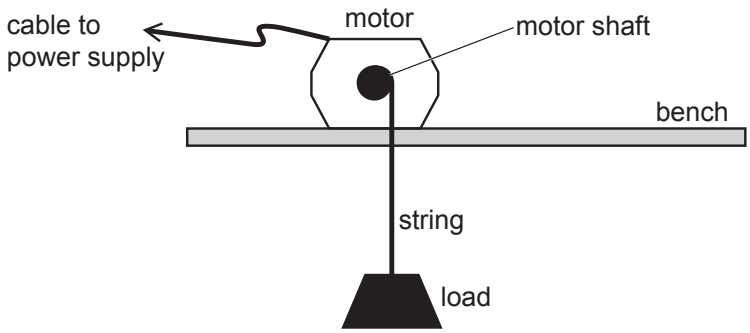


Fig. 4.1 (not to scale)

(b) The student uses the motor to lift a different load. The motor does 80 J of work when it lifts this load. It takes 5.0 s to lift the load.

Calculate the power output of the electric motor.

（2023 夏季 0625/31 第4题(b)）

3. An electric car is charged overnight. In 8.0 hours, 180 MJ of energy is transferred.

What is the power of the charger?

A 6.3 kW **B** 380 kW **C** 23 MW **D** 1400 MW

（2023 冬季 0625/12 第10题）

4. A pump does 460 000 J of work to raise water to fill a tank. It takes 7 minutes to fill the tank.

What is the power of the pump?

A 1.1 kW **B** 66 kW **C** 3200 kW **D** 190 000 kW

（2023 冬季 0625/21 第10题）

二. 功率乘时间求能量

知识点 功率表示单位时间内做的功或转移的能量，平均功率关系为 $P=\frac{W}{t}$ 或 $P=\Delta\frac{E}{t}$。

已知功率和持续时间时，由 $P=\frac{E}{t}$ 得 $E=$ _____；P 用 W、t 用 s，E 的单位为 _____。

分钟换算为秒，1 min = _____ s。

答案：Pt；J；60

怎么认 题目出现功率、持续时间和所求能量时，先写 $P=\frac{E}{t}$，再统一时间单位。

例题 2 A boy produces an average useful power output of 60 W as he rides his bicycle for 2.0 minutes.

How much useful energy does he transfer?

A 0.50 J **B** 30 J **C** 120 J **D** 7200 J

（2025 春季 0625/12 第11题）

解：由 $P=\frac{E}{t}$ 得 $E=Pt$。

$t=2.0\times60=120$ s

$E=60\times120=7200$ J

故选 D。

针对练习

5. A 60 W lamp operates at normal brightness for 2.0 minutes.

How much energy is transferred by the lamp?

A 0.50 J **B** 30 J **C** 120 J **D** 7200 J

（2024 冬季 0625/11 第27题）

6. **(b)** A 15 W lamp is switched on for 5.0 minutes.

Calculate the electrical work done in the lamp circuit during this time.

（2024 冬季 0625/31 第4题(b)）

三. 变形联算时间和效率

知识点 功率表示单位时间内完成的_____或转移的能量，$P=\frac{W}{t}=\Delta\frac{E}{t}$；$W$或$\Delta E$与$t$必须对应同一过程。

力与位移同向且力大小不变时，$W=Fs$；由功率关系可得$t=\frac{E}{P}$。

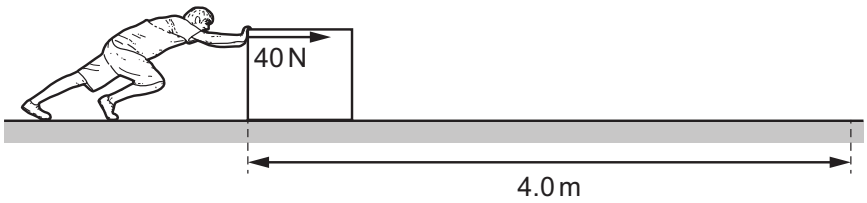
设备的有用输出功率等于输入功率乘_____，效率用小数代入；功率单位为 W，能量单位为 J，时间单位为 s。

$1\ \text{kW h}=3.6\times10^{6}\ \text{J}$，表示功率为1 kW的设备在1 h内转移的能量。

答案：功；效率

怎么认 题目出现力、路程与时间，或功率、能量、效率、kW h 时，先写$P=\frac{E}{t}$。

例题 3 A man applies a force of 40 N to push a box along the floor.



How much power is required to push the box 4.0 m in 3.0 seconds?

A 3.3 W **B** 30 W **C** 53 W **D** 480 W

（2024 夏季 0625/11 第7题）

解：力与位移同向，由$W=Fs$得

$W=40\times4.0=160\ \text{J}$

由$P=\frac{W}{t}$得

$P=\frac{160}{3.0}\approx53\ \text{W}$

故选 C。

7. What is the relationship between the power of a motor, the force exerted by the motor, the distance moved by the force and the time taken?

A $\text{power} = \dfrac{\text{distance moved} \times \text{time taken}}{\text{force}}$

B power = force × distance moved × time taken

C $\text{power} = \dfrac{\text{force} \times \text{time taken}}{\text{distance moved}}$

D $\text{power} = \dfrac{\text{force} \times \text{distance moved}}{\text{time taken}}$

（2024 冬季 0625/13 第10题）

8. Fig. 3.1 shows a simplified diagram of a solar cell.

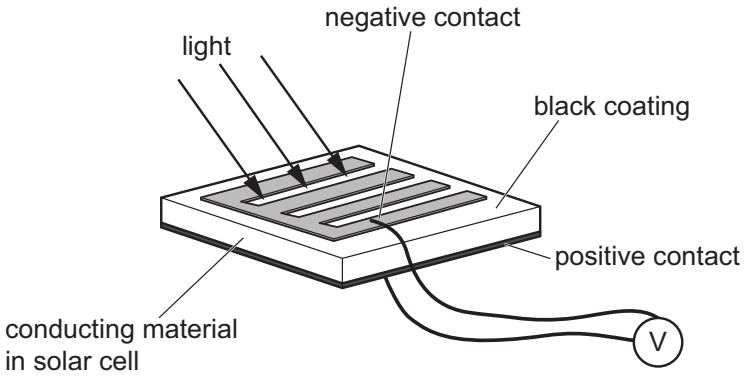


Fig. 3.1

(c) 0.72 kW of light is incident on the solar cell in Fig. 3.1. The cell has an efficiency of 75%.

(i) Calculate the output power of the cell.

(ii) State the meaning of the term kilowatt-hour (kWh).

(iii) Energy is produced by each solar cell for an average of 6 hours per day. A household uses approximately 7400 kWh of electrical energy per year.

Calculate the number of solar cells needed to produce energy for one household. Give your answer as a whole number of solar cells.

（2025 冬季 0625/41 第3题(c)）

9. Fig. 9.1 shows a mobile phone (cell phone) being charged on a wireless charging plate.

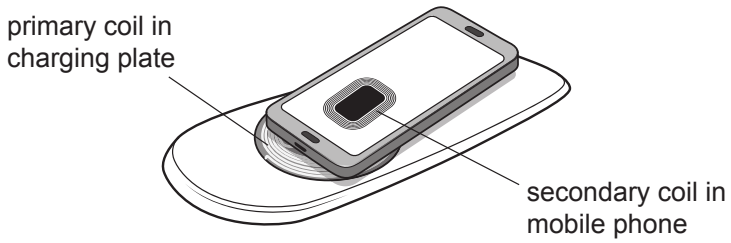


Fig. 9.1

(b) The maximum energy stored in the battery of the mobile phone is 0.012 kW h.

(i) Show that this maximum energy is 4.3×10^4 J.

(ii) The charging plate in Fig. 9.1 has a useful output power of 15 W.
The phone manufacturer claims that the battery can be charged to 50% capacity in less than 30 minutes.

Show that this claim is true.

（2024 夏季 0625/43 第9题(b)）

10. A farmer uses a rope to lift a barrel of fruit from the ground to a platform, as shown in Fig. 2.1.

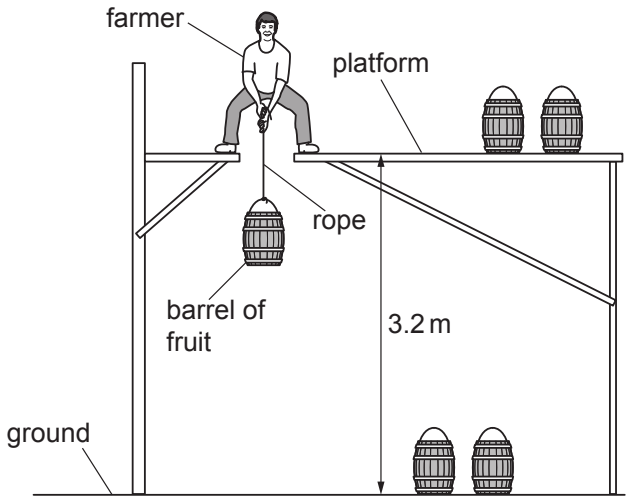


Fig. 2.1

(b) The farmer wants to make the process faster. He buys a machine to lift the barrels of fruit.

(i) The output power of the machine is 75 W.

The work done in lifting a barrel of fruit onto the platform is 450 J.

Calculate the time taken for the machine to lift a barrel of fruit onto the platform.

(ii) The machine uses an electric motor. The farmer installs some wind turbines to supply electrical power for the farm.

Suggest **one** environmental reason for using wind turbines rather than using a diesel (fossil fuel) generator.

（2023 冬季 0625/33 第2题(b)）

1.8 压强

题型 1：固体压强先定总力和接触面积（考频★★★★☆）

知识点 压强表示单位面积上受到的_____，关系为 $p=\frac{F}{A}$。

式中 F 为垂直作用在接触面上的力，A 为_____；物体静止在水平面上且不受其他竖直力时，F 等于物体的总重。

当 F 用 N、A 用 m^2 时，p 的单位为_____，$1\ \mathrm{Pa}=1\frac{\mathrm{N}}{\mathrm{m}^2}$。

答案：力；总接触面积；Pa（帕斯卡）

怎么认 题目出现压强定义、单位，或给出力和接触面积时，先认 $p=\frac{F}{A}$。

一. 先认 p=F/A 和单位

例题 1 A skier is standing still on a flat area of snow.



The total weight of the skier is 550 N. The total area of his skis in contact with the ground is 0.015 m^2.

What is the pressure exerted on the ground by the skier?

A 0.83 $\mathrm{N/m^2}$ **B** 8.3 $\mathrm{N/m^2}$ **C** 3700 $\mathrm{N/m^2}$ **D** 37 000 $\mathrm{N/m^2}$

（2025 春季 0625/12 第13题）

解：物体静止在水平雪地上，雪地受到的压力等于滑雪者的总重，故 $F=550\ \mathrm{N}$。

由 $p=\frac{F}{A}$ 得

$p=550\frac{\mathrm{N}}{0.015\mathrm{m}^2}$

$p\approx 3.7\times 10^4\frac{\mathrm{N}}{\mathrm{m}^2}$

故选 D。

针对练习

1. Which unit is a unit of pressure?

A $\mathrm{kg/m^2}$ **B** $\mathrm{kg/m^3}$ **C** Nm **D** $\mathrm{N/m^2}$

（2025 冬季 0625/12 第10题）

2. How is pressure defined?

A area per unit force

B force per unit area

C mass per unit area

D mass per unit volume

（2024 冬季 0625/13 第11题）

3. **(b)** A different metal block is lying on the ground, as shown in Fig. 3.2.

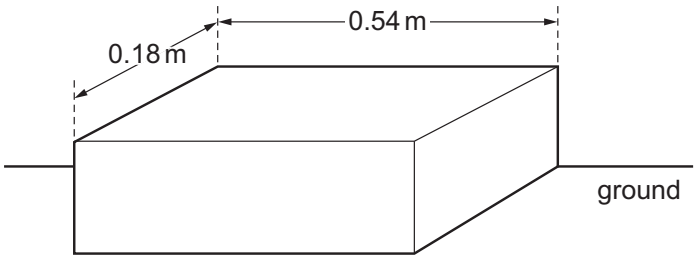


Fig. 3.2 (not to scale)

The weight of the metal block is 890 N.

Calculate the pressure on the ground caused by the block in the position shown in Fig. 3.2.

（2025 夏季 0625/32 第3题(b)）

4. Which situation is **not** explained by the equation $P = \frac{F}{A}$?

A using a longer spanner than normal to undo a tight nut

B hammering a nail into a piece of wood

C tractors using wide tyres in a muddy field

D a sharp kitchen knife cutting vegetables more easily than a blunt one

（2025 冬季 0625/11 第10题）

二. 面积先统一成平方米

知识点 固体压强表示物体对支持面单位接触面积上的_____。

压强满足_____，其中 F 为垂直作用于接触面的力，A 为接触面积；物体静止在水平面上且无其他竖直方向的力时，F 等于物体的重力。

压强的国际单位是帕斯卡，$1\ \mathrm{Pa} = 1\frac{\mathrm{N}}{\mathrm{m}^2}$。

面积由平方厘米换算为平方米时，换算因子也要平方，即 $1\mathrm{cm}^2 =$ _____ m^2。

答案：垂直作用力；$p = \frac{F}{A}$；10^{-4}

怎么认 题目出现物体的重力、接触面积及所求压强时，先把面积换成平方米。

例题 2 Fig. 3.1 shows a computer on the surface of a desk.

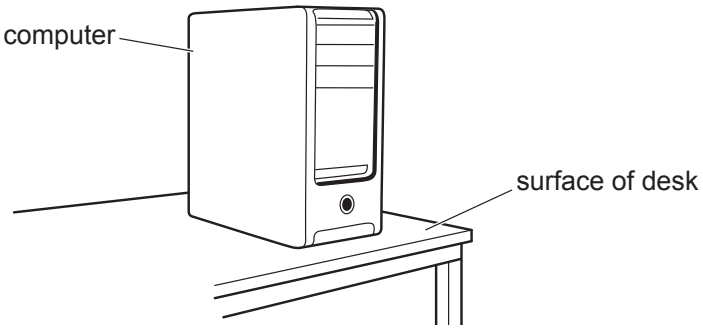


Fig. 3.1

(a) The weight of the computer is 48 N.
The area of the computer in contact with the surface of the desk is 20 cm^2.

Calculate the pressure due to the computer on the surface of the desk.

（2024 春季 0625/32 第3题(a)）

解：电脑静止在水平桌面上，其对桌面的压力等于重力，故 $F = 48\ \mathrm{N}$。
$A = 20\mathrm{cm}^2 = 20 \times 10^{-4}\mathrm{m}^2 = 2.0 \times 10^{-3}\mathrm{m}^2$。
由 $p = \frac{F}{A}$ 得
$p = \frac{48}{2.0\times10^{-3}} = 2.4 \times 10^4\ \mathrm{Pa} = 2.4\frac{\mathrm{N}}{\mathrm{cm}^2}$。
答：压强为 $2.4\frac{\mathrm{N}}{\mathrm{cm}^2}$。

针对练习

5. Fig. 3.1 shows a cross-section through the centre of a solid cone and a cross-section through the centre of a solid cuboid. The cone and the cuboid are placed on the ground as shown in Fig. 3.1.
The solid cone is more stable than the solid cuboid.
The symbol × indicates the position of the centre of gravity of each object.

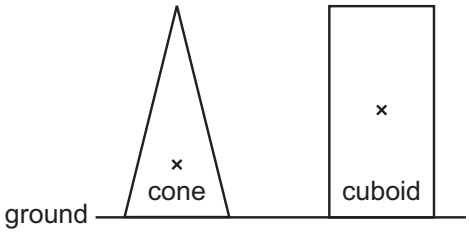


Fig. 3.1

(b) The weight of the solid cuboid is 48 N. The area of the solid cuboid in contact with the ground is 32 cm^2.

Calculate the pressure exerted by the solid cuboid on the ground.

（2025 春季 0625/32 第3题(b)）

6. Fig. 5.1 shows an empty metal cylinder.

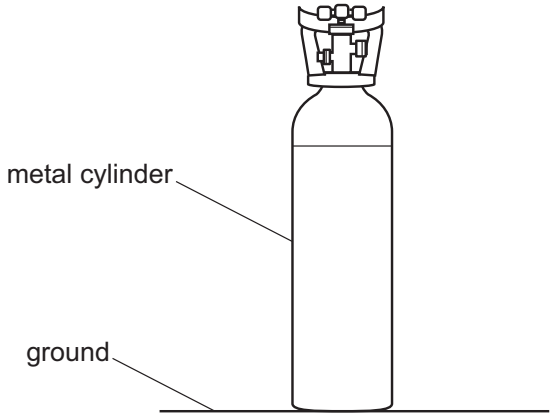


Fig. 5.1

(c) The weight of the metal cylinder is 420 N. The area of the metal cylinder in contact with the ground is 300 cm^2.

Calculate the pressure on the ground due to the metal cylinder.

（2025 冬季 0625/31 第5题(c)）

7. Fig. 2.1 shows the horizontal forces acting on an ice skater. The ice skater is moving forwards.

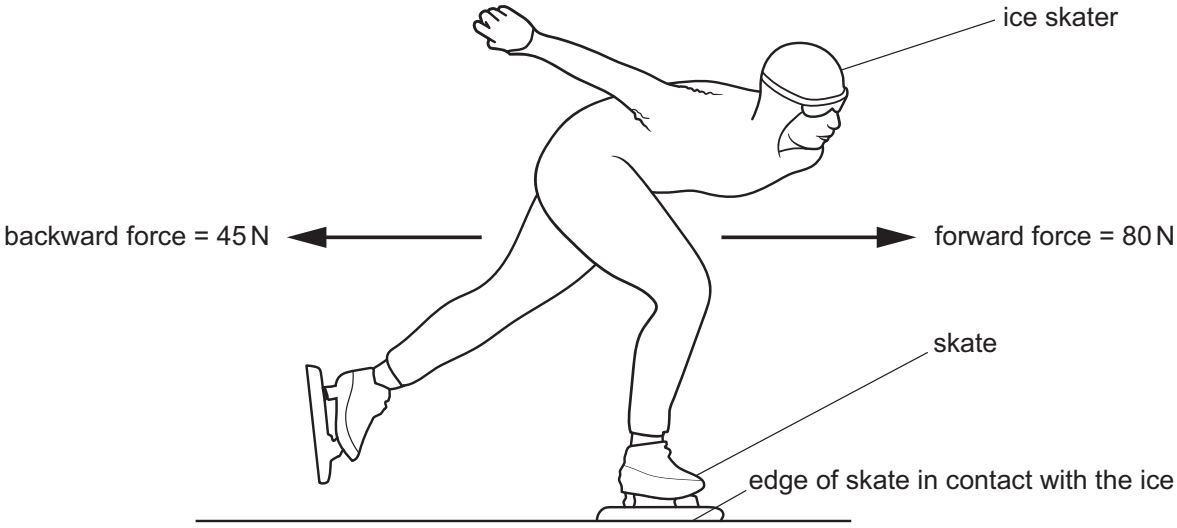


Fig. 2.1

(b) The weight of the ice skater is 700 N.
The area of the skate in contact with the ice is 6.2 cm^2.
Calculate the pressure on the surface of the ice exerted by the skate. Give your answer to two significant figures.

（2025 冬季 0625/32 第2题(b)）

8. A person pushes a pushchair. A young child rides in the pushchair. Fig. 2.1 shows horizontal forces acting on the front wheel of the pushchair.

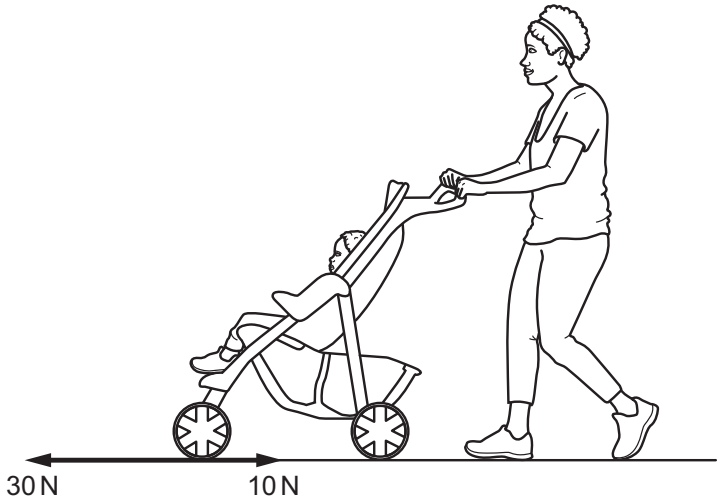


Fig. 2.1 (not to scale)

(a) Calculate the resultant of the horizontal forces shown in Fig. 2.1.

(c) In **(a)**, the weight of the pushchair and child is 240 N.
The total area of contact with the ground is 38 cm^2.

Calculate the pressure on the ground due to the pushchair and child.

（2024 冬季 0625/31 第2题(c)）

三. 同重物体只比较面积

知识点 压强表示垂直作用在单位面积上的力，$p = \frac{F}{A}$，其中 F 为垂直压力，A 为_____。
压强的国际单位是_____，$1\ \mathrm{Pa} = 1\mathrm{N/m^2}$；计算时，力和面积应采用相互对应的单位。
同一物体以不同表面放置时，压力相同，接触面积越大，压强越_____；若压力和面积均改变，应分别比较二者的变化倍数。

答案：接触面积；帕斯卡（Pa）；小

怎么认 题目出现物体的重力、接触面积或不同放置面时，先确定压力和接触面积。

例题 3 A woman has a weight of 600 N. She stands on a horizontal floor. The area of her feet in contact with the floor is 0.050 m^2.

What is the pressure she exerts on the floor?

A 1.2 10^3 N/m^2

B 2.4 10^3 N/m^2

C 1.2 10^4 N/m^2

D 2.4 10^4 N/m^2

（2023 夏季 0625/11 第13题）

解： 物体对水平地面的压力等于其重力，故 $F = 600\ \mathrm{N}$。
由 $p = \frac{F}{A}$ 得
$p = \frac{600}{0.050} = 1.2 \times 10^4 \mathrm{N/m^2}$。
故选 C。

9. Fig. 5.1 shows a metal block at room temperature on a table.

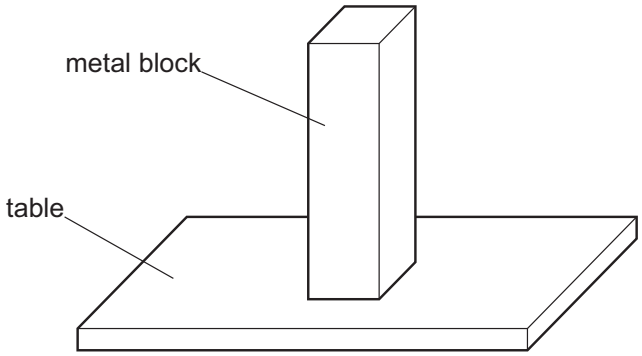


Fig. 5.1

(c) The weight of the metal block is 26 N. The area of the metal block in contact with the table is 42 cm^2.

Calculate the pressure on the table due to the metal block.

（2024 夏季 0625/32 第5题(c)）

10. Why is it easier to push a sharp nail, rather than a blunt nail, into a piece of wood?

A The sharp nail exerts a larger force on the wood.

B The sharp nail exerts a smaller force on the wood.

C The sharp nail exerts a larger pressure on the wood.

D The sharp nail exerts a smaller pressure on the wood.

（2023 冬季 0625/13 第11题）

11. **(a)** Fig. 3.1 shows a person moving across an ice-covered pond to reach a ball on the ice.

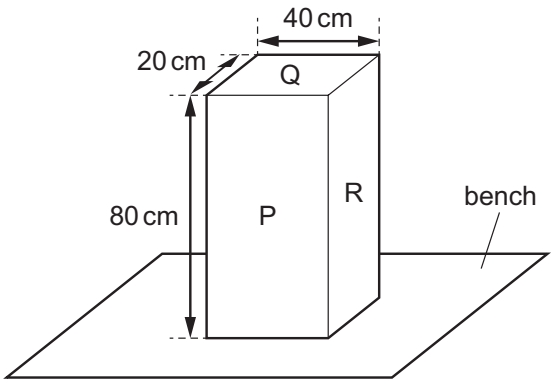


Fig. 3.1

Explain why this way of moving across the ice is safer than walking. Use your understanding of pressure in your answer.

（2023 夏季 0625/42 第3题(a)）

12. The diagram shows a solid block resting on a bench. The dimensions of the block are shown.



On which labelled surface should the block rest to produce the smallest pressure on the bench?

A P

B Q

C R

D P, Q and R produce the same pressure

（2025 春季 0625/12 第12题）

四. 多支点先求总接触面积

知识点 压强表示垂直作用在单位面积上的力，关系式为 _____，其中 F 为压力，A 为接触面积。
物体静止在水平支持面上且无其他竖直外力时，物体对支持面的压力大小等于物体总重力。
有多个接触面时，总接触面积为 _____；反求压力或面积可写成 $F = pA$ 或 $A = \frac{F}{p}$。
F 不变时，接触面积越大，压强越小；压强的 SI 单位是 _____，$1\ \text{Pa} = 1\frac{\text{N}}{\text{m}^2}$。

答案：$p = \frac{F}{A}$；各接触面积之和；Pa

怎么认 题目出现多个脚、轮或接触面并求压强、压力或面积时，先把各接触面积相加。

例题 4 A student has a battery-powered torch. Fig. 3.1 shows the torch.

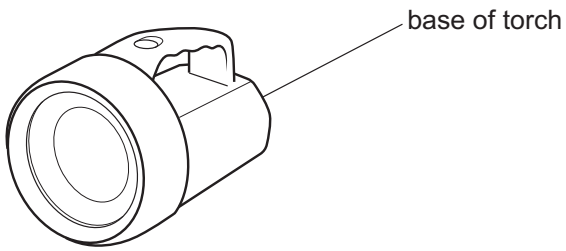


Fig. 3.1

(c) The student places the torch on its base on a shelf. The area of the base of the torch is 44 cm^2. The weight of the torch is 8.5 N.

Calculate the pressure on the shelf due to the torch.

（2023 夏季 0625/32 第3题(c)）

解：物体静止在水平架上，压力大小等于重力，$F = 8.5\ \text{N}$。
由 $p = \frac{F}{A}$ 得
$p = \frac{8.5}{44} = 0.19\frac{\text{N}}{\text{cm}^2}$。
答：压强为 $0.19\frac{\text{N}}{\text{cm}^2}$。

13. **(b)** Fig. 3.1 shows another boy sitting on a solid block of wood.

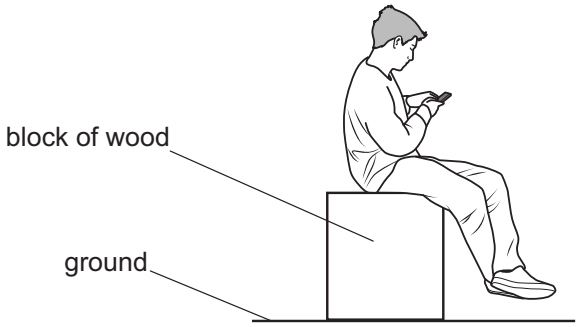


Fig. 3.1

The total weight of the boy and the block is 1200 N.
The area of the block of wood in contact with the ground is 0.16 m^2.

Calculate the pressure exerted on the ground.

（2024 冬季 0625/33 第3题(b)）

14. An elephant of weight 45 000 N stands with all four feet on the floor.

The average pressure on the floor due to the elephant foot in contact with it is 34 000 Pa.

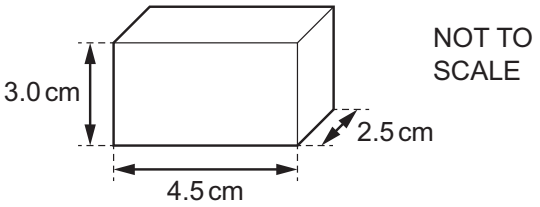
What is the area of each foot of the elephant?

A 0.19 m^2 **B** 0.33 m^2 **C** 0.76 m^2 **D** 1.3 m^2

（2024 冬季 0625/21 第11题）

15. The diagram shows a rectangular metal block with dimensions 2.5 cm × 3.0 cm × 4.5 cm. The block is resting on the ground.

The block exerts a pressure of 0.23 N / cm^2 on the ground.



What is the weight of the metal block?

A 0.020 N **B** 1.7 N **C** 2.6 N **D** 3.1 N

（2024 春季 0625/12 第8题）

16. A solid cube has sides 0.50 m long and a mass of 120 kg. It stands on the ground on one face.

Which pressure does the cube exert on the ground?

A 480 kg / m^3 **B** 960 kg / m^3 **C** 4700 N / m^2 **D** 9400 N / m^2

（2023 夏季 0625/13 第13题）

题型 2：液体压强先找深度和密度（考频★★★★☆）

知识点 压强是垂直作用在单位面积上的_____，$p=\frac{F}{A}$；F 为压力，A 为受力面积，压强单位是 Pa，且 $1\ \text{Pa}=1\frac{\text{N}}{\text{m}^2}$。

对于静止、密度均匀的液体，液面下压强的增量满足 $\Delta p=\rho g\Delta h$，其中 ρ 为液体密度，g 为重力场强度，Δh 为深度的增加量。

同一液体中，深度越大，压强越大；深度相同时，密度越大的液体压强增量越_____，这些关系与容器形状_____。

答案：力；大；无关

怎么认 题目出现液面下不同深度、不同液体密度或分层液体时，先比较深度与密度。

一. 越深越密压强增量越大

例题 1

(a) (i) Define pressure.

(ii) Describe how pressure in a liquid varies with its depth and with its density.

variation with depth

variation with density

（2023 夏季 0625/43 第2题(a)）

解：(i) 压强是垂直作用在单位面积上的力，即 $p=\frac{F}{A}$。

(ii) 由 $\Delta p=\rho g\Delta h$ 得，液体密度一定时，深度越大，压强越大；深度一定时，液体密度越大，压强越大。

答：液体压强随深度增大而增大，随密度增大而增大。

针对练习

1. Which row describes how the pressure beneath the surface of a liquid depends on the depth below the surface and on the density of the liquid?

	depth below surface	density of liquid
A	pressure decreases with increasing depth	pressure decreases with increasing density
B	pressure decreases with increasing depth	pressure increases with increasing density
C	pressure increases with increasing depth	pressure decreases with increasing density
D	pressure increases with increasing depth	pressure increases with increasing density

（2024 夏季 0625/13 第8题）

2. When a diver swims down from the surface of the water to a depth of 10 m, the pressure experienced increases from 100 000 N / m^2 to 200 000 N / m^2.

Which statement explains this increase in pressure?

A The density of the water increases with depth.

B The gravitational field strength increases with depth.

C The weight of water above the diver increases with depth.

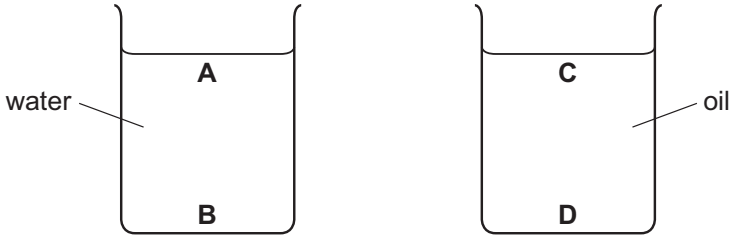
D Water cannot be compressed.

（2023 冬季 0625/11 第11题）

3. Two beakers are filled to the same depth, one with water and one with oil.

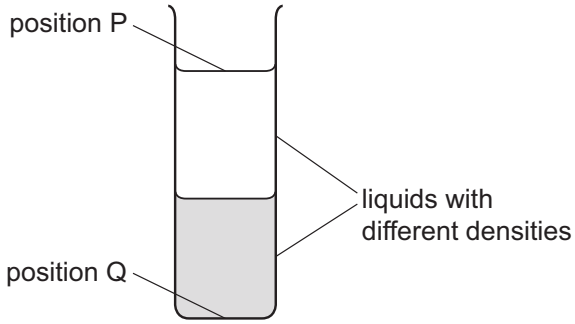
The density of water is 1000 kg / m^3. The density of oil is 920 kg / m^3.

In which position is the pressure the greatest?

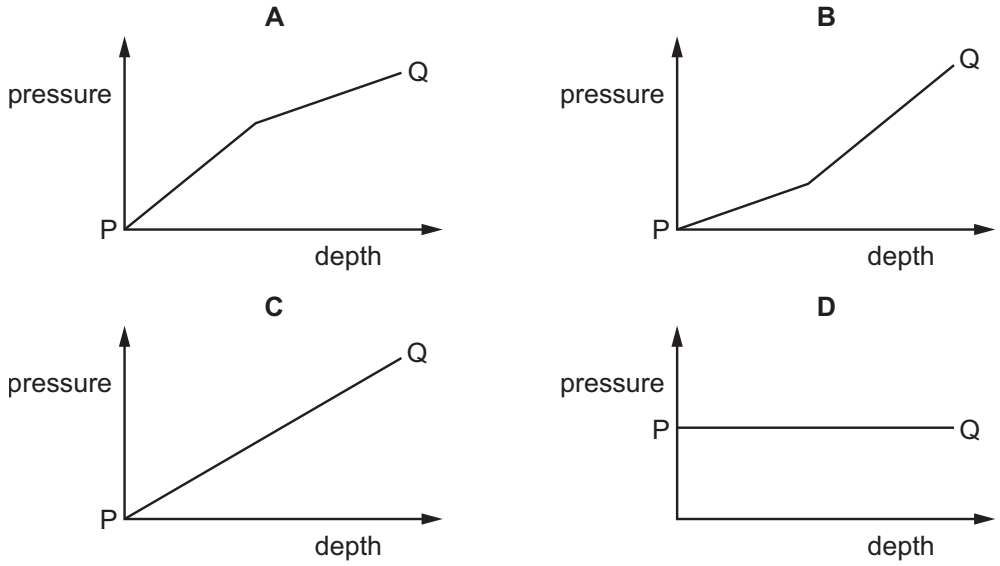


（2025 冬季 0625/22 第9题）

4. A tall cylinder is partly filled with two liquids, which do **not** mix. The two liquids have different densities. A student measures the pressure due to the liquids at different depths.



Which graph shows how the liquid pressure varies between positions P and Q?



（2025 春季 0625/22 第7题）

二. 用 ρgΔh 算压强差

知识点 液体内部两点的竖直深度差为 Δh 时，液体造成的压强差为 _____，其中 ρ 为液体密度，g 为重力场强度。

同种液体中，深度越大，液体压强越大；同一深度处，液体密度越大，液体压强越大。

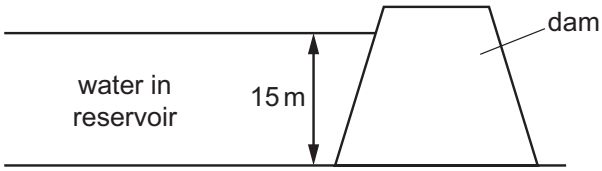
ρ、g、Δh 的单位分别为 _____、N kg^{-1}、m，所得 Δp 的单位为 Pa。

该式用于密度均匀的静止液体；Δh 取两点的竖直深度差，Δp 不包括液面上方空气造成的压强。

答案：$\Delta p = \rho g \Delta h$；kg m^{-3}

怎么认　题目出现液体密度、两点的竖直深度差和压强差时，先统一单位，再写 $\Delta p = \rho g \Delta h$。

例题 2　A dam holds water in a reservoir. The height of the water in the reservoir is 15 m.



The density of water is 1000 kg / m^3.

What is the pressure due to the water at the bottom of the dam?

A 6.8 Pa　**B** 1500 Pa　**C** 15 000 Pa　**D** 150 000 Pa

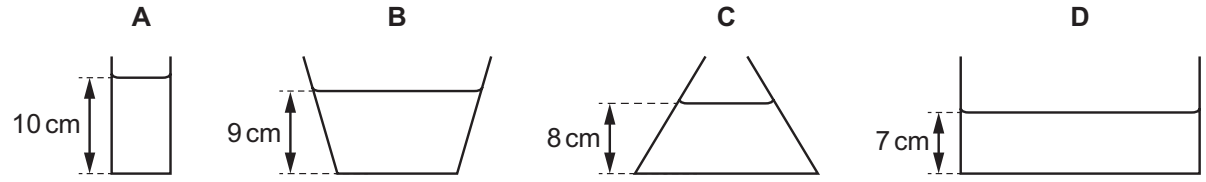
（2023 夏季 0625/21 第13题）

解：水面处水造成的压强为零，坝底与水面的竖直深度差为 $\Delta h = 15\ \ \mathrm{m}$。
由液体压强关系得
$\Delta p = \rho g \Delta h$
$= 1000 \times 10 \times 15$
$= 150000\ \ \mathrm{Pa}$。
故选 D。

针对练习

5. Four tanks contain water to the depths shown.

At the bottom of which tank is the pressure due to the water greatest?



（2024 冬季 0625/23 第11题）

6. An object is a depth *h* below the surface of a liquid. The pressure due to the liquid at this depth is *p*. The gravitational field strength is *g*.

What is the density ρ of the liquid?

A $\rho = pgh$　**B** $\rho = \frac{pg}{h}$　**C** $\rho = \frac{ph}{g}$　**D** $\rho = \frac{p}{hg}$

（2023 冬季 0625/22 第11题）

7. The equation $\Delta p = \rho g \Delta h$ can be used for a liquid.

What is the meaning of the term ρ?

A pressure due to the liquid

B density of the liquid

C total pressure due to the liquid and the air above the liquid

D density of an object placed in the liquid

（2024 夏季 0625/22 第8题）

8. Fig. 4.1 shows a bottle part-filled with water. The air inside the bottle is at the same pressure as the air outside the bottle. The bottle and its contents are at room temperature.

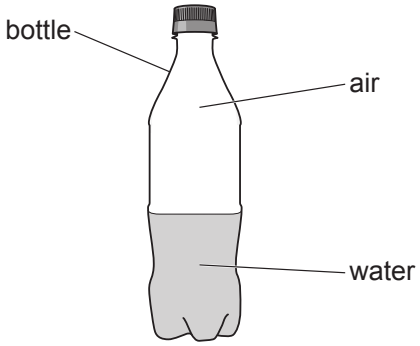


Fig. 4.1

(c) Another plastic bottle is filled to the top with water. The height of the bottle is 40.0 cm. The density of water is 1.0×10^3 kg / m^3.

Calculate the pressure difference between the top and bottom of the water.

（2023 冬季 0625/42 第4题(c)）

三. 总压强先扣外界压强

知识点 液体内部两点的压强差由液体密度和竖直深度差决定：_____；液体静止且密度均匀时成立。

若给出总压强，则液体产生的压强为 _____，其中 $p_{外}$ 为液面外的压强。

面积 A 上受到的压力为 _____。压强、密度和深度的单位分别为 Pa、kg/m³ 和 m。

答案：$\Delta p = \rho g \Delta h$；$\Delta p = p_{总} - p_{外}$；$F = \Delta p A$

怎么认 题目出现液体深度、密度和总压强时，先减去液面外压强，再由 $\Delta p = \rho g \Delta h$ 求未知量。

例题 3 An oil tank has a base of area 2.5 m^2 and is filled with oil to a depth of 1.2 m.

The density of the oil is 800 kg / m^3.

What is the force exerted on the base of the tank due to the oil?

A 940 N **B** 2400 N **C** 9400 N **D** 24 000 N

（2023 春季 0625/22 第14题）

解： 由液体内部压强变化公式得

$\Delta p = \rho g h$

$= 800 \times 9.8 \times 1.2$

$= 9408$ Pa

由 $F = \Delta p A$ 得

$F = 9408 \times 2.5$

$= 23520$ N

≈ 24000 N

故选 D。

9. An object taken underwater will be damaged if the total pressure acting on it is greater than 2.1 MPa.

What is the maximum depth that the object can be taken underwater before it breaks?

atmospheric pressure = 101 000 Pa

density of water = 1000 kg / m^3

A 10.3 m **B** 204 m **C** 214 m **D** 225 m

（2024 夏季 0625/23 第8题）

10. **(a)** **(i)** A rectangular glass tank contains 3.0 m^3 of liquid. The mass of the liquid is 2800 kg. Calculate the density of the liquid.

(ii) A metal block is placed in the tank and it sinks to the bottom. The top surface of the block is 1.1 m below the surface of the liquid.

Fig. 4.1 shows the block on the bottom of the tank.

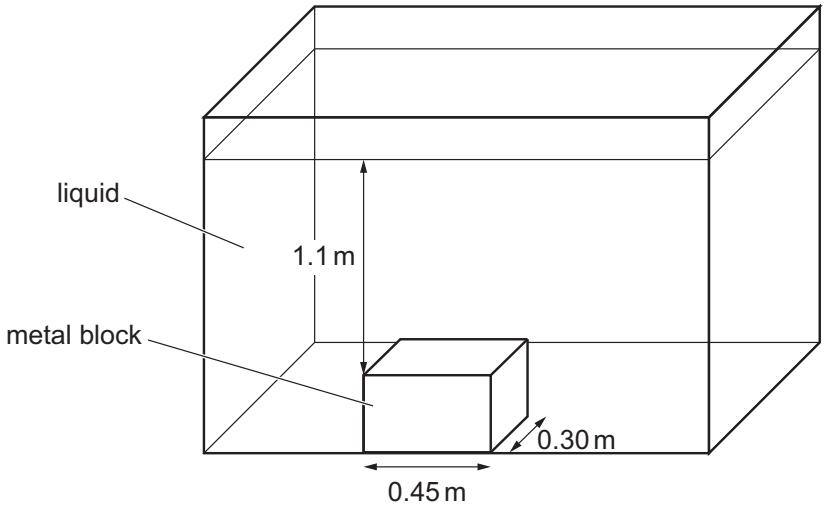


Fig. 4.1

Calculate the force exerted by the liquid on the top of the block.

（2025 冬季 0625/43 第4题(a)）

11. **(b)** Fig. 3.2 shows a side view of the pond with a layer of ice floating freely on the water.

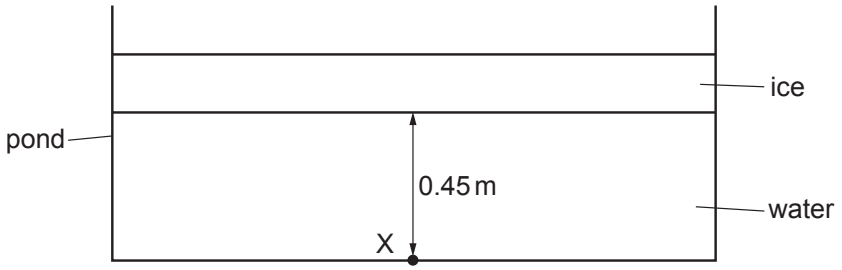


Fig. 3.2

The surface area of the pond is $5.0\,m^2$.
The mass of the ice is 690 kg.
The density of water is $1000\,kg/m^3$.
Point X is 0.45 m below the ice.

Calculate the pressure at point X due to the ice and the water.

（2023 夏季 0625/42 第3题(b)）

12. Liquids are difficult to compress whereas gases can be compressed easily.

(b) Fig. 3.1 shows a rectangular block floating in water. The density of the water is $1000\,kg/m^3$.

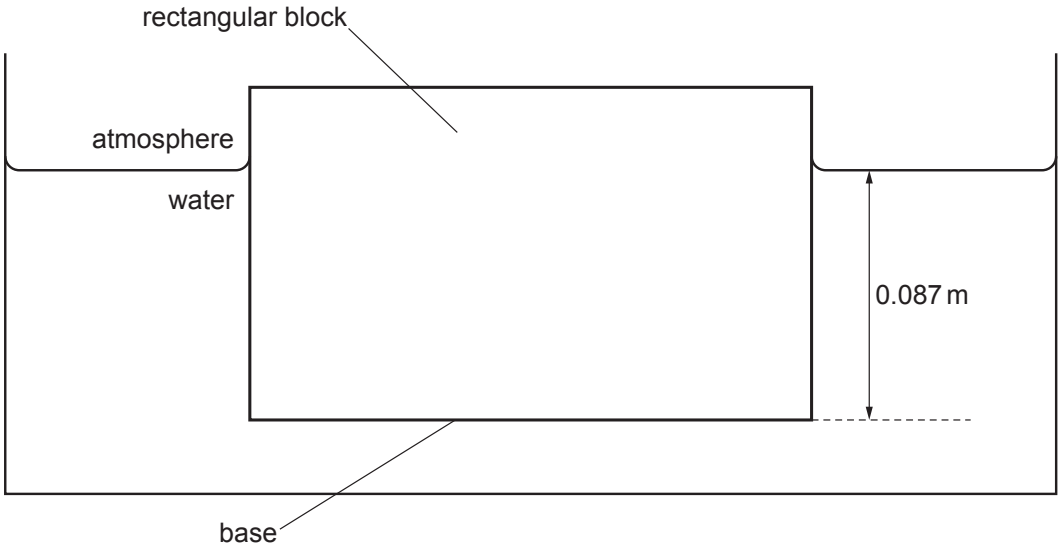


Fig. 3.1

The area of the base of the block is $0.014\,m^2$. The base of the block is at a depth of 0.087 m below the surface of the water.

(i) Show that the pressure due to the water at the base of the block is approximately 850 Pa.

(ii) Calculate the force *F* on the base of the block caused by the pressure given in **(b)(i)**.

(iii) Force *F* is equal to the weight of the block.

Calculate the mass of the block.

（2023 冬季 0625/41 第3题(b)）