学生手册 2026–2028

CIE IGCSE Physics 全基础题型

0625 · Core & Extended · 空间物理

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[6] 专题 6 空间物理

6.1.1 地球

题型 1：认准地日月周期现象（考频★★★★☆）

知识点 地球绕自身转轴自转一周约需_____，由此形成昼夜的周期变化。
地球绕太阳公转一周约需_____，由此形成季节的周期变化。
月球绕地球公转一周约需_____，由此形成月相的周期变化。

答案：24 小时；365 天；1 个月

怎么认 题目出现地球自转、地球绕太阳或月球绕地球及所求周期时，先写三组固定配对。

一. 用 24 小时、365 天、1 个月配运动

例题 1 Approximately how long does it take for the Moon to make one complete orbit of the Earth?

A 24 hours

B 1 month

C 1 season

D 1 year

（2023 春季 0625/12 第38题）

解：月球绕地球公转一周的周期约为 1 个月。
故选 B。

针对练习

1. What is the time taken for the Earth to spin once on its axis and the time taken for the Earth to orbit the Sun?

	spin on its axis	orbit the Sun
A	24 hours	1 month
B	24 hours	365 days
C	1 month	1 month
D	1 month	365 days

（2025 夏季 0625/11 第38题）

2. Which statement is correct?

A The Earth orbits the Sun once in approximately 24 hours.

B The Earth orbits the Moon once in approximately 1 week.

C The Moon orbits the Earth once in approximately 1 month.

D The Sun orbits the Earth once in approximately 365 days.

（2025 夏季 0625/22 第38题）

3. Fig. 11.1 represents the Earth in orbit around the Sun.

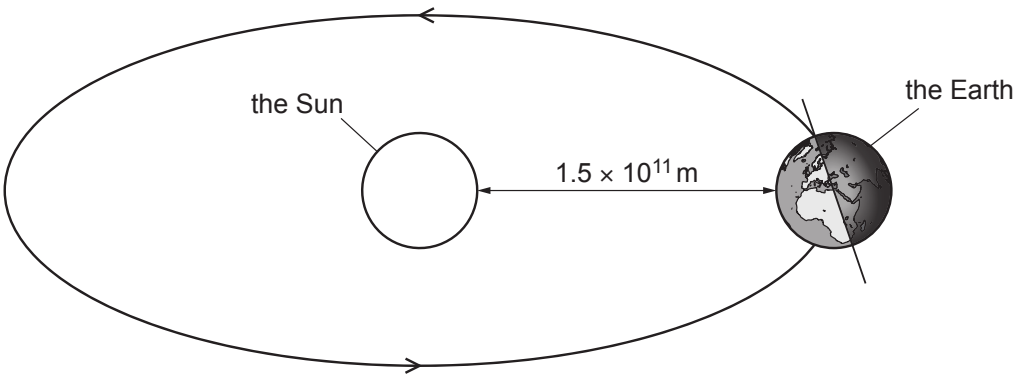


Fig. 11.1 (not to scale)

(a) (i) State the name of the force that keeps the Earth in orbit around the Sun.

(ii) State the time taken by the Earth to complete **one** orbit of the Sun. Include the unit.

(iii) State the time taken by the Earth to rotate **once** on its axis. Include the unit.

(iv) The Sun consists mainly of two gases. State the names of the **two** gases.

Question continued on next side

（2023 冬季 0625/33 第11题(a)）

二. 由自转判昼夜与太阳日动

知识点 地球绕倾斜的地轴自西向东自转，约 _____ 小时自转一周。

地球自转使各地周期性转入向阳面和转出向阳面，形成昼夜交替。

太阳的视运动方向与地球自转方向相反，看起来每天由 _____ 向 _____ 运动。

答案：24；东；西

怎么认 题目出现昼夜图或太阳每日视运动时，先写地球约每 24 小时自西向东自转一周。

例题 2 **(a)** Fig. 12.1 represents the Earth and the Sun at one point in the Earth's orbit of the Sun.

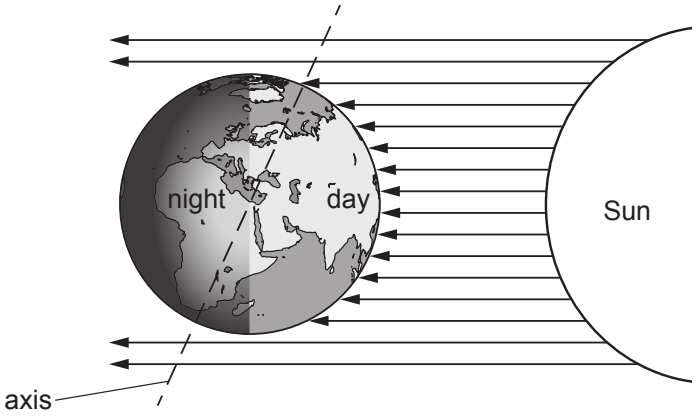


Fig. 12.1 (not to scale)

Explain the apparent daily motion of the Sun across the sky.

（2023 夏季 0625/31 第12题(a)）

解：地球绕地轴约每 24 h 自西向东自转一周。
观察者随地球转动，太阳相对地面看起来每天由东向西越过天空。
答：太阳的视日运动由地球约每 24 小时一次的自转造成。

针对练习

4. In which direction does the Sun appear to move every day, when viewed from the Earth?

A east to west

B north to south

C south to north

D west to east

（2025 夏季 0625/23 第38题）

5. The Sun, the Earth and the Moon are all bodies in the Solar System.

The Earth has a periodic cycle of day and night and a periodic cycle of seasons.

Which row relates the periods of these cycles to the motions of these bodies?

	period of day and night	period of the seasons
A	the Earth orbits the Sun	the Earth rotates about its axis
B	the Earth orbits the Sun	the Moon orbits the Earth
C	the Earth rotates about its axis	the Earth orbits the Sun
D	the Earth rotates about its axis	the Moon orbits the Earth

（2025 夏季 0625/12 第38题）

6. Which row explains the apparent daily motion of the Sun across the sky and the cycle of phases of the Moon?

	the daily motion of the Sun across the sky	the cycle of phases of the Moon
A	the Earth rotates on its axis once every 24 hours	the Earth orbits the Sun once approximately every 365 days
B	the Earth rotates on its axis once every 24 hours	the Moon orbits the Earth approximately once every month
C	the Moon orbits the Earth approximately once every month	the Earth orbits the Sun once approximately every 365 days
D	the Moon orbits the Earth approximately once every month	the Earth rotates on its axis once every 24 hours

（2024 夏季 0625/13 第37题）

三. 由月球公转判月相

知识点 月相是地球上观察到的月球亮面形状的周期性变化，其成因是_____。

太阳始终照亮月球朝向太阳的一半；从地球观察时，可见亮面的比例由日、地、月的相对位置决定。

月球位于地球和太阳之间时接近新月，位于地球背向太阳的一侧时为满月，位于太阳与地球连线的近似垂直方向时为弦月。

月球绕地球一周约需_____，月相以此周期循环。

答案：月球绕地球公转；一个月

怎么认 题目出现太阳光方向、地球和月球位置并求月相时，先标出月球受光面，再判断可见亮面比例。

例题 3 **(a)** Fig. 10.1 represents different positions A–H of the Moon as it rotates around the Earth.

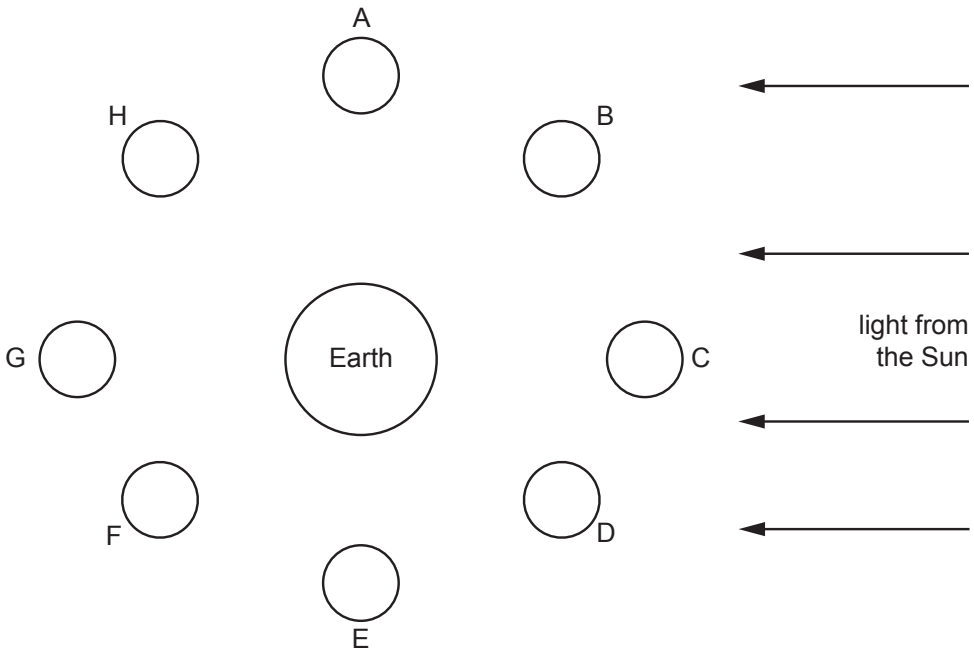


Fig. 10.1

(i) State a position of the Moon where an observer on Earth sees:

1. there is a quarter Moon 

2. there is a full Moon 

(ii) State the approximate time taken for the Moon to orbit the Earth.

（2024 春季 0625/42 第10题(a)）

解：太阳光从图中右侧射向左侧，月球朝向太阳的一半始终被照亮。
月球在 A 或 E 处时，太阳与地球的连线和地球与月球的连线近似垂直，从地球看到受光面的一半，故弦月位置为 A 或 E。
月球在 G 处时，地球位于太阳与月球之间，从地球看到月球的整个受光面，故满月位置为 G。
月球绕地球一周约需 1 个月。
答：弦月为 A 或 E；满月为 G；公转周期约为 1 个月。

针对练习

7. What causes the phases of the Moon?

A the Earth orbiting the Sun

B the Earth turning on its axis

C the Moon orbiting the Earth

D the Moon orbiting the Sun

（2025 冬季 0625/12 第38题）

8. What is the cause of the phases of the Moon?

A the movement of the Earth around the Sun

B the movement of the Moon around the Sun

C the movement of the Moon around the Earth

D the movement of the Sun around the Moon

（2024 夏季 0625/12 第38题）

四. 看地轴朝向判季节

知识点 地球的自转轴相对公转轨道平面倾斜，地球公转时地轴朝向近似保持不变。

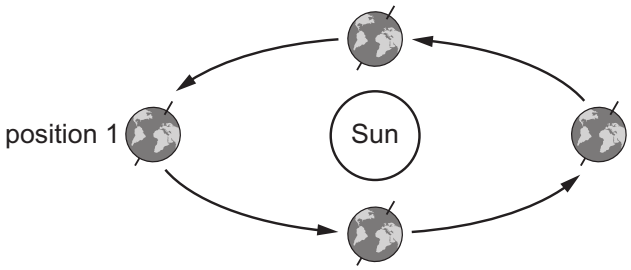
某半球倾向太阳时，太阳高度较大且白昼较长，该半球为_____；背向太阳时为_____。

地球约_____绕太阳一周，因此季节按年周期变化。

答案：夏季；冬季；365 天

怎么认 题目出现地球公转图、地轴朝向或所求季节时，先判断所问半球倾向还是背向太阳。

例题 4 The diagram shows the Earth orbiting the Sun.



Which row identifies and explains the correct season in the northern hemisphere on the Earth in position 1?

	season	explanation
A	summer	the northern hemisphere tilts away from the Sun
B	summer	the northern hemisphere tilts towards the Sun
C	winter	the northern hemisphere tilts away from the Sun
D	winter	the northern hemisphere tilts towards the Sun

（2025 春季 0625/12 第40题）

解：在位置 1，北极一端的地轴倾向太阳，北半球太阳高度较大且白昼较长，因此处于夏季。故选 B。

针对练习

9. It is summer in the northern hemisphere of the Earth in June.

Which statement explains why?

A The Earth is closer to the Sun in June.

B The Earth spins on its axis in the opposite direction to that in which it rotates around the Sun.

C The Moon is full in June.

D The north pole of the axis of the Earth's rotation is tilted towards the Sun in June.

（2023 冬季 0625/21 第38题）

10. The Earth is a planet that orbits the Sun once in approximately 365 days.

What does this enable us to explain?

A the cycle of day and night

B the cycle of phases of the moon

C the periodic nature of the seasons

D the apparent daily motion of the Sun

（2024 夏季 0625/11 第37题）

11. Fig. 12.1 represents the Earth's orbit of the Sun.

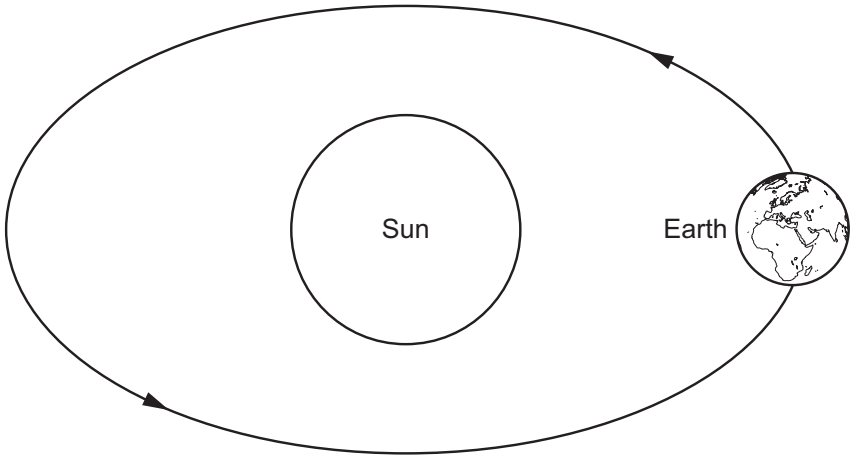


Fig. 12.1 (Not to scale)

(b) Explain why the Earth has an annual cycle of seasons.

（2025 春季 0625/32 第12题(b)）

12. **(b)** Suggest why countries that are a significant distance from the Equator experience significant temperature variation throughout the year.

（2023 夏季 0625/42 第10题(b)）

题型 2：用轨道量求时间与速率（考频★★☆☆☆）

知识点 平均轨道速率等于天体或卫星运行一周的路程与轨道周期之比。

把轨道看作半径为 r 的圆时，一周路程为_____，故 $v=\frac{2\pi r}{T}$，且 $T=\frac{2\pi r}{v}$。

计算前应将长度和时间的单位_____；若 r 用 m、T 用 s，则 v 的单位为 $\mathrm{m/s}$。

按匀速圆周运动处理时，若一段轨道占一周的比例为 k，所用时间为_____。

答案：$2\pi r$；统一；kT

怎么认 题目出现轨道半径、周期、平均轨道速率或圆周比例时，先判断用比例关系还是 $v=\frac{2\pi r}{T}$。

例题 1 The average distance from the Earth to the Sun is 1.5×10^{11} m.

What is the orbital speed of the Earth?

A 4.0×10^{5} km / day

B 1.3×10^{6} km / day

C 2.6×10^{6} km / day

D 1.9×10^{14} km / day

（2024 夏季 0625/23 第38题）

解： 地球公转周期约为
$T=365\ \text{day}$。
轨道半径为
$r=1.5\times10^{11}\ \text{m}=1.5\times10^{8}\ \text{km}$。
把轨道看作圆，由 $v=\frac{2\pi r}{T}$ 得
$v=\frac{2\pi\times1.5\times10^{8}}{365}$
$\approx2.6\times10^{6}\ \text{km/day}$。
故选 C。

针对练习

1. **(b)** Venus has an average radius of orbit of 1.1×10^{11} m and an orbital period of 220 Earth days. Calculate the average orbital speed of Venus. Give your answer in m / s.

（2024 冬季 0625/42 第11题(b)）

2. An artificial satellite orbits planet X at a distance $r = 7.0\times10^{6}$ m from the centre of planet X.

The average orbital speed v of the satellite is 3500 m / s.

What is the orbital period?

A 21 minutes

B 52 minutes

C 1 hour and 45 minutes

D 3 hours and 29 minutes

（2025 冬季 0625/23 第38题）

3. Fig. 10.1 shows the path of the Earth as it orbits the Sun. X is a position on the Earth where scientists observe the apparent motion of the Sun throughout the year.

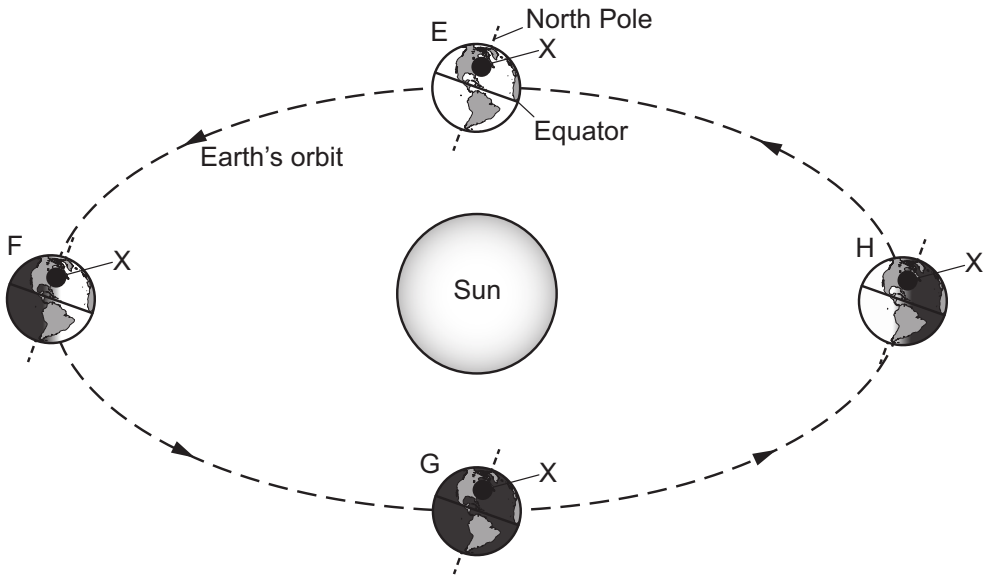


Fig. 10.1

(a) Determine how many days it takes the Earth to move around its orbit from F to G.
Explain your answer.

（2025 春季 0625/42 第10题(a)）

6.1.2 太阳系

题型 1：辨太阳系成员与行星（考频★★★★☆）

知识点 太阳系由一颗恒星太阳、八颗行星、天然卫星以及其他较小天体组成。

行星绕_____运动，天然卫星绕_____运动。

八颗行星按离太阳由近到远依次为水星、金星、地球、火星、木星、土星、天王星和海王星。

离太阳最近的四颗行星较小，主要由岩石构成；最远的四颗行星较大，主要由气体构成。

矮行星、小行星和彗星均属于太阳系，冥王星属于_____。

答案：太阳；行星；矮行星

怎么认 题目出现天体绕行关系、太阳系成员或行星性质时，先判断每个天体绕谁运动。

一. 按绕行关系辨天体

例题 1 Which statement about the Solar System is correct?

A All the planets are rocky.

B Only the Earth has a moon.

C Pluto is a dwarf planet.

D There are many stars in the Solar System.

（2023 夏季 0625/12 第38题）

解：A 错，只有离太阳最近的四颗行星主要由岩石构成；B 错，地球以外的行星也有天然卫星；C 对，冥王星是矮行星；D 错，太阳系中只有一颗恒星太阳。

故选 C。

针对练习

1. Fig. 10.1 shows the path of the Earth as it orbits the Sun. X is a position on the Earth where scientists observe the apparent motion of the Sun throughout the year.

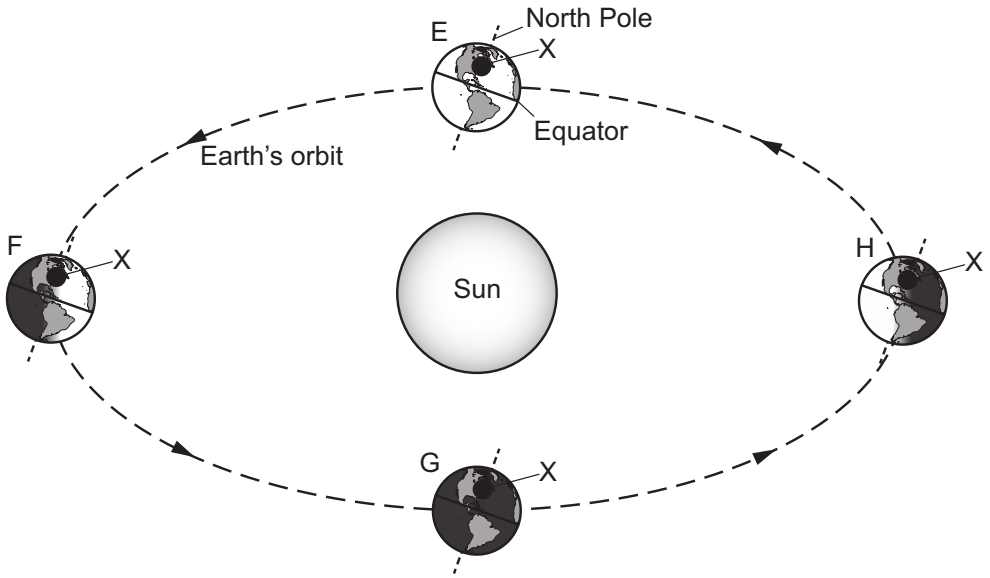


Fig. 10.1

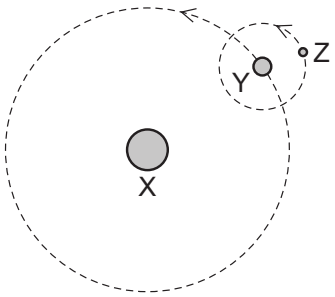
(d) Earth is a planet in the Solar System. State **one other** type of naturally occurring object that is present in the Solar System.

（2025 春季 0625/42 第10题(d)）

2. The diagram represents three objects, X, Y and Z, in space.

Object Y orbits object X.

Object Z orbits object Y.



Which types of object are X, Y and Z?

	object X	object Y	object Z
A	planet	moon	star
B	planet	star	moon
C	star	planet	moon
D	star	moon	planet

（2025 冬季 0625/11 第38题）

3. **(b)** The arrows on Fig. 7.1 show the path of satellite television (TV) signals travelling from a transmitter to a receiver.

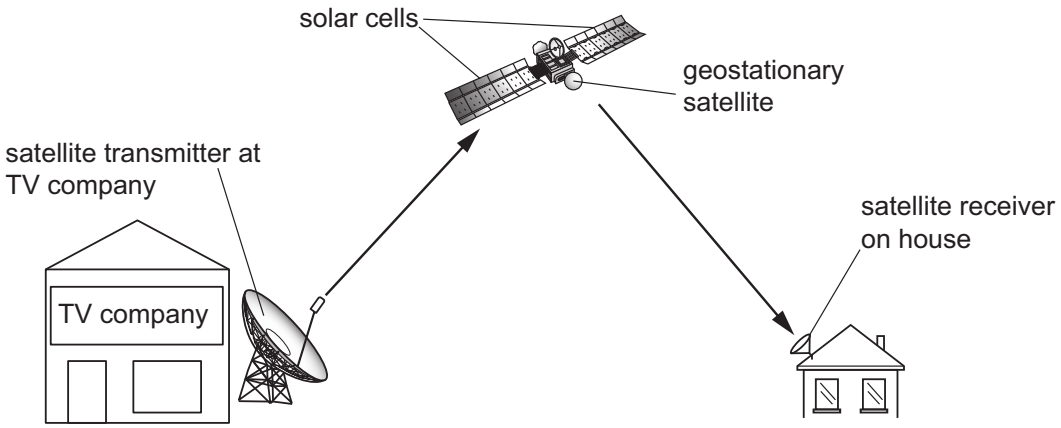


Fig. 7.1 (not to scale)

(i) State the type of electromagnetic (e.m.) wave used for the satellite television signal.

(ii) The geostationary satellite is in orbit.
Describe the orbit of a geostationary satellite used for satellite television signals.

(iii) State the source of the energy that powers the solar cells.

(iv) State how energy is transferred from the solar cells for use by the satellite.

（2024 冬季 0625/33 第7题(b)）

二. 先默写八大行星顺序

知识点 太阳系由太阳、八颗绕太阳运动的行星，以及矮行星、小行星、彗星等天体组成；卫星绕行星运动。

八大行星按距太阳由近到远依次为水星、_____、地球、火星、木星、土星、_____、海王星。

前四颗行星较小且主要由岩石构成，后四颗行星较大且主要由气体构成。

答案：金星；天王星

怎么认 题目出现行星名称及距太阳远近时，先默写由近到远的顺序，再按要求截取或反向排列。

例题 2

There are eight planets in our Solar System.

Table 12.1 shows the names of some of the planets in order of distance from the Sun.

Table 12.1

Mercury				Jupiter			Neptune

increasing distance from the Sun

(a) Complete Table 12.1 by writing the names of the other planets in order of increasing dista from the Sun.

（2023 冬季 0625/32 第12题(a)）

解：按距太阳由近到远，八大行星的顺序为

水星、金星、地球、火星、木星、土星、天王星、海王星。

表中已给出水星、木星和海王星，故其余五个空依次填金星、地球、火星、土星、天王星。

答：金星、地球、火星、土星、天王星。

针对练习

4. **(a)** **(i)** State the name of **one** planet that has an orbit further away from the Sun than Venus.

(ii) State the name of **one** planet that has an orbit closer to the Sun than Venus.

（2024 冬季 0625/42 第11题(a)）

5. Which planet orbits the Sun between Mars and Saturn?

A Earth

B Jupiter

C Mercury

D Neptune

（2023 冬季 0625/11 第38题）

6. Fig. 11.1 represents the Solar System. The Sun and five of the eight planets are labelled.

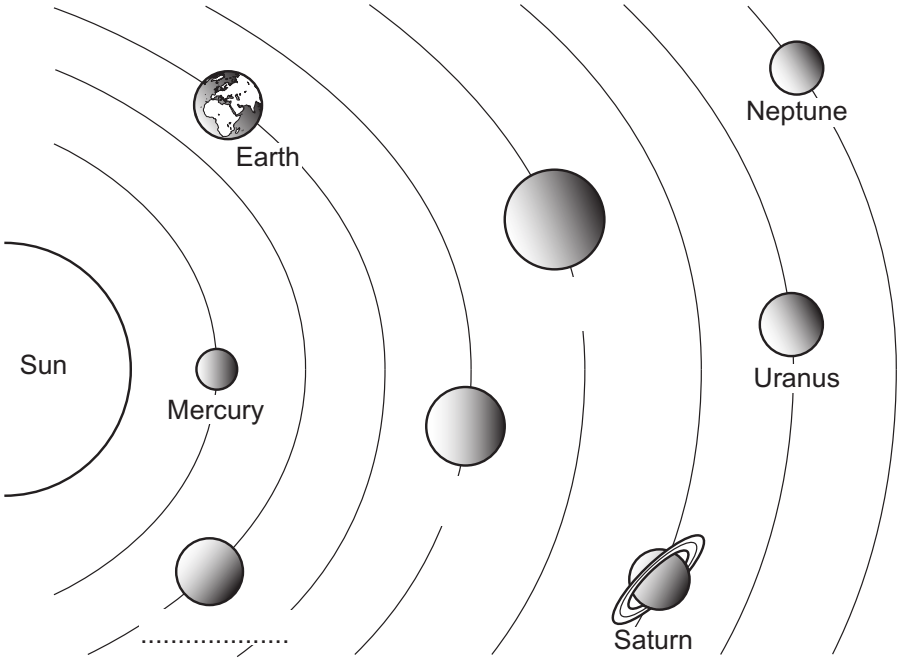


Fig. 11.1 (not to scale)

(a) Complete the **three** missing labels on Fig. 11.1 by writing the name of each planet on its dotted line.

（2025 夏季 0625/32 第11题(a)）

7. Which list correctly shows the planets in decreasing order of distance from the Sun?

A Jupiter → Saturn → Neptune → Uranus

B Jupiter → Saturn → Uranus → Neptune

C Neptune → Uranus → Saturn → Jupiter

D Uranus → Neptune → Saturn → Jupiter

（2024 春季 0625/22 第36题）

三. 按位置分岩石与气态行星

知识点 太阳系八大行星按距太阳由近到远依次为水星、金星、地球、火星、木星、土星、天王星、海王星。

离太阳最近的四颗行星体积较_____，主要由_____组成，称为岩石行星。

离太阳最远的四颗行星体积较_____，主要由气体组成，称为气态行星。

按吸积模型，内太阳系温度较高，主要聚集高熔点固态物质；外太阳系温度较低，气体和冰质物质也能聚集。

平均密度是质量与体积之比，单位为 kg/m³；表面引力场强由行星质量和半径共同决定，单位为 N/kg。

答案：小；岩石；大

怎么认 题目出现行星名称、距太阳远近、大小或成分时，先分内侧四颗与外侧四颗。

例题 3 Which planet is classed as a rocky planet?

A Jupiter

B Saturn

C Uranus

D Venus

（2024 夏季 0625/12 第37题）

解：离太阳最近的四颗行星为水星、金星、地球和火星，均为岩石行星。

金星属于岩石行星，木星、土星和天王星属于气态行星。

故选 D。

针对练习

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

(a) Describe the composition of Jupiter and the Earth.

（2025 夏季 0625/41 第10题(a)）

9. There are eight planets in our Solar System.

Table 12.1 shows the names of some of the planets in order of distance from the Sun.

Table 12.1

Mercury				Jupiter			Neptune

increasing distance from the Sun

(c) Complete the sentences to describe Mercury and Jupiter. Use words from the list.

large **rocky** **gaseous** **small** **liquid**

（2023 冬季 0625/32 第12题(c)）

10. Which planet in our Solar System is nearest to the Sun and what is the nature of the planet?

	planet	nature
A	Mercury	rocky
B	Mercury	gaseous
C	Venus	rocky
D	Venus	gaseous

（2023 夏季 0625/11 第38题）

11. 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.

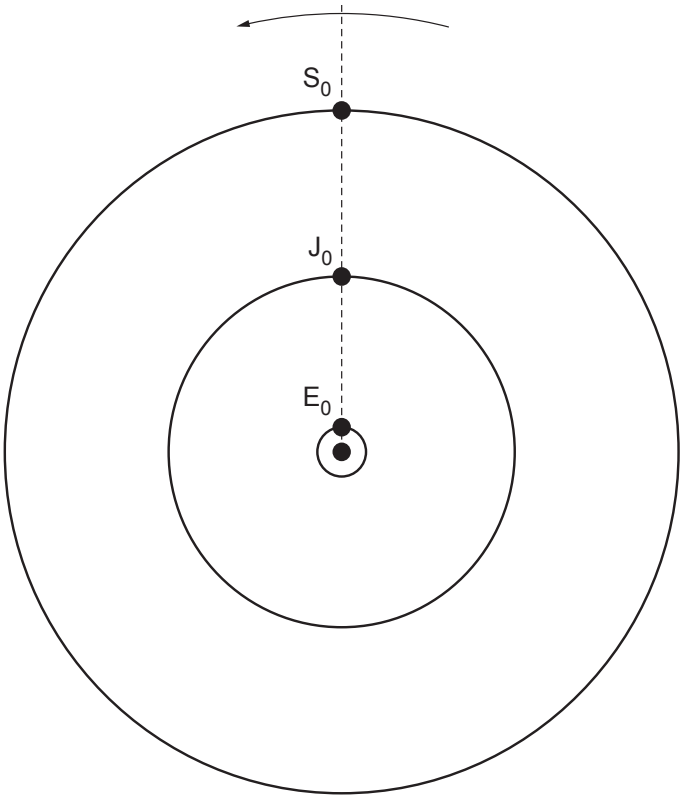


Fig. 9.1 (not to scale)

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

(c) (i) Choose **two** words from the list to describe **each** planet.

gaseous **large** **rocky** **small**

(ii) The average density of Jupiter is much less than that of the Earth.
The gravitational field strength at the surface of Jupiter is greater than that at the surface of the Earth.

Explain how these differences in density and in gravitational field strength are consistent with your answers to **(c)(i)**.

density

gravitational field strength

（2023 夏季 0625/43 第9题(c)）

四. 从表格辨行星与趋势

知识点 太阳系八大行星由近及远依次为水星、金星、地球、火星、木星、土星、天王星、海王星。

公转周期是行星绕太阳一周所用的时间；比较总体趋势时，距太阳越远，公转周期通常越_____，平均表面温度通常越_____。

距太阳最近的四颗行星较小且以岩石为主，最远的四颗行星较大且以气体为主。

按吸积模型，近太阳处温度较高，轻质物质不易凝聚；较远处温度较低，可吸积较多气体。

表中质量、距离、公转周期和表面引力场强常用 kg、km、天或地球年、N/kg；只有单位与表头倍率_____后才能比较。

答案：长；低；统一

怎么认 题目出现多颗行星的数据表和未知行星或变化趋势时，先按距日顺序锁定行星，再统一单位逐列比较。

例题 4 Table 9.1 gives information about three planets in the Solar System.

Table 9.1

planet	mass / 10^{24} kg	average distance from Sun / 10^{6} km	orbital period / days	gravitational field strength at surface / N/kg
Earth	5.97	149.6	365.2	9.8
Jupiter	1898	778.6	4331	23.1
X	4.87	108.2	224.7	8.9

(a) State the name of planet X.

（2023 冬季 0625/42 第9题(a)）

解：八大行星由近及远排列，金星在地球内侧。

表中 X 的平均距日距离为 108.2×10^6 km，小于地球的 149.6×10^6 km；公转周期为 224.7 天，也小于地球的 365.2 天。

这些数据与金星相符。

答：金星。

针对练习

12. The table gives the orbital durations of planets in the Solar System.

planet	Mercury	Venus	Earth	Jupiter	Saturn	Uranus	Neptune
orbital duration / days	88	225	365	4330	10 700	30 600	59 800

What is the orbital duration of Mars?

A 295 days **B** 690 days **C** 7100 days **D** 20 600 days

（2024 冬季 0625/23 第38题）

13. The table gives data about four planets in our Solar System.

	Uranus	Earth	planet X	planet Y
mean surface temperature / °C	–195	15	–65	–140

What are planets X and Y?

	planet X	planet Y
A	Mars	Saturn
B	Mars	Neptune
C	Mercury	Saturn
D	Mercury	Neptune

（2024 春季 0625/22 第40题）

14. Table 11.1 shows some information about two of the planets in the Solar System.

Table 11.1

name of planet	mass of planet / kg	distance from the Sun / km	time for one rotation on its axis / hours
Venus	4.87×10^{24}	108.2×10^{6}	5832
Earth	5.97×10^{24}	149.6×10^{6}	24

(a) (i) Venus is a similar size to the Earth.

State why the gravitational field strength at the surface of the Earth is greater than the gravitational field strength at the surface of Venus.

(ii) Calculate the time, in Earth days, for **one** day on Venus.

(iii) Calculate the time taken for light to travel from the Sun to Venus. The speed of light is 3.0×10^{8} m / s.

（2024 夏季 0625/32 第11题(a)）

15. **(b)** Table 9.1 shows data about planets in our solar system.

Table 9.1

planet	average radius of orbit around the Sun / 10^6 km	time for one orbit / Earth years	average surface temperature / °C
Venus	108	0.62	460
Earth	150	1.00	15
Mars	228	1.90	–65
Jupiter	778	12.00	–110
Saturn	1430	29.00	–140

(i) The orbit of Venus is approximately circular.

Calculate the average orbital speed *v* of Venus. Give your answer in km / h.

(ii) State how the average surface temperature of a planet changes as its distance from the Sun increases.

（2025 冬季 0625/43 第9题(b)）

题型 2：由气体尘埃写行星形成（考频★★☆☆☆）

知识点 太阳系的吸积模型认为，太阳系起源于含多种元素的气体和尘埃云；物质在_____作用下聚集并绕原恒星旋转。

旋转物质逐渐形成绕太阳运行的_____，盘内尘埃、气体和岩石不断碰撞。

较小颗粒结合成较大岩块，并继续_____，逐渐形成行星及其内核。

靠近太阳处形成岩质小行星，远离太阳处形成气态大行星。

答案：引力；原行星盘；吸积

怎么认 题目出现气体尘埃云、吸积模型或询问行星形成时，先写引力聚集和旋转，再写盘内碰撞、聚合与吸积。

例题 1 Fig. 11.1 shows the Sun and the four innermost planets, A, B, C, and D, of the Solar System.

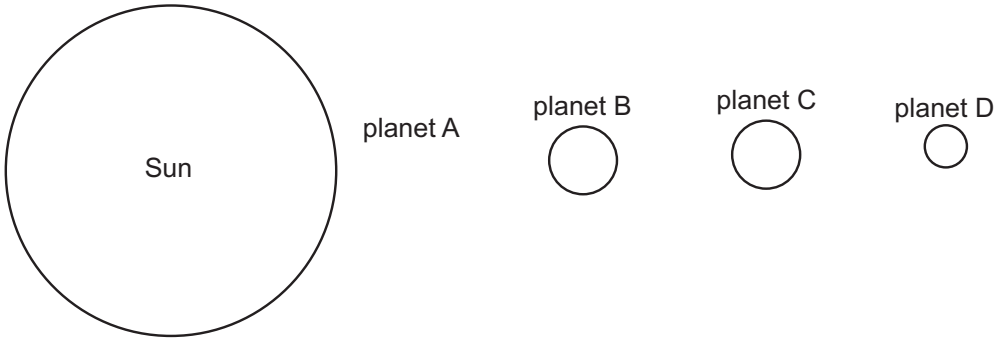


Fig. 11.1 (not to scale)

(b) Describe how the four innermost planets of the Solar System were formed.

（2023 夏季 0625/32 第11题(b)）

解：含多种元素的尘埃和气体绕太阳旋转，并在引力作用下聚集。
旋转的物质形成绕太阳运行的原行星盘。
盘内颗粒不断碰撞并结合成较大的岩块，岩块继续吸积，形成行星内核。
行星内核继续吸引周围物质，逐渐形成四颗内行星。
答：四颗内行星由原行星盘中的物质在引力作用下碰撞、聚合并持续吸积形成。

针对练习

1. Fig. 11.1 represents the planets in the Solar System.

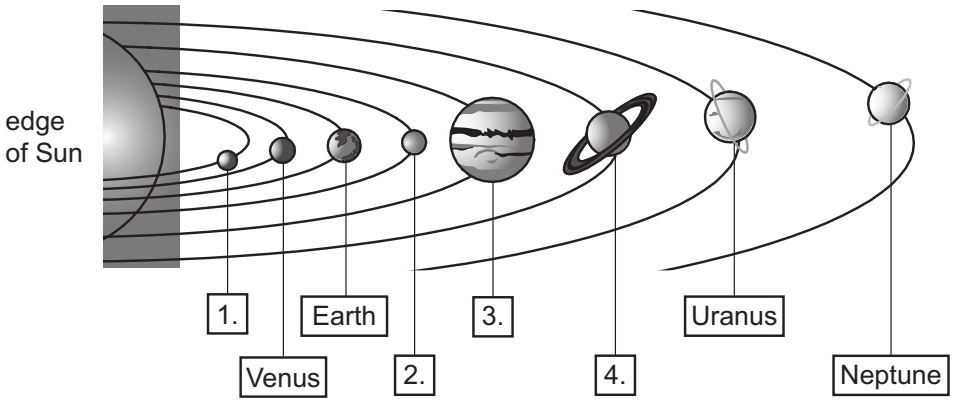


Fig. 11.1 (not to scale)

(b) Describe how the planets in the Solar System were formed.
Use your ideas about the accretion model. You may draw a diagram as part of your answer.

（2024 冬季 0625/31 第11题(b)）

2. **(a)** Fig. 11.1 represents part of the Solar System.

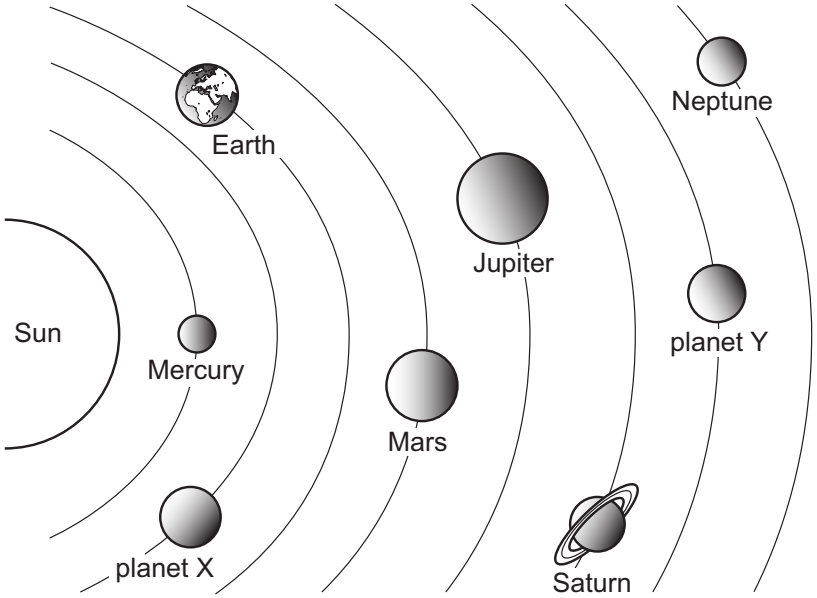


Fig. 11.1 (not to scale)

(i) State the name of planet X and the name of planet Y.

(ii) Mercury is nearer to the Sun than Jupiter is.
State **two** other ways in which Mercury is different from Jupiter.

(iii) Complete the sentences about the Solar System.

The accretion model states that the Solar System was formed from clouds of dust and

（2024 冬季 0625/32 第11题(a)）

题型 3：先判引力再算光行时间（考频★★★☆☆）

知识点 引力场强表示单位质量在引力场中某点所受的引力，单位为_____。
绕同一中心天体时，距离中心越大，引力场强越_____；比较大小相近的行星表面时，质量越大，表面引力场强通常越强。
太阳对行星的_____维持行星绕太阳运动。

答案：N/kg；小；引力

怎么认 题目出现不同距离或行星质量与表面场强时，先找中心天体，再判断质量和距离的影响。

一. 按质量与距离判引力

例题 1 A space probe measures the gravitational field strength at four different distances from a planet.

The point furthest from the planet is measured first and the point nearest the planet is measured last.

In which order were the measurements taken?

A 6.3 N/kg, 10 N/kg, 14 N/kg, 20 N/kg

B 10 N/kg, 14 N/kg, 6.3 N/kg, 20 N/kg

C 20 N/kg, 14 N/kg, 6.3 N/kg, 10 N/kg

D 20 N/kg, 14 N/kg, 10 N/kg, 6.3 N/kg

（2025 冬季 0625/22 第38题）

解：探测器由最远处向最近处移动。
绕同一行星，距离越小，引力场强越大，故测量值应由小到大排列。
$6.3\ \mathrm{N/kg} < 10\ \mathrm{N/kg} < 14\ \mathrm{N/kg} < 20\ \mathrm{N/kg}$。
故选 A。

针对练习

1. Mars is one of the four rocky planets nearest the Sun.

(a) State why the gravitational field strength at the surface of the Earth is greater than the gravitational field strength at the surface of Mars.

（2025 冬季 0625/31 第11题(a)）

2. **(a)** The Solar System includes the Sun and eight planets.

(i) State the name of the force that keeps the planets in orbit around the Sun.

(ii) State the name of the galaxy that includes the Solar System.

（2025 夏季 0625/31 第11题(a)）

3. Fig. 11.1 represents the four planets nearest to the Sun.

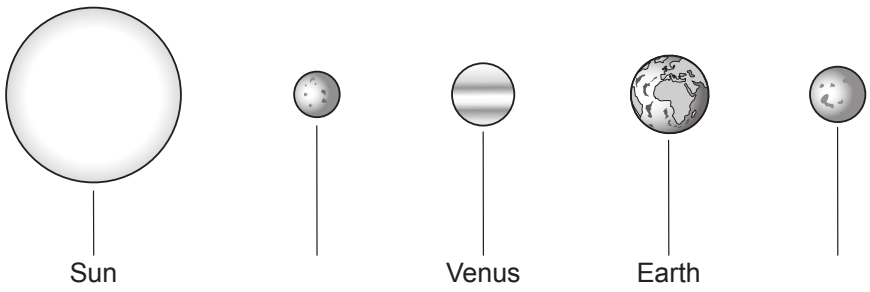


Fig. 11.1 (not to scale)

(c) The mass of the Earth is greater than the mass of Venus.

The gravitational field strength on the surface of the Earth is 9.8 N/kg.

Suggest a value for the gravitational field strength on the surface of Venus.

Give a reason for your answer.

（2024 春季 0625/32 第11题(c)）

二. 把距离除以光速

知识点 天体绕另一天体运行时，所需的向心力由_____提供。

光或无线电波传播的时间为 $t =$ _____，其中 s 为传播距离，c 为传播速率。

距离单位须与速率中的长度单位一致；若 s 用 m、c 用 m/s，则 t 的单位为 s。

信号往返时，传播距离为 $2d$；单程传播时，传播距离为 d。

答案：万有引力；$\frac{s}{c}$

怎么认 题目出现天体绕行图及信号传播的距离、速率和时间时，先判维持轨道的力，再用 $t = \frac{s}{c}$。

例题 2

Fig. 12.1 represents the Earth's orbit of the Sun.

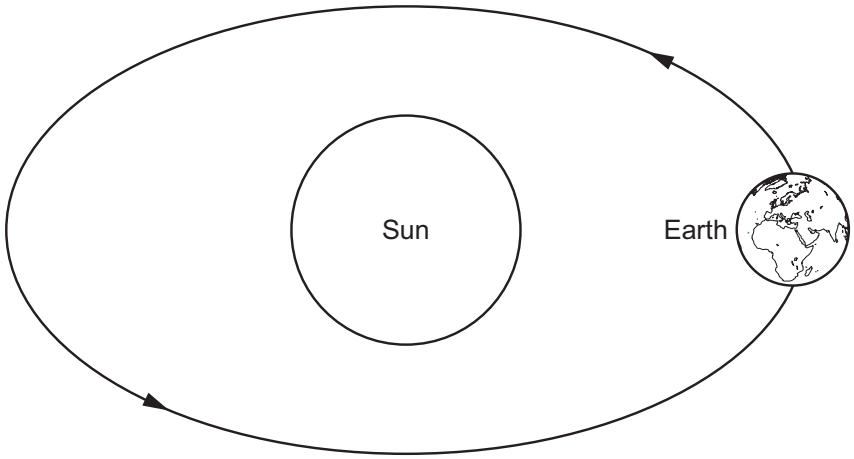


Fig. 12.1 (Not to scale)

(c) The distance of the Earth from the Sun is 1.48×10^{11} m. The speed of light is 3.0×10^{8} m/s.

Calculate the time it takes light from the Sun to reach the Earth.

（2025 春季 0625/32 第12题(c)）

解：光从太阳到地球为单程传播，由 $t = \frac{s}{c}$ 得

$t = \frac{1.48 \times 10^{11}}{3.0 \times 10^{8}}$

$t = 4.93 \times 10^{2}\ \text{s} \approx 490\ \text{s}$

答：光从太阳到达地球所需的时间为 490 s。

针对练习

4. **(d)** Jupiter is 7.8×10^{11} m from the Sun. The speed of light in a vacuum is 3.0×10^{8} m/s.

Calculate the time taken for light from the Sun to reach Jupiter.

（2024 夏季 0625/42 第10题(d)）

5. **(a)** Fig. 11.1 shows the Moon orbiting the Earth.

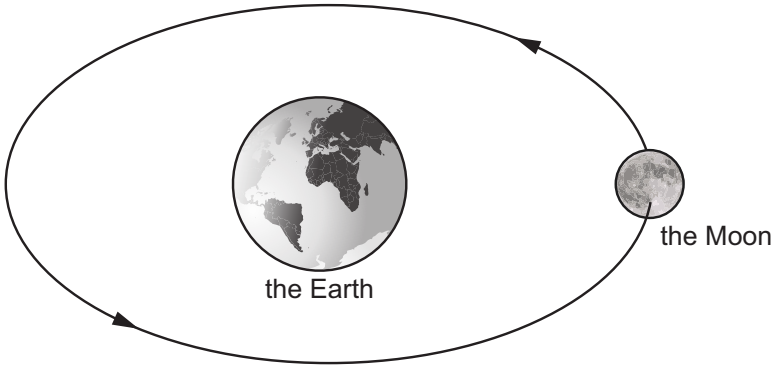


Fig. 11.1

(i) State the name of the force that keeps the Moon in orbit around the Earth.

(ii) State the time taken by the Moon to complete **one** orbit of the Earth. Include the unit.

(iii) A device on the Moon sends a radio signal to the Earth.
The distance from the Moon to the Earth is 3.8×10^8 m.
The speed of a radio wave is 3.0×10^8 m/s.

Calculate the time the radio signal takes to travel from the Moon to the Earth.

（2024 冬季 0625/33 第11题(a)）

6. **(b)** The average distance of the Earth from the Sun is 1.5×10^8 km.

(i) Calculate the average orbital speed of the Earth in km/h.

(ii) The speed of light in a vacuum is 3.0×10^8 m/s. Calculate the time taken for light from the Sun to reach the Earth.

（2024 春季 0625/42 第10题(b)）

题型 4：用周期与半径处理轨道（考频★★★☆☆）

知识点 行星或卫星沿近似圆轨道运动一周，经过的路程为轨道周长 $2\pi r$，其中 r 为平均轨道半径。
平均轨道速率等于一周的路程除以轨道周期，即 $v =$ _____，其中 T 为轨道周期。
使用该式时，应按所求速率的单位换算半径和周期；若 r 用 km、T 用 s，则 v 的单位为 _____。

答案：2 pi r / T；km/s

怎么认 题目出现轨道半径、周期并求平均轨道速率时，先写 $v = 2\pi\frac{r}{T}$。

一. 先写 v=2πr/T

例题 1 **(a)** The time taken for Mars to orbit the Sun is 690 Earth days. The average orbital radius of Mars is 2.28×10^8 km. An Earth day is 24 h.

Calculate the average orbital speed of Mars in km/s.

（2023 春季 0625/42 第10题(a)）

解： 由近似圆轨道一周的路程为 $2\pi r$，得

$T = 690 \times 24 \times 60 \times 60 = 59616000$ s

$v = 2\pi\frac{r}{T}$

$v = \frac{2\pi \times 2.28 \times 10^8}{59616000}$

$v \approx 24\ \text{km/s}$

答：火星的平均轨道速率约为 24 km/s。

针对练习

1. A planet orbits the Sun with orbital period T. The average radius of the orbit is r.

What is the average orbital speed of the planet?

A $2\pi rT$ **B** $\frac{2\pi r}{T}$ **C** $\frac{T}{2\pi r}$ **D** $\frac{\pi r}{2T}$

（2023 冬季 0625/23 第40题）

2. A satellite is in orbit around the Earth. The orbit has radius r and period T.

Which expression gives the orbital speed of the satellite?

A $\frac{r}{2\pi T}$ **B** $\frac{T}{2\pi r}$ **C** $\frac{2\pi r}{T}$ **D** $\frac{2\pi T}{r}$

（2025 冬季 0625/21 第38题）

3. **(a)** State the equation that defines the average orbital speed v of a planet. State the meaning of any symbols you use.

（2023 夏季 0625/42 第10题(a)）

4. The time taken for the Earth to orbit the Sun is approximately 365 days.

The average radius of the Earth's orbit around the Sun is 1.5×10^8 km.

What is the average orbital speed of the Earth?

A 30 m/s

B 4.8×10^3 m/s

C 3.0×10^4 m/s

D 4.1×10^{10} m/s

（2023 冬季 0625/22 第38题）

二. 用时间/周期推轨道位置

知识点 当天体沿圆轨道作匀速圆周运动时，周期 T 是绕中心天体一周所用的时间，经过时间 t 转过的角度为 $\theta = 360° \times \frac{t}{T}$。

若 $\frac{t}{T}$ 大于 1，应去掉_____，保留不足一圈的部分，再沿题图所示方向确定位置。

相同时间内，周期越_____，天体转过的角度越大；t 与 T 须使用相同的时间单位，角度单位为度。

答案：完整圈的整数部分；短

怎么认 题目出现轨道方向、周期和经过时间，并要求标出新位置时，先算各天体的剩余分数圈。

例题 2

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.

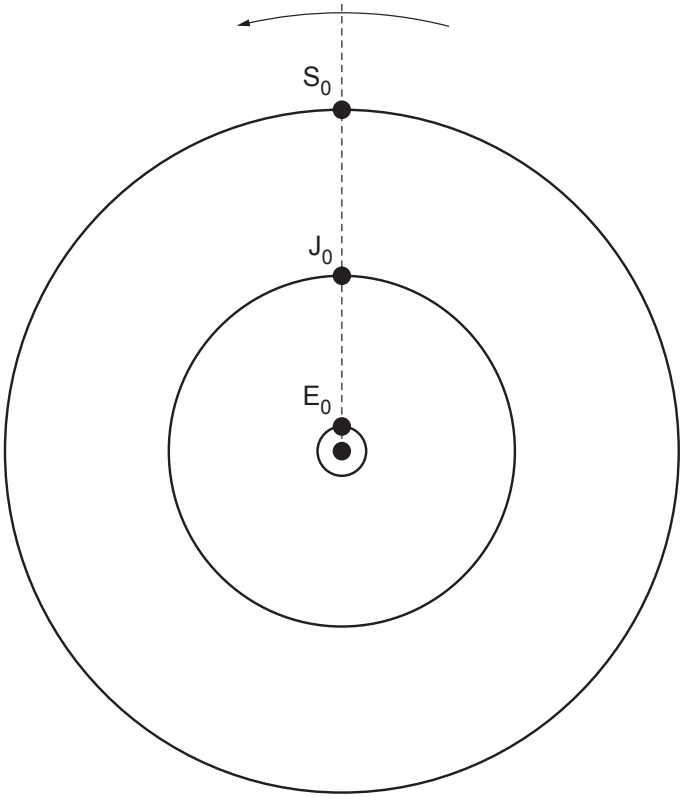


Fig. 9.1 (not to scale)

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

(a) On Fig. 9.1, mark the positions of Saturn and Jupiter 5.0 years after the original positions shown.

Label these positions S_1 and J_1. Show your working.

（2023 夏季 0625/43 第9题(a)）

解： 由转过角度与周期的关系，土星转过的角度为

$\theta_S = 360° \times \frac{5.0}{30} = 60°$

木星转过的角度为

$\theta_J = 360° \times \frac{5.0}{12} = 150°$

沿逆时针方向，从 S_0 转过 $60°$ 标出 S_1，从 J_0 转过 $150°$ 标出 J_1。

答：S_1 位于 S_0 逆时针 $60°$ 处，J_1 位于 J_0 逆时针 $150°$ 处。

5. 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.

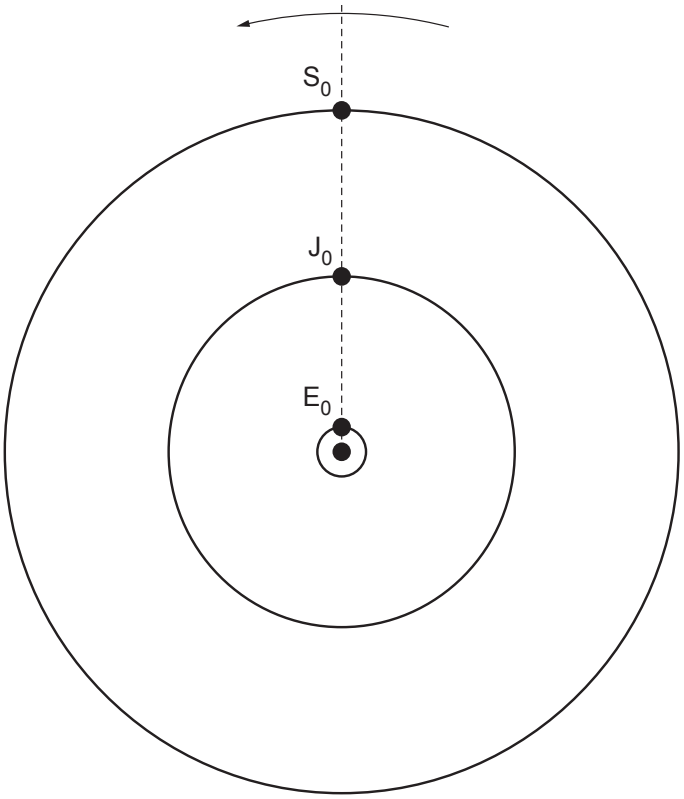


Fig. 9.1 (not to scale)

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

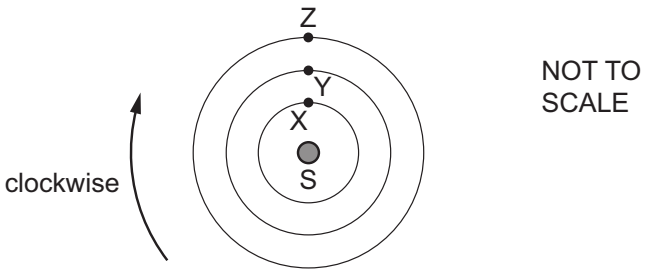
(b) (i) On Fig. 9.1, mark the positions of Saturn and Jupiter 20 years after the original positions shown in Fig. 9.1.

Label these positions S_2 and J_2.

(ii) State what is observed from the Earth's orbit after 20 years.

（2023 夏季 0625/43 第9题(b)）

6. The diagram shows a star S and the initial arrangement of three planets, X, Y and Z.



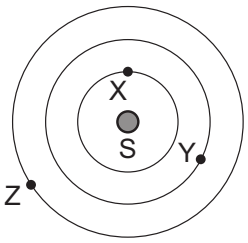
Each planet orbits clockwise in a circle about S.

The time for one orbit of Y is three times the time taken for one orbit of X.

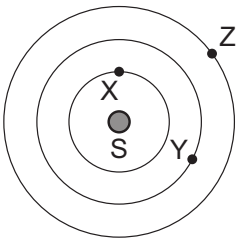
The time for one orbit of Z is twice the time taken for one orbit of Y.

Starting from the initial arrangement, which diagram shows the positions of the planets after X has made one complete orbit?

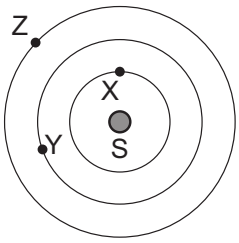
A



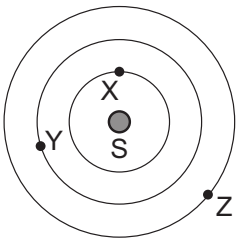
B



C



D



（2023 冬季 0625/23 第38题）

题型 5：读椭圆轨道的远近与快慢（考频★★★★☆）

知识点 太阳系中，行星和绕太阳运行的彗星沿_____轨道运动。

太阳位于椭圆的_____焦点，通常不在椭圆的几何中心；轨道近似为圆时，太阳才近似位于中心。

同一椭圆轨道上，天体越接近太阳，速率越大；越远离太阳，速率越小。

若距离和速率用 SI 单位表示，单位分别为米和 m/s。

答案：椭圆；一个

怎么认 题目出现闭合轨道图、太阳位置或要求判断行星和彗星轨道时，先认出椭圆，再把太阳放在一个焦点。

一. 先把太阳放在焦点

例题 1 **(b)** State the shape of the orbits of the planets.

（2023 春季 0625/42 第10题(b)）

解：行星绕太阳运行的轨道是椭圆。

答：椭圆。

针对练习

1. **(a)** Sketch a diagram to show the orbital path of a comet around the Sun.

Mark the position of the Sun on your diagram using an S.

（2025 冬季 0625/43 第10题(a)）

2. Which type of object rotates around the Sun with an elliptical orbit?

A planet

B galaxy

C red giant

D moon

（2024 冬季 0625/21 第38题）

3. Fig. 10.1 shows the orbit of the Earth and the orbit of a comet around the Sun.

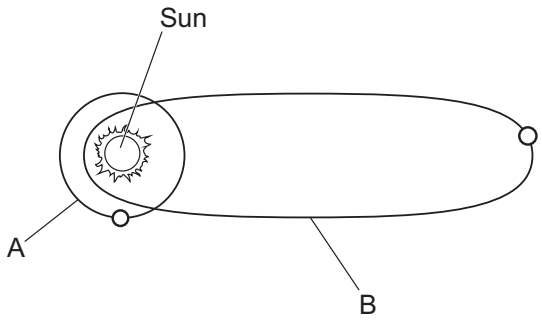


Fig. 10.1

(a) State which orbit, A or B, is the orbit of the comet.
Explain your answer.

（2025 冬季 0625/41 第10题(a)）

4. Which statement about the orbits of comets is correct?

A Comets have elliptical orbits and the Sun is at the centre of the orbit.

B Comets have elliptical orbits and the Sun is **not** at the centre of the orbit.

C Comets have circular orbits and the Sun is at the centre of the orbit.

D Comets have circular orbits and the Sun is **not** at the centre of the orbit.

（2023 夏季 0625/23 第38题）

二. 距太阳越远平均速率越小

知识点 比较绕太阳运行的行星时，平均距日距离越大，太阳在轨道处的引力场强度越_____，行星的平均轨道速率越_____。

平均距日距离可用 km 或 AU 表示，轨道速率可用 $\mathrm{m\ s^{-1}}$ 或 $\mathrm{km\ s^{-1}}$ 表示。

答案：小；小

怎么认 题目出现行星距太阳的远近及轨道速率比较时，先比较平均距日距离。

例题 2 **(c)** State the relationship between the orbital speeds of the planets and their distances from the Sun.

（2024 冬季 0625/42 第11题(c)）

解：行星的平均距日距离越大，太阳在其轨道处的引力场越弱，行星的平均轨道速率越小。

答：行星距太阳越远，轨道速率越小。

针对练习

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

(c) State and explain the difference between the orbital speed of Jupiter and the orbital speed of the Earth.

（2025 夏季 0625/41 第10题(c)）

6. The orbit of Mercury is closer to the Sun than the orbit of the Earth is to the Sun.

How do the values of the gravitational field strength of the Sun near Mercury and the orbital speed of Mercury compare to those values for the Earth?

	gravitational field strength of the Sun near Mercury	orbital speed of Mercury
A	greater	faster
B	greater	slower
C	smaller	faster
D	smaller	slower

（2025 夏季 0625/23 第40题）

三. 用能量守恒判近快远慢

知识点 椭圆轨道上，天体离太阳最近的位置称为近日点，最远的位置称为远日点。

在仅有引力做功、机械能守恒时，动能与引力势能相互转化，二者总和_____。

天体靠近太阳时，引力势能_____、动能增大、轨道速率增大；远离太阳时相反。

故近日点轨道速率最大、引力势能最小，远日点相反；轨道速率的单位为 m/s，引力势能的单位为 J。

答案：保持不变；减小

怎么认 题目出现椭圆轨道及距太阳远近、轨道速率或能量变化时，先判断近日点和远日点。

例题 3 A planet in the Solar System is at the point in its orbit where it is closest to the Sun.

Which row is correct?

	orbital speed	energy in gravitational potential store
A	at its maximum	at its maximum
B	at its maximum	at its minimum
C	at its minimum	at its maximum
D	at its minimum	at its minimum

（2024 夏季 0625/21 第37题）

解：行星位于近日点，与太阳的距离最小。

在仅有引力做功时，机械能守恒，

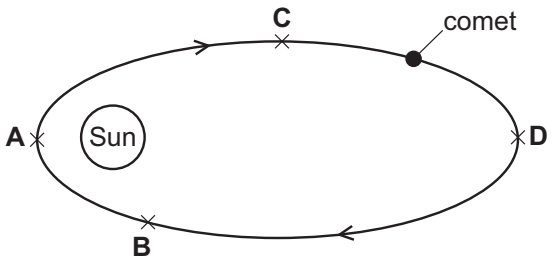
$E_{总} = E_k + E_p$

距离减小使引力势能达到最小，故动能达到最大；由 $E_k = \frac{1}{2}mv^2$，轨道速率达到最大。故选 B。

针对练习

7. The diagram shows a comet moving in an elliptical orbit around the Sun.

At which position is the comet moving with the greatest speed?



（2024 春季 0625/22 第38题）

8. **(d)** Comets are balls of ice and dust. Some comets orbit the Sun.

State how the speed of a comet changes as it orbits the Sun.
Explain your answer using ideas about the conservation of energy.

You may include a labelled diagram in your answer.

（2024 冬季 0625/42 第11题(d)）

9. Pluto is a dwarf planet. Fig. 10.1 shows the direction of motion of Pluto as it follows its elliptical orbit around the Sun.

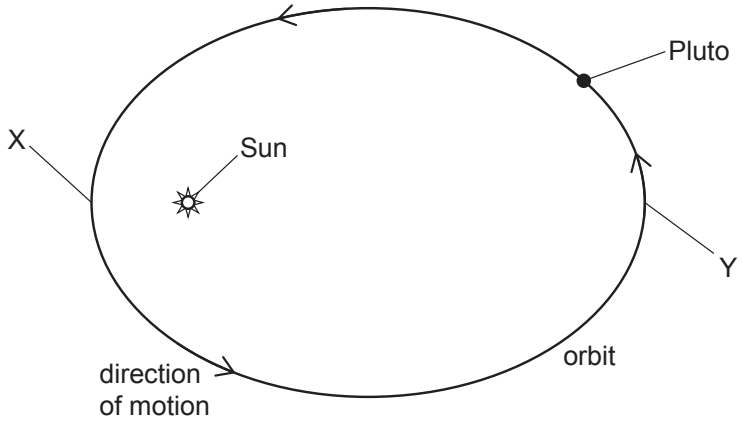


Fig. 10.1 (not to scale)

(a) Point X is the point in the orbit closest to the Sun and point Y is the point furthest away.

The orbital speed of Pluto varies as it orbits the Sun.

(i) Describe how the speed of Pluto varies as it moves from X to Y and then back to X.

(ii) Explain, in terms of energy transfers, why the speed of Pluto varies in this way.

（2023 夏季 0625/41 第10题(a)）

6.2.1 太阳是一颗恒星

题型 1：辨太阳的组成与辐射（考频★★★☆☆）

知识点 太阳是一颗中等大小的恒星，主要由_____和_____组成，其中质量占比最多的是氢。
太阳辐射的能量主要分布在红外线、可见光和_____三个电磁波区域。
恒星的能量来自核反应；稳定恒星中，氢核发生聚变，形成氦核并释放能量。

答案：氢；氦；紫外线

怎么认 题目出现太阳的主要元素或主要辐射区域时，先写氢、氦及红外线、可见光、紫外线。

一. 先锁定中等恒星与氢氦

例题 1

The Sun has a mass of 2.0 10^{30} kg.

Which element accounts for most of this mass?

A carbon

B hydrogen

C oxygen

D uranium

（2023 春季 0625/12 第39题）

解：太阳是一颗中等大小的恒星，主要由氢和氦组成，其中质量占比最多的是氢。
故选 B。

针对练习

1. The Sun mostly consists of which gases?

A helium and hydrogen

B helium and nitrogen

C hydrogen and oxygen

D oxygen and nitrogen

（2024 夏季 0625/12 第40题）

2. **(b)** **(i)** The Sun consists mostly of **two** elements.

State the names of the **two** elements.

(ii) The Sun radiates energy mostly in three regions of the electromagnetic spectrum. One of these regions is visible light.

State the name for each of the other **two** regions.

（2025 冬季 0625/33 第10题(b)）

3. Fig. 11.1 represents the Solar System. The Sun and five of the eight planets are labelled.

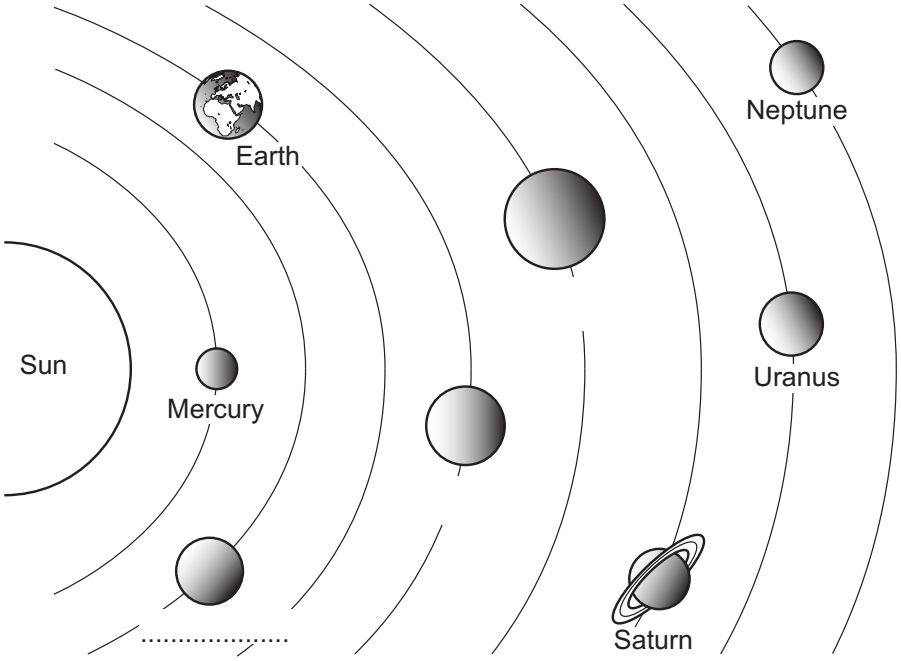


Fig. 11.1 (not to scale)

(b) (i) The Sun consists mainly of two elements.

Name the **two** elements.

(ii) The Sun radiates energy mainly in three regions of the electromagnetic spectrum. Ultraviolet is one of the three regions.

State the name of **one** of the other two regions.

（2025 夏季 0625/32 第11题(b)）

4. The table shows some elements and some regions of the electromagnetic spectrum.

Which row shows one of the most common elements in the Sun and one of the regions in which the Sun radiates most of its energy?

	element	region
A	iron	gamma
B	iron	infrared
C	hydrogen	gamma
D	hydrogen	infrared

（2023 冬季 0625/13 第40题）

二. 把主要辐射定在红外至紫外

知识点 太阳是一颗中等大小的恒星，主要由氢和氦组成。

太阳的大部分能量辐射集中在_____、_____和_____三个波段。

按波长由短到长，这三个波段依次为紫外线、可见光、红外线。

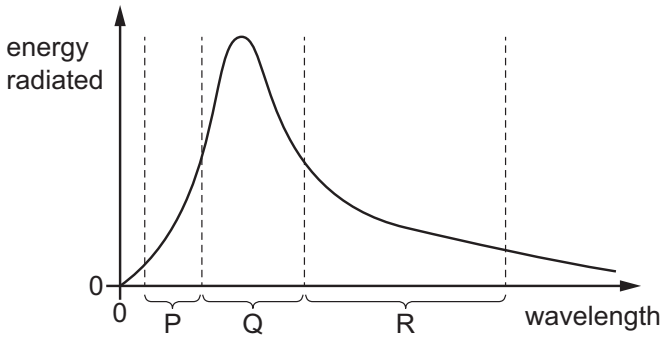
波长的国际单位是米（m）；能量–波长图中横轴向右表示波长增大。

稳定恒星中的氢原子核发生聚变，形成氦并释放能量。

答案：红外线；可见光；紫外线

怎么认 题目出现太阳主要辐射的三段或能量–波长图时，先列红外线、可见光和紫外线，再按波长定位。

例题 2 The graph shows the energy radiated by the Sun at different wavelengths. Most of the energy is radiated in just three parts of the electromagnetic spectrum, labelled P, Q and R.



Which parts of the electromagnetic spectrum are P and R?

	P	R
A	gamma ray	radio
B	infrared	ultraviolet
C	radio	gamma ray
D	ultraviolet	infrared

（2023 夏季 0625/12 第39题）

解：太阳的大部分能量辐射位于紫外线、可见光和红外线三个波段。
由图中波长从左向右增大，P、Q、R 依次为紫外线、可见光、红外线。
所以 P 为紫外线，R 为红外线。故选 D。

针对练习

5. In which regions of the electromagnetic spectrum does the Sun radiate most of its energy?

A microwave to infrared

B ultraviolet to X-ray

C infrared to ultraviolet

D radio to infrared

（2024 夏季 0625/13 第39题）

6. **(b)** The Sun is a medium-sized star powered by nuclear fusion reactions which release energy.

(i) State what happens during nuclear fusion reactions which form helium.

(ii) State **two** regions of the electromagnetic spectrum by which the Sun radiates most of its energy.

（2025 冬季 0625/41 第9题(b)）

7. What are the three main types of radiation emitted by the Sun?

A infrared, radio waves and ultraviolet

B infrared, visible light and ultraviolet

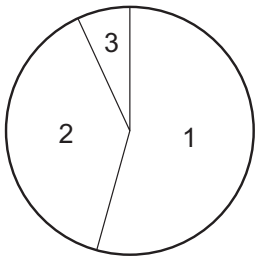
C microwaves, visible light and X-rays

D radio waves, X-rays and ultraviolet

（2024 夏季 0625/11 第39题）

8. The Sun radiates most of its energy in three regions of the electromagnetic spectrum.

In the pie chart, region 1 is infrared radiation and region 2 is visible radiation.



What is region 3?

A microwave

B radio

C ultraviolet

D X-ray

（2024 春季 0625/22 第37题）

题型 2：写稳定恒星的供能反应（考频★★☆☆☆）

知识点 核聚变是两个或多个较轻的原子核结合成较重原子核的反应，反应过程中释放能量。

在稳定恒星的中心，多个_____原子核发生核聚变，形成_____原子核并释放能量。

核聚变需要极高温度，使带正电的原子核具有足够的动能，克服彼此的_____。

答案：氢；氦；静电排斥

怎么认 题目出现稳定恒星或太阳的供能反应时，先写氢核聚变成氦核并释放能量。

例题 1 The energy generated in stable stars comes from nuclear reactions.

Which type of reaction occurs in the Sun?

A Helium nuclei break up to give hydrogen nuclei.

B Helium nuclei join together to form hydrogen nuclei.

C Hydrogen nuclei break up to give helium nuclei.

D Hydrogen nuclei join together to form helium nuclei.

（2023 春季 0625/22 第39题）

解：太阳是稳定恒星，氢原子核在其中心结合形成氦原子核，这一反应属于核聚变。故选 D。

针对练习

1. Which reaction produces the energy that powers the Sun?

A fission of hydrogen

B fission of uranium

C fusion of hydrogen

D fusion of uranium

（2024 冬季 0625/23 第39题）

2. Stars are powered by nuclear reactions that release energy.

Which statement describes the nuclear reaction in stable stars?

A Nuclear fission converts helium into hydrogen.

B Nuclear fission converts hydrogen into helium.

C Nuclear fusion converts helium into hydrogen.

D Nuclear fusion converts hydrogen into helium.

（2025 夏季 0625/22 第39题）

3. The Milky Way is one of many billions of galaxies. Each galaxy contains many billions of stable stars.

(a) Stable stars transfer energy into space by emitting electromagnetic radiation from their surfaces.

Describe what happens in the core of a stable star to release energy that is eventually transferred into space.

（2023 冬季 0625/41 第10题(a)）

4. Research is being carried out to produce electrical energy from the fusion of hydrogen nuclei.

Which row shows two of the problems in designing a fusion reactor?

	temperature needed	why obtaining a high density of hydrogen nuclei is difficult
A	very low	the nuclei are negatively charged and repel each other
B	very low	the nuclei are positively charged and repel each other
C	very high	the nuclei are negatively charged and repel each other
D	very high	the nuclei are positively charged and repel each other

（2023 夏季 0625/23 第11题）

6.2.2 恒星

题型 1：认星系与光年（考频★★★★☆）

知识点 星系是由_____颗恒星组成的巨大天体系统。

太阳是一颗恒星，太阳系位于_____中；银河系是一个星系。

天文距离可用光年表示，1 光年是光在真空中一年传播的距离，约为 9.5×10^{15} m。

答案：许多亿；银河系

怎么认 题目出现太阳所属星系或星系定义时，先确定太阳是恒星、太阳系位于银河系。

一. 把太阳放进银河系

例题 1 Which description of a galaxy is correct?

A a collection of billions of stars

B a collection of gaseous planets orbiting a star

C a collection of rocky planets orbiting a star

D all of the stars that exist

（2023 夏季 0625/13 第39题）

解：星系是由许多亿颗恒星组成的天体系统。故选 A。

针对练习

1. **(d)** The Sun is a star in a galaxy.

State the name of the galaxy.

（2023 夏季 0625/31 第12题(d)）

2. What is the name of the galaxy that contains the Sun?

A Andromeda

B Milky Way

C Red Shift

D Universe

（2025 冬季 0625/11 第40题）

3. **(a)** Name the galaxy that contains the Sun.

（2024 夏季 0625/42 第11题(a)）

4. The Milky Way is the galaxy in which the Solar System is located.

(a) State what a galaxy is.

（2024 冬季 0625/41 第9题(a)）

二. 先定义光年为距离

知识点 光年是_____单位，一光年等于光在真空中一年传播的距离。

1 ly = _____ m，常用于表示恒星等天体之间的距离。

答案：距离；9.5×10^{15}

怎么认 题目出现 light-year、光在一年内传播的距离或所测量时，先判定其表示距离。

例题 2 **(b)** Define a light-year.

（2023 春季 0625/32 第12题(b)）

解：光年表示距离，一光年等于光在真空中一年传播的距离。
答：光在真空中一年传播的距离。

针对练习

5. **(a)** Define a light-year in words.

（2025 夏季 0625/43 第10题(a)）

6. Which quantity does a light-year measure?

A an angle

B a distance

C a speed

D a time

（2023 冬季 0625/11 第40题）

7. What is the distance travelled by light in one year?

A 5.9×10^{15} m

B 5.9×10^{15} km

C 9.5×10^{15} m

D 9.5×10^{15} km

（2024 夏季 0625/23 第40题）

8. What is the meaning of a light-year?

A the distance light travels in space in one year

B the number of years it takes light to travel from the Sun to the Earth

C the speed that light travels in space

D the time it takes light to travel from the Sun to the nearest star

（2024 春季 0625/12 第39题）

三. 用光年算距离或时延

知识点 光年是光在真空中一年内传播的距离，是长度单位；$1\ \text{ly} = 9.5 \times 10^{15}\ \text{m}$。

光或无线电信号在真空中以光速传播，距离为 x 光年时，单程传播时间为 _____ 年。

若信号往返同一段距离，传播路程和时间均为单程的 _____ 倍。

太阳是银河系中的一颗恒星，银河系内其他恒星比太阳距离地球远得多。

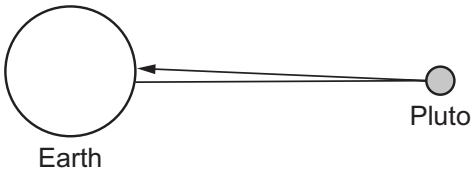
答案：x；2

怎么认 题目出现以光年给出的距离及光或无线电信号传播时，先判断单程或往返。

例题 3

The diagram shows a radio signal from the Earth being reflected by Pluto and returning to the Earth.

The distance between the Earth and Pluto is 0.00050 light-years.



What is the time taken for the radio signal to return to the Earth after being sent?

A 2000 years

B 1000 years

C 0.0010 years

D 0.00050 years

（2024 冬季 0625/13 第39题）

解：无线电信号从地球到冥王星再返回，传播路程为单程的两倍。

$t = 2 \times 0.00050$ 年

$= 0.0010$ 年

故选 C。

针对练习

9. Fig. 10.1 shows the orbit of the Earth and the orbit of a comet around the Sun.

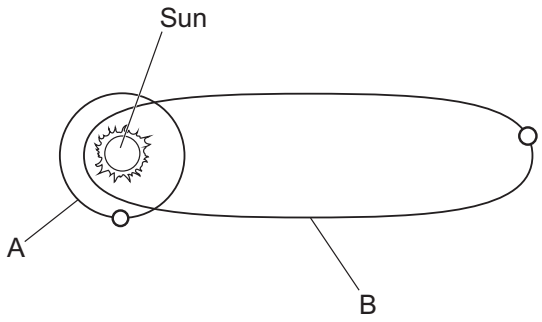


Fig. 10.1

(c) At one position in its orbit, the comet is 6.6×10^{-6} light-years away from the Earth.

(i) State the meaning of light-year.

(ii) Determine the distance in metres between the comet and the Earth.

（2025 冬季 0625/41 第10题(c)）

10. **(c)** **(i)** Define one light-year.

(ii) Scientists can send spacecraft to planets. There are many planets outside the Solar System.

Suggest **one** reason, other than cost, why scientists do **not** send spacecraft to planets outside the Solar System.

（2024 夏季 0625/33 第11题(c)）

11. The nearest star to the Sun is about four light-years away from the Earth.

A student makes three statements about the star.

1 Light from the star takes about four years to reach the Earth.

2 Light from the Sun takes about four years to travel to the star and back to the Earth.

3 The star is outside our galaxy.

Which statements are correct?

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

（2023 冬季 0625/23 第39题）

12. The nearest star to the Sun is Proxima Centauri at a distance of 4.2 light years.

Which statements are correct?

1 Telescope images of Proxima Centauri show it as it was 4.2 years ago.

2 If a spacecraft near Proxima Centauri sent a radio message to the Earth, it would take 4.2 years to arrive.

3 Proxima Centauri is outside the Milky Way galaxy.

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

（2023 春季 0625/12 第40题）

题型 2：沿质量分支走恒星演化（考频★★★★☆）

知识点 含氢的星际气体和尘埃云在自身_____作用下向内坍缩，内部温度升高，形成原恒星。
原恒星内部温度足够高时发生核聚变，高温产生向外的作用力。
当向内的引力与向外的作用力_____时，原恒星成为稳定恒星。

答案：引力；平衡

怎么认 题目出现星际气体云、原恒星或稳定恒星时，先写引力坍缩、升温、核聚变和受力平衡。

一. 从引力坍缩写到稳定

例题 1 The Sun is one of many billions of stars in the Milky Way. The Sun emits a very large quantity of energy as electromagnetic radiation.

(c) Approximately 4.6 billion years ago, the Sun formed from an interstellar cloud of gas and became a stable star.

(i) Describe and explain what happens as an interstellar cloud of gas forms a protostar.

(ii) Describe and explain what happens as a protostar becomes a stable star.

（2024 夏季 0625/41 第9题(c)）

解：(i) 星际气体云在自身引力作用下向内坍缩，内部温度升高，形成原恒星。
(ii) 原恒星内部发生核聚变，高温产生向外的作用力；当向内的引力与向外的作用力平衡时，原恒星成为稳定恒星。
答：星际气体云经引力坍缩形成原恒星，原恒星达到受力平衡后成为稳定恒星。

针对练习

1. **(a)** State the condition required for a protostar to become a stable star.

（2024 春季 0625/42 第11题(a)）

2. What happens when a protostar becomes a stable star?

A Most of the hydrogen is converted to helium and the protostar expands.

B The inward force due to gravity is balanced by an outward force due to the high temperature.

C The protostar collapses due to gravity and the temperature increases.

D The protostar runs out of hydrogen as fuel for the nuclear reaction.

（2024 冬季 0625/22 第38题）

二. 中心氢耗尽后先膨胀

知识点 恒星由含氢的星际气体和尘埃云在引力作用下聚集，先形成_____，再成为稳定恒星。
稳定恒星中心的氢逐渐耗尽并转化为氦后，恒星先_____；较小质量恒星成为红巨星，较大质量恒星成为_____。
红巨星演化后留下白矮星；红超巨星发生超新星爆发后，形成中子星或黑洞。

答案：原恒星；膨胀；红超巨星

怎么认 题目出现恒星各阶段的先后顺序或中心氢耗尽时，先从稳定恒星沿质量分支排列。

例题 2 In which order are the objects listed formed during the life cycle of a star?

A protostar → red giant → supernova → stable star

B protostar → stable star → red giant → supernova

C red giant → stable star → protostar → supernova

D red giant → supernova → protostar → stable star

（2024 夏季 0625/23 第39题）

解：由恒星演化顺序，星际气体和尘埃云先形成原恒星，原恒星再成为稳定恒星。
稳定恒星中心的氢逐渐耗尽后膨胀，形成红巨星；大质量恒星随后发生超新星爆发。
题中各阶段的先后顺序为原恒星、稳定恒星、红巨星、超新星。故选 B。

针对练习

3. Which stages in the life cycle of a star are listed in the order that they occur?

A interstellar dust cloud → stable star → protostar

B protostar → red giant → stable star

C red giant → white dwarf → protostar

D stable star → red giant → white dwarf

（2023 夏季 0625/21 第40题）

4. Which statement about the life cycle of a star is correct?

A All stars eventually run out of hydrogen as fuel.

B A red giant forms a planetary nebula with a supernova at its centre.

C A white dwarf star eventually forms a black hole.

D Most stars expand and form protostars.

（2024 夏季 0625/22 第39题）

5. **(c)** Describe what happens to a star when most of the fuel in its centre has been converted to helium.

（2025 冬季 0625/41 第9题(c)）

三. 按质量选末态

知识点 恒星的演化路径主要由质量决定；质量不同，晚期形态和末态不同。

较小质量恒星演化为红巨星，外层物质形成行星状星云，余下白矮星。

较大质量恒星演化为_____，随后发生超新星爆炸；抛出的物质形成星云，坍缩的内核形成_____或_____。

答案：红超巨星；中子星；黑洞

怎么认 题目出现恒星类型或询问超新星前后天体时，先按质量分支写出演化顺序。

例题 3 What is a possible result of a supernova explosion?

A a neutron star

B a red giant star

C a red supergiant star

D a white dwarf star

（2025 冬季 0625/22 第40题）

解： 较大质量恒星演化为红超巨星，随后发生超新星爆炸。

爆炸后坍缩的内核可能形成中子星或黑洞，中子星符合题意。

故选 A。

针对练习

6. What can be formed directly following a supernova?

A a nebula and a neutron star

B a nebula and a white dwarf

C a red supergiant and a neutron star

D a red supergiant and a protostar

（2025 冬季 0625/23 第40题）

7. The table lists some information about some stars.

Which star will eventually explode as a supernova?

	name of star	type of star	temperature / °C
A	Aldebaran	red giant	3 700
B	Betelgeuse	red supergiant	3 300
C	Geminga	neutron star	520 000
D	Sirius B	white dwarf	25 000

（2023 冬季 0625/21 第40题）

8. **(a)** Stars more massive than the Sun can eventually form black holes.

Describe how a black hole can be formed from a more massive star.

（2024 冬季 0625/43 第10题(a)）

6.2.3 宇宙

题型 1：认宇宙层级与银河系尺度（考频★★☆☆☆）

知识点 宇宙由数十亿个星系组成，银河系是其中一个星系。

银河系的直径约为 _____ 光年；光年是光在真空中一年内传播的_____，是长度单位。

答案：100000；距离

怎么认 题目出现银河系直径或宇宙组成时，先写出 100000 光年或数十亿个星系。

例题 1 What is the approximate diameter of the Milky Way?

A 100 light-years

B 1000 light-years

C 10 000 light-years

D 100 000 light-years

（2024 春季 0625/12 第40题）

解：银河系的直径约为 100000 光年。

故选 D。

针对练习

1. What is the approximate diameter of the Milky Way?

A 100 000 kilometres

B 1 000 000 kilometres

C 100 000 light-years

D 1 000 000 light-years

（2024 夏季 0625/13 第40题）

2. What makes up the Universe?

A many billions of galaxies

B Mercury, Venus, the Earth, Mars, Jupiter, Saturn, Uranus and Neptune only

C the Sun, the Earth and the Moon only

D the Solar System only

（2024 夏季 0625/12 第39题）

3. Fig. 11.1 represents the Sun and part of the Solar System.

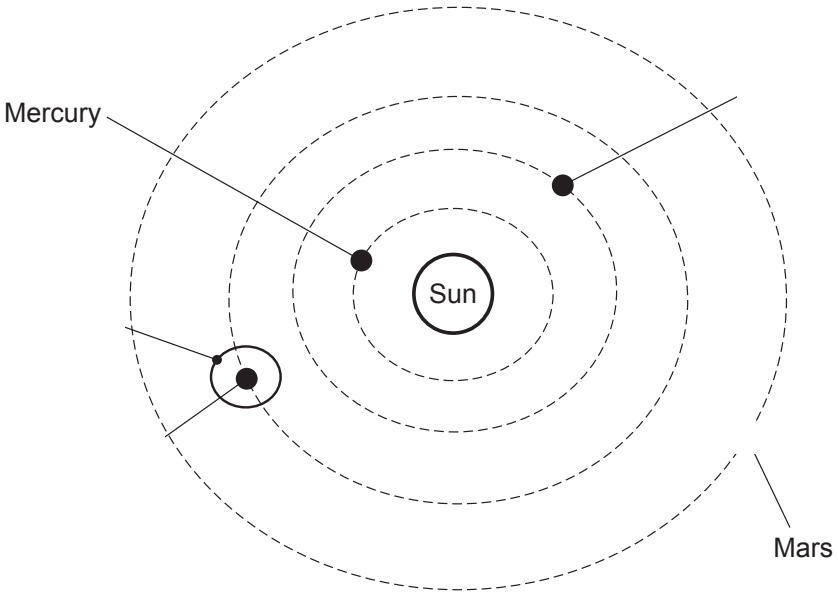


Fig. 11.1 (not to scale)

(c) Give an estimate for the diameter of the Milky Way galaxy.

（2023 冬季 0625/31 第11题(c)）

题型 2：由谱线认红移与膨胀（考频★★★☆☆）

知识点 红移是远离观测者的恒星或星系发出的电磁辐射，其观测波长比发射波长_____的现象。
比较同一元素的同一条谱线，观测波长变长、频率_____时，说明光源正在远离地球。
波长常用单位为 nm，频率单位为 Hz。
遥远星系普遍发生红移，是宇宙正在_____并支持大爆炸理论的证据。

答案：更长；降低；膨胀

怎么认 题目出现同一元素的发射波长和观测波长时，先比较两者；观测波长更长就判红移。

一. 观测波长变长就判红移

例题 1 Light from distant stars is redshifted.

What is redshift?

A a decrease in observed wavelength caused by a star moving away from the Earth

B a decrease in observed wavelength caused by a star moving towards the Earth

C an increase in observed wavelength caused by a star moving away from the Earth

D an increase in observed wavelength caused by a star moving towards the Earth

（2023 夏季 0625/13 第40题）

解：由红移的定义，恒星远离地球时，其发出的光的观测波长增加。
故选 C。

针对练习

1. Electromagnetic radiation from distant galaxies is redshifted when observed from the Earth.

This is evidence that supports the Big Bang Theory.

Which statement is correct?

A Light from galaxies that are moving towards the Earth is redshifted.

B Redshift is an increase in the wavelength of electromagnetic radiation.

C The Big Bang Theory says that the Solar System is expanding out into the Universe.

D The Big Bang Theory says that, billions of years ago, the Universe expanded to its current size in a few seconds.

（2025 夏季 0625/11 第39题）

2. Light received from distant galaxies is observed to have a longer wavelength than the light originally emitted. This is called redshift.

Which conclusion do astronomers form about distant galaxies from this observation?

A They are all moving around each other.

B They are all moving away from each other.

C They are all moving in circular orbits.

D They are all moving towards each other.

（2025 冬季 0625/12 第40题）

3. **(b)** Hydrogen in a very distant galaxy emits electromagnetic radiation which is observed on the Earth.

Scientists on the Earth measure the wavelength of the radiation from the very distant galaxy. The wavelength is 918 nm.

On the Earth, hydrogen in the laboratory emits electromagnetic radiation of wavelength 656 nm.

Name the effect that the scientists observe and state what this shows about the very distant galaxy.

（2024 冬季 0625/43 第9题(b)）

4. **(c)** Light from a distant galaxy is redshifted.

(i) Explain what is meant by redshift.

(ii) State the quantity that the redshift of a galaxy is used to calculate.

（2023 春季 0625/42 第10题(c)）

二. 由普遍红移推宇宙膨胀

知识点 退行恒星或星系发出的电磁辐射，其观测波长比发射波长_____，这种现象称为红移。
遥远星系的光普遍发生红移，表明星系正在_____；距离越远，红移越大，退行速率越大。
星系的普遍退行说明宇宙正在_____，并支持大爆炸理论；波长常用 nm 表示。

答案：长；远离地球；膨胀

怎么认 题目出现遥远星系谱线波长变长或普遍红移时，先判断星系正在退行，再推出宇宙膨胀。

例题 2

An astronomer observes redshift in the light from a distant galaxy.

Which statement about redshift is correct?

A It is the decrease in the observed wavelength of red light emitted from receding galaxies.

B It is evidence that the Universe is contracting and supports the Big Bang Theory.

C It is evidence that the Universe is expanding and supports the Big Bang Theory.

D Redshift is when light from receding galaxies appears blue.

（2023 夏季 0625/12 第40题）

解： 退行星系发出的光发生红移，观测波长增大。
遥远星系普遍退行，说明宇宙正在膨胀，并支持大爆炸理论。故选 C。

针对练习

5. Which statement about the Universe is correct?

A The Universe consists of 100 000 galaxies.

B Redshift is a decrease in the observed wavelength of electromagnetic radiation emitted from receding galaxies.

C Light emitted from distant galaxies appears redshifted.

D Redshift of the light from distant galaxies gives evidence that the Universe is contracting.

（2025 夏季 0625/21 第39题）

6. **(c)** Describe the evidence for an expanding Universe.

（2025 夏季 0625/31 第11题(c)）

7. **(c)** Table 9.1 shows a wavelength of electromagnetic radiation from hydrogen observed in the laboratory and from three galaxies.

The galaxies are at different distances from the Earth.

Table 9.1

object	wavelength of hydrogen from object, observed on the Earth / nm
gas tube in laboratory	656
nearby galaxy	667
distant galaxy	750
very distant galaxy	918

Describe what Table 9.1 shows about the motions of the galaxies and state what this suggests is happening to the Universe.

（2024 冬季 0625/43 第9题(c)）

8. **(b)** An astronomer observes light from a distant galaxy.

She writes this conclusion:

'*The observed wavelength of light from the distant galaxy is longer than the wavelength of the light emitted by the galaxy.*'

Explain how this conclusion supports the Big Bang Theory of the Universe.

（2024 冬季 0625/33 第11题(b)）

题型 3：用宇宙微波背景证早期宇宙（考频★★☆☆☆）

知识点 宇宙微波背景辐射（CMBR）产生于_____，现在可从太空_____观测到。
宇宙膨胀使该辐射的波长增大，这种现象称为_____；波长被拉长后进入微波波段。
CMBR 是支持大爆炸理论的观测证据之一。

答案：宇宙形成后不久；各个方向；红移

怎么认 题目出现CMBR的产生时间、观测方向或波长变化时，先写早期产生，再用宇宙膨胀解释红移。

例题 1 **(c)** Cosmic microwave background radiation (CMBR) is observed at all points in space.

(i) State when this radiation was produced.

(ii) Explain why this radiation is now in the microwave region of the electromagnetic spectrum.

（2024 夏季 0625/42 第11题(c)）

解：(i) CMBR 是早期宇宙遗留的辐射，产生于宇宙形成后不久。
(ii) 宇宙膨胀使该辐射发生红移，波长逐渐增大，现已进入微波波段。
答：产生于宇宙形成后不久；宇宙膨胀使其红移至微波波段。

针对练习

1. **(b)** State when cosmic microwave background radiation (CMBR) was formed and where we detect it coming from.

（2023 冬季 0625/43 第10题(b)）

2. **(a)** Cosmic microwave background radiation (CMBR) can be observed in every direction in space around us.

(i) State when CMBR was produced.

(ii) State and explain how the wavelength of this radiation has changed since it was formed.

（2025 冬季 0625/43 第9题(a)）

3. Which statement about the cosmic microwave background radiation (CMBR) is correct?

A CMBR now has a frequency higher than that of infrared radiation.

B CMBR has always had exactly the same frequency.

C CMBR had a shorter wavelength in the past.

D CMBR was produced a long time after the Universe was formed.

（2025 夏季 0625/21 第40题）

4. Fig. 11.1 represents the Solar System. The Sun and five of the eight planets are labelled.

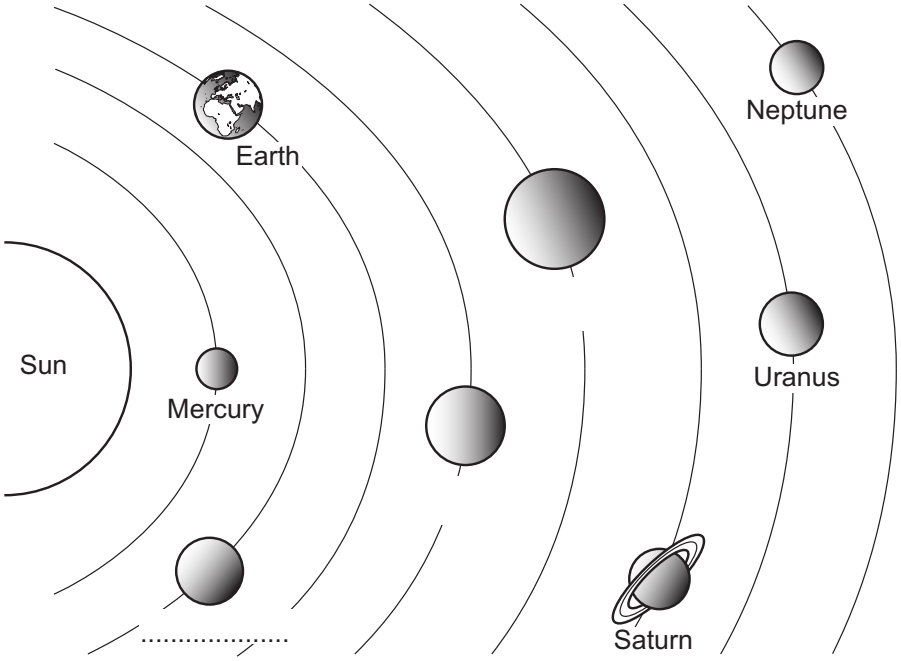


Fig. 11.1 (not to scale)

(c) **(i)** Scientists use the Big Bang Theory to explain the way the Universe began.

State **one** piece of evidence that supports the Big Bang Theory.

(ii) Scientists use the accretion model to explain the formation of the Solar System.

Complete the following sentences about the accretion model.

（2025 夏季 0625/32 第11题(c)）

题型 4：先定星系距离与退行速率（考频★★☆☆☆）

知识点 超新星的固有亮度已知，比较其固有亮度与观测亮度，可确定所在星系的_____；观测亮度越小，距离越大。

退行星系的星光发生红移，谱线的观测波长增大；测量波长变化可确定星系的_____。

遥远星系满足哈勃定律 $v = H_0 d$。若 v 的单位为 $\mathrm{km\ s^{-1}}$，d 的单位为 Mpc，则 H_0 的单位为 $\mathrm{km\ s^{-1}Mpc^{-1}}$。

答案：距离；退行速率

怎么认 题目出现超新星亮度、星系谱线波长变化或红移时，先分别对应距离、退行速率。

例题 1

An astronomer observes a distant galaxy.

The table shows how the distance and the speed of recession of the galaxy are determined.

Which row is correct?

	distance	speed of recession
A	brightness of a supernova in the galaxy	change in wavelength of starlight from the galaxy
B	brightness of a supernova in the galaxy	brightness of the galaxy
C	brightness of the galaxy	change in wavelength of starlight from the galaxy
D	brightness of the galaxy	brightness of a supernova

（2024 夏季 0625/21 第40题）

解：超新星的固有亮度已知，比较其观测亮度可确定星系距离。
星系光谱的谱线波长变化表示红移，由红移可确定星系的退行速率。
故选 A。

针对练习

1. Which quantity can be determined using the brightness of a supernova in a distant galaxy?

A the speed at which the galaxy is moving away from the Earth

B the distance of the galaxy from the Earth

C the Hubble constant

D the age of the Universe

（2023 夏季 0625/23 第40题）

2. **(b)** **(i)** State **one** measurement that is taken when determining the speed *v* at which a galaxy is moving away from the Earth.

(ii) Write down an equation relating *v* and the distance *d* of a far galaxy.

(iii) State how the distance *d* of a far galaxy can be determined other than by using the equation in **(ii)**.

（2023 夏季 0625/43 第10题(b)）

题型 5：用哈勃定律处理星系数据（考频★★★★☆）

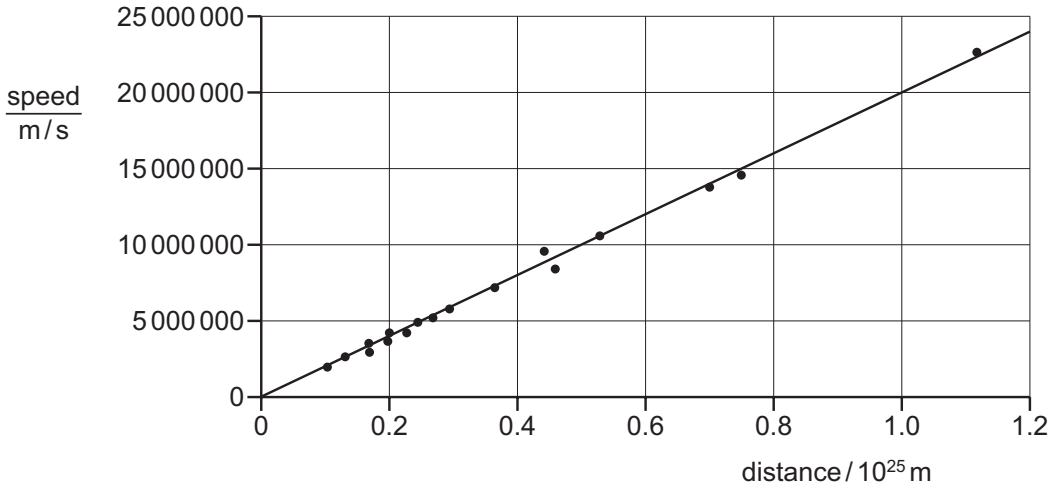
知识点 哈勃定律指出，星系远离地球的退行速率 v 与它到地球的距离 d _____，即 $v = H_0 d$。
哈勃常数 H_0 = _____；在 v–d 图中，它等于最佳拟合直线的斜率，单位为 _____。
由图求值时，应在线上取相距较远的两点，计算 $\Delta\frac{v}{\Delta}d$，并把坐标轴倍率计入读数。

答案：成正比；$\frac{v}{d}$；s^{-1}

怎么认 题目出现星系退行速率和距离，或 v–d 最佳拟合直线时，先写 $H_0 = \frac{v}{d}$。

一. 用 v/d 或图线斜率求 H_0

例题 1 A student plots a graph of the speed of different galaxies moving away from the Earth against their distance from the Earth.



Using the best straight line shown on the graph, what is the value of the Hubble constant H_0?

A $2.0 \times 10^{-18}\,\text{s}^{-1}$

B $2.2 \times 10^{-18}\,\text{s}^{-1}$

C $4.5 \times 10^{17}\,\text{s}$

D $5.0 \times 10^{17}\,\text{s}$

（2025 春季 0625/22 第40题）

解： 由哈勃定律，$v = H_0 d$，故最佳拟合直线的斜率为 H_0。

取直线上的 $(0,0)$ 和 $(1.0\times10^{25}\ \text{m}, 2.0\times10^{7}\ \text{m/s})$，得

$H_0 = \frac{\Delta v}{\Delta d}$

$= \frac{2.0\times10^{7}\ \text{m/s}}{1.0\times10^{25}\ \text{m}}$

$= 2.0 \times 10^{-18}\text{s}^{-1}$。

故选 A。

针对练习

1. Two quantities define the Hubble constant H_0.

- the speed at which the galaxy is moving away from the Earth v
- the distance of the galaxy from the Earth d

What is the relationship between v and d and what is the current estimate for H_0?

	relationship	current estimate for H_0
A	v is proportional to d	$2.2 \quad 10^{-18}\,s^{-1}$
B	v is proportional to $\frac{1}{d}$	$2.2 \quad 10^{-18}\,s^{-1}$
C	v is proportional to d	$3.0 \quad 10^{8}\,m/s$
D	v is proportional to $\frac{1}{d}$	$3.0 \quad 10^{8}\,m/s$

（2023 春季 0625/22 第40题）

2. What is the definition of the Hubble constant?

A the ratio of the speed at which a galaxy is receding from the Earth to its distance from the Earth

B the value of the change in wavelength of the galaxy's starlight due to redshift

C the constant used to represent the rate of expansion of the Universe in all directions

D the estimated constant equal to the age of the Universe

（2023 夏季 0625/22 第40题）

3. To determine the value of the Hubble constant, an astronomer measures the distance of a galaxy from the Earth as 2.5×10^{21} km.

She also measures the speed of recession of the galaxy from the Earth as $5.2 \times 10^{3}\,km/s$.

From these data, what is the value of the Hubble constant?

A $7.7 \times 10^{-26}\,s^{-1}$

B $2.1 \times 10^{-18}\,s^{-1}$

C $4.8 \times 10^{17}\,s^{-1}$

D $1.3 \times 10^{25}\,s^{-1}$

（2024 冬季 0625/21 第40题）

4. **(c)** Fig. 10.1 is a scatter graph showing how the speed of galaxies moving away from the Earth varies with their distances from the Earth.

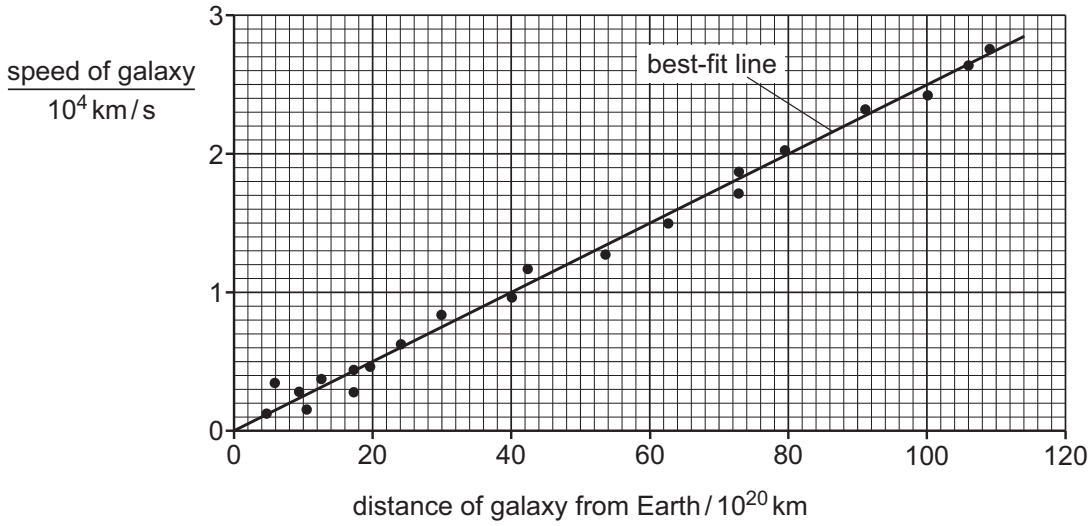


Fig. 10.1

A scientist draws a best-fit line on the scatter graph.

Use this best-fit line to determine a value for the Hubble constant.

（2025 夏季 0625/43 第10题(c)）

二. 变形 v=H₀d 求速率或距离

知识点 哈勃定律表明星系远离地球的速率 v 与星系到地球的距离 d 成_____，关系为 $v = H_0 d$。
H_0 为哈勃常数，当前估计为 $2.2 \times 10^{-18} \text{s}^{-1}$。
求速率时用 $v = H_0 d$；求距离时变形得 $d =$ _____，各量的单位必须相容。
$1\ \text{ly} = 9.5 \times 10^{15}\ \text{m}$，$1\ \text{km/s} = 10^3\ \text{m/s}$；距离越大的星系远离速率越大。

答案：正比；$\frac{v}{H_0}$

怎么认 题目出现星系的远离速率、距离及哈勃常数时，先按所求写出关系式或其变形式。

例题 2 A galaxy is moving away from the Earth at a velocity of 3000 km / s.

What is the distance between the Earth and the galaxy?

A 7.3×10^{-25} m

B 7.3×10^{-22} m

C 1.4×10^{21} m

D 1.4×10^{24} m

（2025 夏季 0625/22 第40题）

解：由哈勃定律 $v = H_0 d$ 得
$d = \frac{v}{H_0}$
$3000\ \text{km/s} = 3.0 \times 10^6\ \text{m/s}$
$d = \frac{3.0 \times 10^6}{2.2 \times 10^{-18}} = 1.36 \times 10^{24}\ \text{m} \approx 1.4 \times 10^{24}\ \text{m}$
故选 D。

针对练习

5. A galaxy is 3.0×10^{20} km from the Earth.

At which speed is the galaxy moving away from the Earth?

A 660 km / s **B** 6600 km / s **C** 660 m / s **D** 6600 m / s

（2024 夏季 0625/21 第39题）

6. **(c)** The Whirlpool galaxy is 2.3×10^{7} light-years from the Earth. The current value of the Hubble constant is 2.2×10^{-18} per second.

Calculate the speed at which the Whirlpool galaxy is moving away from the Earth.

（2025 冬季 0625/42 第10题(c)）

7. **(d)** A galaxy is moving away from the Earth with a speed of 33 000 km / s.
The value of the Hubble constant is 2.2×10^{-18} per second.

Calculate the distance from the galaxy to the Earth. Give your answer in light-years.

（2023 夏季 0625/42 第10题(d)）

8. A galaxy is approximately 1.2×10^{26} m from the Earth.

(b) **(i)** State the current estimate for the Hubble constant H_0.

(ii) Calculate the speed at which the galaxy is moving away from the Earth.

(iii) Scientists have measured the speeds at which distant galaxies are moving away from the Earth and their distances from the Earth.

These measurements suggest that all the Universe was once at a single point.

Explain why.

（2024 夏季 0625/43 第11题(b)）

三. 用 1/H_0 估算宇宙年龄

知识点 哈勃常数 H_0 等于远处星系相对观测者的退行速率 v 与距离 d 的比值，即 $H_0 =$ _____。
当 v 以 m s^{-1}、d 以 m 表示时，H_0 的单位为 _____。
若宇宙的膨胀速率保持不变，则宇宙年龄可估算为 $t \approx \frac{d}{v} =$ _____；换算成年需除以每年的秒数。

答案：$\frac{v}{d}$；s^{-1}；$\frac{1}{H_0}$

怎么认 题目出现哈勃常数并求宇宙年龄，或给出星系距离和退行速率时，先写 $t \approx \frac{1}{H_0}$ 或 $t \approx \frac{d}{v}$。

例题 3 Which quantity is an estimate of the age of the Universe?

A H_0 **B** d × H_0 **C** $\frac{1}{H_0}$ **D** v × H_0

（2024 冬季 0625/22 第40题）

解：由 $H_0 = \frac{v}{d}$ 得
$\frac{1}{H_0} = \frac{d}{v}$。
星系退行所需时间约为距离除以速率，因此
$t \approx \frac{d}{v} = \frac{1}{H_0}$。
故选 C。

针对练习

9. **(b)** **(i)** Define the Hubble constant.

(ii) The current estimate for the Hubble constant is 2.2×10^{-18} per second.

State the equation which gives an estimate for the age of the Universe.

(iii) Calculate an estimate for the age of the Universe.

（2024 春季 0625/42 第11题(b)）

10. A galaxy is at a distance of 60 million light-years from the Earth. The galaxy is moving away at a speed of 1300 km / s.

One light-year is about 9.5×10^{12} km.

There are about 3.2×10^{7} seconds in one year.

Which expression can be used to estimate the age of the Universe in years?

A $\dfrac{60 \times 10^{6} \times 3.2 \times 10^{7}}{1300 \times 9.5 \times 10^{12}}$

B $\dfrac{60 \times 10^{6} \times 9.5 \times 10^{12}}{1300 \times 3.2 \times 10^{7}}$

C $\dfrac{1300 \times 9.5 \times 10^{12}}{60 \times 10^{6} \times 3.2 \times 10^{7}}$

D $\dfrac{1300 \times 3.2 \times 10^{7}}{60 \times 10^{6} \times 9.5 \times 10^{12}}$

（2025 冬季 0625/21 第40题）

11. **(a)** **(i)** **1.** State what is represented in space physics by the symbol H_0.

2. Write down the equation that defines H_0 in terms of the speed that a far galaxy is moving away from the Earth and its distance from the Earth.

(ii) The numerical value of H_0 is 2.2×10^{-18}. State the unit of H_0.

(iii) Use this value of H_0 to determine an estimate for the age of the Universe in seconds.

（2023 冬季 0625/43 第10题(a)）

12. The Milky Way is one of many billions of galaxies. Each galaxy contains many billions of stable stars.

(c) The Hubble constant H_0 is equal to 2.2×10^{-18} per second.

(i) Calculate the distance from the Earth of a galaxy that is moving away at a speed of 1.3×10^{7} m / s.

(ii) Calculate an estimate for the age of the Universe. Give your answer in years.

（2023 冬季 0625/41 第10题(c)）