

Week 28

IGCSE Physics

Homework bundle for this week

本周作业合集

exercises.lol

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6. Space physics

Starter Quiz · 课前小测

IGCSE Physics

Name: _____ Score: _____

- What causes day and night?
 - ☐ the Earth spinning on its axis
 - ☐ the Earth orbiting the Sun
 - ☐ the Moon orbiting the Earth
 - ☐ the Sun switching off
- How do the inner and outer planets differ?
 - ☐ the inner four are small and rocky; the outer four are large and gaseous
 - ☐ the inner four are gaseous; the outer four are rocky
 - ☐ they are all the same
 - ☐ the inner planets have no Sun
- What powers the Sun?
 - ☐ nuclear fusion of hydrogen into helium
 - ☐ burning hydrogen like a fire
 - ☐ nuclear fission of uranium
 - ☐ friction
- Light from a distant galaxy is redshifted. This means the galaxy is:
 - ☐ moving away from us, so its light is stretched to a longer wavelength
 - ☐ moving toward us
 - ☐ standing still
 - ☐ getting hotter
- What causes the seasons?
 - ☐ the tilt of the Earth's axis as it orbits the Sun
 - ☐ the Earth getting closer to and further from the Sun
 - ☐ the Moon blocking the Sun
 - ☐ the Sun changing brightness
- The phases of the Moon happen because we see different amounts of its lit side as it orbits.
 - ☐ True ☐ False

7. A satellite orbits at radius $r = 7.0 \times 10^6$ m with a period $T = 5800$ s. What is its orbital speed, in m/s?

_____ m/s

8. The Sun is about 1.5×10^{11} m away. How long does its light take to reach Earth, in seconds? (light speed 3.0×10^8 m/s)

_____ s

9. The cosmic microwave background radiation (CMBR) is found coming from every direction in space.

☐ True ☐ False

10. The Hubble constant is about $H_0 = 2.0 \times 10^{-18}$ per second. Estimate the age of the Universe ($1/H_0$), in seconds.

_____ s

6. Space physics

Answers · 答案

IGCSE Physics

1. the Earth spinning on its axis

The Earth rotates once in about 24 hours, so each place faces the Sun (day) then faces away (night).

2. the inner four are small and rocky; the outer four are large and gaseous

The four inner planets are small and rocky; the four outer planets are large and gaseous (gas giants and ice giants).

3. nuclear fusion of hydrogen into helium

In a stable star, hydrogen nuclei fuse into helium in the core, releasing huge amounts of energy.

4. moving away from us, so its light is stretched to a longer wavelength

A receding source stretches the light to a longer wavelength — toward the red end of the spectrum.

5. the tilt of the Earth's axis as it orbits the Sun

The tilted axis means each hemisphere leans toward the Sun for half the year (summer) and away for the other half (winter).

6. True

As the Moon orbits Earth, the fraction of its sunlit side that we can see changes, giving new, half and full moon.

7. 7600 m/s

$$v = \frac{2\pi r}{T} = \frac{2\pi \times 7.0 \times 10^6}{5800} \approx 7600 \text{ m/s.}$$

8. 500 s

$$\text{time} = \frac{d}{v} = \frac{1.5 \times 10^{11}}{3.0 \times 10^8} = 500 \text{ s (about 8 minutes).}$$

9. True

The CMBR fills all of space, coming from every direction — it is early radiation stretched into microwaves as the Universe expanded.

10. 5e+17 s

$$\text{Age} \approx \frac{1}{H_0} = \frac{1}{2.0 \times 10^{-18}} = 5.0 \times 10^{17} \text{ s (roughly 16 billion years).}$$

6.1 The Earth and the Solar System

Name: _____ Class: _____ Date: _____ Total: 9 marks

KEY WORDS orbit 轨道 • solar system 太阳系 • orbits and gravity 轨道与引力 • planet 行星
• sun 太阳

Objective

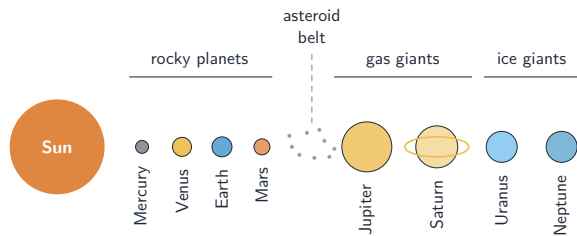
Build the skills to answer exam questions on **the Earth and the Solar System** 地球与太阳系 — day/night/seasons, **orbital speed** $v = \frac{2\pi r}{T}$, the planets, and **orbits and gravity** 轨道与引力.

You must be able to:

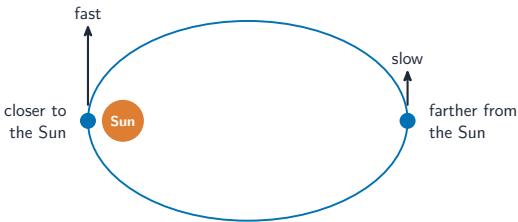
- explain day, year, seasons and Moon phases
- use $v = \frac{2\pi r}{T}$ for an orbit
- describe the Solar System and elliptical orbits

1 Worked examples

Orbits and orbital speed



Four small rocky planets, then the asteroid belt, then four large gaseous planets



An object speeds up when closer to the Sun ($PE \rightarrow KE$) and slows down when farther away

Space station, $r = 7.0 \times 10^6 \text{ m}$, $T = 5800 \text{ s}$: $v = \frac{2\pi r}{T} = \frac{2\pi(7.0 \times 10^6)}{5800} \approx 7600 \text{ m/s}$.

2 Practice

2.1 State what causes day and night. [1]

2.2 Name the force that keeps a planet in orbit around the Sun. [1]

3 Exam-style questions

3.1 Compared with the inner planets, the outer planets orbit the Sun: [1]

- A faster
- B more slowly
- C at the same speed
- D in the opposite direction

3.2 A moon orbits a planet at a radius of 4.0×10^8 m with a period of 2.0×10^6 s.

(a) Find its orbital speed. [3]

(b) State what happens to the gravitational field strength of the planet as you move further from it. [1]

3.3 A comet moves in a very stretched elliptical orbit. Explain why it moves fastest when closest to the Sun. [2]

Solutions

2.1 the Earth spinning (rotating) on its axis.

2.2 gravity / the Sun's gravitational attraction.

3.1 B. The Sun's gravity is weaker further out, so outer planets move more slowly.

3.2 (a) $v = \frac{2\pi r}{T} = \frac{2\pi(4.0 \times 10^8)}{2.0 \times 10^6}$; $= 1.3 \times 10^3$ m/s.

(b) it decreases (gets weaker).

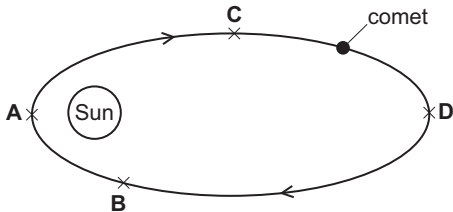
3.3 as the comet comes closer, its gravitational potential energy falls; by conservation of energy this becomes kinetic energy, so it speeds up.

36 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

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

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



40 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

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

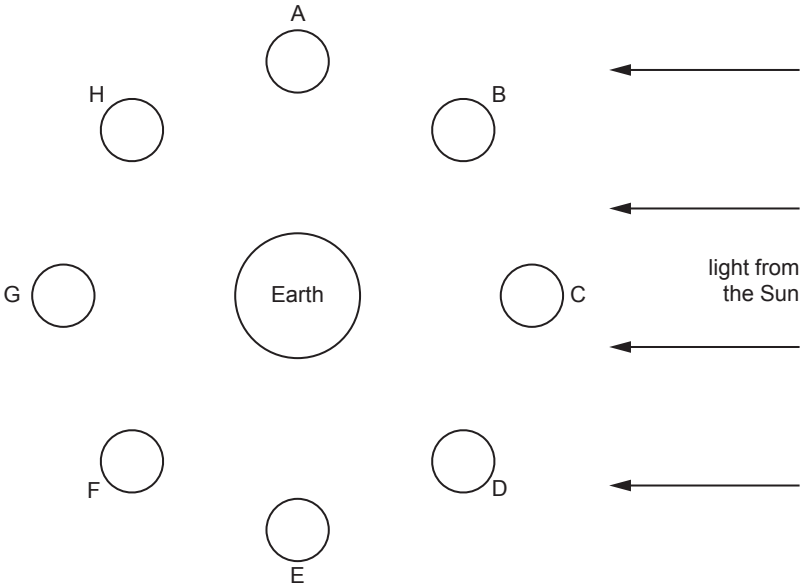


Fig. 10.1

(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 

[2]

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

time = [1]

(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.

average orbital speed = km/h [3]

(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.

time = [2]

[Total: 8]

10 (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.

average speed = [3]

(b) State the shape of the orbits of the planets.

..... [1]

(c) Light from a distant galaxy is redshifted.

(i) Explain what is meant by redshift.

.....

..... [2]

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

..... [1]

[Total: 7]

6.2 Stars and the Universe

Name: _____ Class: _____ Date: _____ **Total: 10 marks**

KEY WORDS redshift 红移 • big bang 大爆炸 • light-year 光年
• cosmic microwave background radiation 宇宙微波背景辐射 • stars and the universe 恒星与宇宙

Objective

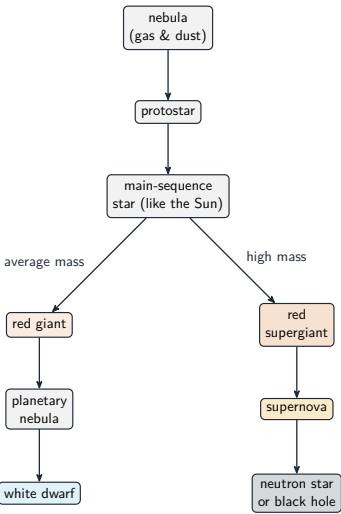
Build the skills to answer exam questions on **stars and the Universe** 恒星与宇宙 — the Sun as a star, galaxies and **light-years** 光年, the **life cycle of a star** 恒星演化, **redshift** 红移 and the **Big Bang** 大爆炸.

You must be able to:

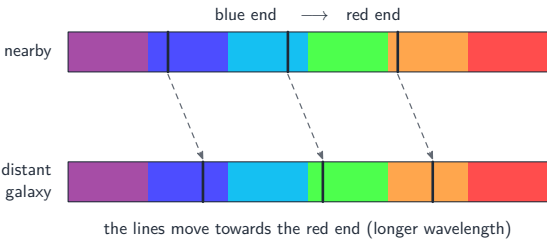
- describe the Sun (fusion of hydrogen to helium) and galaxies
- describe a star’s life cycle (by mass)
- explain redshift as evidence for an expanding Universe

1 Worked examples

■ Life cycle & redshift



Every star begins in a nebula; a heavy star ends in a supernova → neutron star or black hole



Light from receding galaxies is redshifted; the farther the galaxy, the bigger the redshift

Sun: a medium star, powered by fusion of hydrogen into helium. **Hubble:** $H_0 = \frac{v}{d}$, and age $\approx \frac{1}{H_0}$.

2 Practice

2.1 State the nuclear reaction that powers the Sun. [1]

2.2 State what a light-year measures. [1]

3 Exam-style questions

3.1 Redshift of light from distant galaxies is evidence that the Universe is: [1]

- **A** shrinking
- **B** expanding
- **C** unchanging
- **D** rotating

3.2 A medium-mass star like the Sun runs out of hydrogen fuel.

(a) Describe what it becomes, in order, after this. [3]

(b) State what is left at the very end. [1]

3.3 The Hubble constant is about $H_0 = 2.2 \times 10^{-18} \text{ s}^{-1}$.

(a) Estimate the age of the Universe in seconds. [2]

(b) State one other piece of evidence for the Big Bang. [1]

Solutions

2.1 nuclear fusion (of hydrogen nuclei into helium).

2.2 distance (the distance light travels in one year).

3.1 B. Redshift shows galaxies are receding — the Universe is expanding.

3.2 (a) it swells into a red giant; throws off its outer layers as a planetary nebula; leaving a white dwarf.

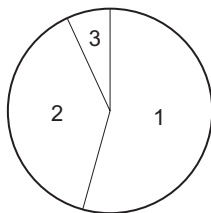
(b) a white dwarf.

3.3 (a) $\text{age} \approx \frac{1}{H_0} = \frac{1}{2.2 \times 10^{-18}}; = 4.5 \times 10^{17} \text{ s}.$

(b) the cosmic microwave background radiation (CMBR).

37 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

39 Nuclear reactions in the Sun release large quantities of energy.

Which statement about this process is correct?

- A** It involves the fission of helium to produce hydrogen.
- B** It involves the fission of hydrogen to produce helium.
- C** It involves the fusion of helium to produce hydrogen.
- D** It involves the fusion of hydrogen to produce helium.

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

.....

 [1]

(b) (i) Define the Hubble constant.

.....

 [2]

(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.

..... [1]

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

estimate of age = s [1]

[Total: 5]

39 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.

- 10 (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.

average speed = [3]

- (b)** State the shape of the orbits of the planets.

..... [1]

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

- (i)** Explain what is meant by redshift.

.....

..... [2]

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

..... [1]

[Total: 7]