Topic 6 · Space physics

The Earth and the Solar System, orbits and gravitational field strength, the life cycle of stars, and the evidence for an expanding Universe.

SUGGESTED TIME	TOTAL MARKS	QUESTIONS	MULTIPLE CHOICE
40 minutes	**39**	**10**	**6**

SECTION	**6 · Space physics**
IN THE FORMAT OF	Papers 1 and 2 (multiple choice), Papers 3 and 4 (theory), with a data-handling question in place of a practical
ROUTES	Core only — 5 questions, 10 marks. Core and Supp. — the whole paper, 10 questions, 39 marks. Every question is tagged in the left margin.
DEMAND	**Recall 4 · Routine 2 · Demanding 3 · Discriminating 1** *Pitched at the board's own level, not above it. Multiple choice is mostly one step, with a couple of two-step items and one that rewards the candidate who does not take the obvious route. Structured questions open on a 1-mark recall and close on an explanation or a suggestion worth two marks — the marks real candidates most often drop.*
SYLLABUS POINTS	6.1 · 6.2

INSTRUCTIONS

- Answer all questions in the spaces provided.
- Show your working. Method marks are awarded even where the final answer is wrong.
- Give your answers to a sensible number of significant figures, with a unit.
- The mark scheme for this paper follows the last question.

> *Written by GioPhysics from the published syllabus. These are practice papers in the style of Cambridge IGCSE Physics 0625; they are not Cambridge papers, contain no past-paper questions, and the official syllabus and specimen materials remain the authority.*
>
> Cambridge IGCSE Physics 0625 syllabus — https://www.cambridgeinternational.org/Images/697209-2026-2028-syllabus.pdf

THE PAPER

Topic 6 · Space physics

Answer all questions. 39 marks in 40 minutes.

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1 CORE

MULTIPLE CHOICE · RECALL · 6.1 **[1]**

What causes the seasons on Earth?

A The Earth's distance from the Sun changes during the year.

B The Earth's axis is tilted relative to the plane of its orbit.

C The Earth spins on its axis once every 24 hours.

D The Sun's output of energy varies during the year.

Answer ☐

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2 CORE

MULTIPLE CHOICE · RECALL · 6.1 **[1]**

Which list gives four planets in order of increasing distance from the Sun?

A Mercury, Venus, Mars, Earth

B Venus, Earth, Mars, Jupiter

C Earth, Venus, Jupiter, Saturn

D Mars, Earth, Saturn, Jupiter

Answer ☐

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3 SUPP.

MULTIPLE CHOICE · ROUTINE · 6.1 **[1]**

A planet orbits its star in a nearly circular path of radius 1.1×10^{11} m, taking 1.9×10^{7} s to complete one orbit. What is its average orbital speed?

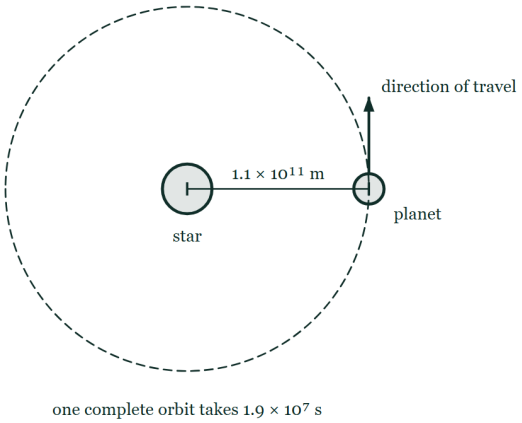

Fig. 3.1 *A planet moving on a nearly circular orbit around its star. The star is a disc at the centre of a dashed circle and the planet is a smaller disc on that circle, level with the star and to its right. The distance from the centre of the star out to the planet is marked 1.1 × 10¹¹ m, an arrow at the planet points along the orbit to show the direction in which it travels, and a note beneath states that one complete orbit takes 1.9 × 10⁷ s.*

A 5.8×10^{3} m/s

B 1.8×10^{4} m/s

C 3.6×10^{4} m/s

D 5.8×10^{4} m/s

Answer ☐

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4 CORE

MULTIPLE CHOICE · RECALL · 6.2 **[1]**

What is a light-year?

A the time taken for light to travel across the Milky Way

B the distance travelled by light in one year

C the time taken for light from the Sun to reach the Earth

D the age of the light emitted by a distant galaxy

Answer ☐

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5 CORE

MULTIPLE CHOICE · RECALL · 6.2 **[1]**

A star with a mass much greater than that of the Sun reaches the end of its life. Which sequence of stages is correct?

A red giant → planetary nebula → white dwarf

B red supergiant → supernova → neutron star or black hole

C white dwarf → supernova → red supergiant

D protostar → white dwarf → black hole

Answer ☐

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6 SUPP.

MULTIPLE CHOICE · DEMANDING · 6.2 **[1]**

Light from a distant galaxy shows a spectral line at a wavelength longer than the wavelength of the same line measured in a laboratory on Earth. What does this show?

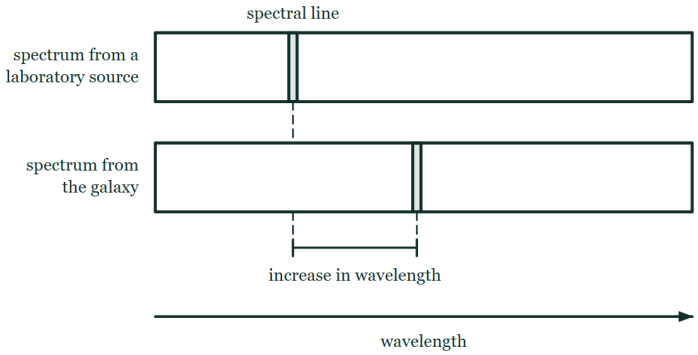

Fig. 6.1 *Two spectra drawn one above the other against a common horizontal wavelength scale that increases to the right. The upper strip is the spectrum of a source in the laboratory on Earth, with one spectral line marked in it. The lower strip is the spectrum of light received from the distant galaxy, in which the same line appears further to the right. A dashed line dropped from each line marks its position on the scale, and the gap between the two positions is labelled as the increase in wavelength.*

A The galaxy is moving towards the Earth.

B The galaxy is moving away from the Earth.

C The galaxy is hotter than the laboratory source.

D Light slows down as it travels across space.

Answer ☐

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7 CORE

STRUCTURED · ROUTINE · 6.1 **[6]**

The Earth spins on its own axis and also orbits the Sun. The Moon orbits the Earth, taking about one month to complete an orbit.

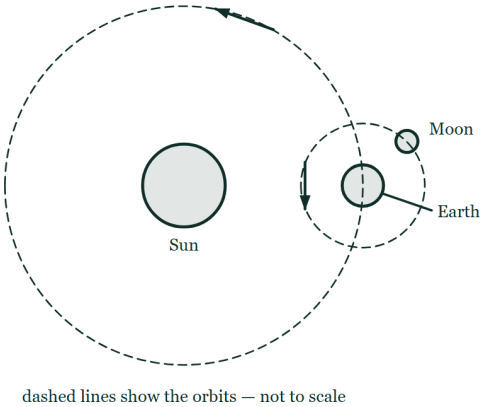

Fig. 7.1 *A not-to-scale plan view of the Sun, the Earth and the Moon. The Sun is a disc at the centre of a large dashed circle, and the Earth is a smaller disc sitting on that circle to the right of the Sun. A second, much smaller dashed circle is drawn around the Earth with the Moon on it, up and to the right of the Earth. A short arrow on each dashed circle shows the direction in which the Earth travels around the Sun and the Moon around the Earth.*

(a) STATE **[2]**

State the approximate time taken for one rotation of the Earth on its axis, and for one orbit of the Earth around the Sun.

(b) EXPLAIN **[2]**

Explain why the Moon can be seen from Earth even though it produces no light of its own.

(c) EXPLAIN **[2]**

The Sun is much further from the Earth than the Moon is, yet the Sun and the Moon appear almost the same size in the sky. Explain how this is possible.

8 STRUCTURED · DEMANDING · 6.1 **[7]**

SUPP.

The table gives the orbital radius and the orbital period of four planets in the Solar System.

planet	orbital radius / 10^{11} m	orbital period / 10^{7} s
Earth	1.50	3.16
Mars	2.28	5.94
Jupiter	7.78	37.4
Saturn	14.3	92.9

(a) CALCULATE **[3]**

Calculate the average orbital speed of Jupiter.

(b) DETERMINE **[2]**

Without further calculation, determine whether Saturn's orbital speed is greater or smaller than Jupiter's, and justify your answer using the table.

(c) EXPLAIN **[2]**

Explain, in terms of gravitational field strength, why planets further from the Sun move more slowly.

9 STRUCTURED · DEMANDING · 6.2 **[8]**

SUPP.

A star forms from a cloud of dust and gas that is pulled together by gravitational attraction. The Sun is a stable star roughly halfway through its life.

(a) EXPLAIN **[2]**

Explain why the Sun is stable at present, in terms of the forces acting within it.

(b) DESCRIBE **[3]**

Describe the process by which energy is released in the core of the Sun.

(c) DESCRIBE **[3]**

Describe what will happen to the Sun once the hydrogen in its core has been used up.

10 DATA ANALYSIS · DISCRIMINATING · 6.2 **[12]**

SUPP.

Astronomers measure the speed at which distant galaxies are moving away from the Earth and the distance to each galaxy. The table gives values for four galaxies.

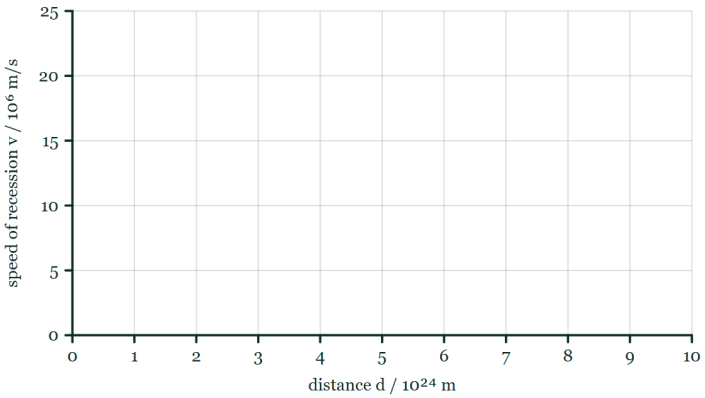

Fig. 10.1 *An empty graph grid on which the readings in the table can be plotted. The horizontal axis is labelled distance d / 10²⁴ m and runs from 0 to 10 with a numbered gridline at every unit; the vertical axis is labelled speed of recession v / 10⁶ m/s and runs from 0 to 25 with a numbered gridline every 5. No points are plotted on the grid.*

galaxy	distance d / 10²⁴ m	speed of recession v / 10⁶ m/s
P	1.2	2.6
Q	3.5	7.7
R	6.0	13.2
S	9.4	20.7

(a) DESCRIBE **[2]**

Describe the relationship between the speed of recession and the distance shown by the table.

(b) DETERMINE **[3]**

Determine a value for the Hubble constant H_0 from these data, and give its unit.

(c) ESTIMATE **[2]**

Use your value of H_0 to estimate the age of the Universe. Give your answer in seconds.

(d) EXPLAIN **[3]**

Explain how the relationship in (a) supports the idea that the Universe began with the Big Bang.

(e) SUGGEST **[2]**

The astronomers measured only four galaxies. Suggest two reasons why a value of H_0 obtained this way is less reliable than one obtained from several hundred galaxies.

MARK SCHEME

Topic 6 · Space physics — mark scheme

One line per mark, as an examiner would award them. A note under a part is the error that part is set to catch.

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1 CORE

MULTIPLE CHOICE · RECALL · 6.1 **[1]**

What causes the seasons on Earth?

KEY **B** **The Earth's axis is tilted relative to the plane of its orbit.**

A is the near-universal misconception, and it is testable against the fact that the northern and southern hemispheres have opposite seasons at the same moment. C gives day and night, not the seasons.

A01

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2 CORE

MULTIPLE CHOICE · RECALL · 6.1 **[1]**

Which list gives four planets in order of increasing distance from the Sun?

KEY **B** **Venus, Earth, Mars, Jupiter**

A, C and D each swap one neighbouring pair, so none can be eliminated by a rough sense of the order alone — the candidate has to know the actual sequence. The four rocky planets run Mercury, Venus, Earth, Mars, and Jupiter is the first of the gas giants beyond them.

A01

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3 SUPP.

MULTIPLE CHOICE · ROUTINE · 6.1 **[1]**

A planet orbits its star in a nearly circular path of radius 1.1×10^{11} m, taking 1.9×10^{7} s to complete one orbit. What is its average orbital speed?

KEY **C** **3.6×10^{4} m/s**

A divides the radius by the time and forgets the circumference entirely. B uses πr rather than $2\pi r$, which is the commonest slip once the candidate has remembered that a circumference is involved.

A02

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4 CORE

MULTIPLE CHOICE · RECALL · 6.2 **[1]**

What is a light-year?

KEY **B** **the distance travelled by light in one year**

A, C and D are all times. The name misleads, which is why this item appears on real papers so often: a light-year is a distance.

A01

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5 CORE

MULTIPLE CHOICE · RECALL · 6.2 **[1]**

A star with a mass much greater than that of the Sun reaches the end of its life. Which sequence of stages is correct?

KEY **B** **red supergiant → supernova → neutron star or black hole**

A is the route for a star of about the Sun's mass, and is the answer of a candidate who has learned one life cycle rather than two.

A01

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6 SUPP.

MULTIPLE CHOICE · DEMANDING · 6.2 **[1]**

Light from a distant galaxy shows a spectral line at a wavelength longer than the wavelength of the same line measured in a laboratory on Earth. What does this show?

KEY **B** **The galaxy is moving away from the Earth.**

A is the answer of a candidate who knows the term redshift but not which way it runs. D contradicts the constancy of the speed of light in a vacuum, on which the whole method depends.

AO2

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7 CORE

STRUCTURED · ROUTINE · 6.1 **[6]**

The Earth spins on its own axis and also orbits the Sun. The Moon orbits the Earth, taking about one month to complete an orbit.

(a) STATE · AO1 **[2]**

State the approximate time taken for one rotation of the Earth on its axis, and for one orbit of the Earth around the Sun.

1. rotation: 24 hours (1 day)
2. orbit: 365 days (1 year)

(b) EXPLAIN · AO1 **[2]**

Explain why the Moon can be seen from Earth even though it produces no light of its own.

1. light from the Sun falls on the Moon
2. and is reflected from the Moon's surface to the Earth

(c) EXPLAIN · AO2 **[2]**

The Sun is much further from the Earth than the Moon is, yet the Sun and the Moon appear almost the same size in the sky. Explain how this is possible.

1. the Sun's diameter is very much larger than the Moon's — about 400 times larger
2. and the Sun is about 400 times further away, so the two subtend almost the same angle at the Earth

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8 SUPP.

STRUCTURED · DEMANDING · 6.1 **[7]**

The table gives the orbital radius and the orbital period of four planets in the Solar System.

(a) CALCULATE · AO2 **[3]**

Calculate the average orbital speed of Jupiter.

1. $v = 2\pi r / T$
2. $v = 2\pi \times 7.78 \times 10^{11} / 37.4 \times 10^{7}$
3. $v = 1.31 \times 10^{4}$ m/s

(b) DETERMINE · AO2 **[2]**

Without further calculation, determine whether Saturn's orbital speed is greater or smaller than Jupiter's, and justify your answer using the table.

1. Saturn's radius is about 1.8 times Jupiter's, but its period is about 2.5 times Jupiter's
2. the period grows by the larger factor, so $2\pi r/T$ is smaller — Saturn moves more slowly

(c) EXPLAIN · AO1 **[2]**

Explain, in terms of gravitational field strength, why planets further from the Sun move more slowly.

1. the Sun's gravitational field strength decreases with distance from the Sun
2. so a more distant planet is held by a weaker force and a smaller speed is enough to maintain its orbit

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9 STRUCTURED · DEMANDING · 6.2 **[8]**

SUPP.

A star forms from a cloud of dust and gas that is pulled together by gravitational attraction. The Sun is a stable star roughly halfway through its life.

(a) EXPLAIN · AO1 **[2]**

Explain why the Sun is stable at present, in terms of the forces acting within it.

1 the inward gravitational attraction of the Sun's own mass

2 is balanced by the outward pressure produced by the energy released in the core, so the Sun neither collapses nor expands

(b) DESCRIBE · AO1 **[3]**

Describe the process by which energy is released in the core of the Sun.

1 hydrogen nuclei fuse together at the very high temperature and pressure of the core

2 forming helium nuclei

3 the mass of the products is slightly less than that of the reactants, and the difference is released as energy

(c) DESCRIBE · AO1 **[3]**

Describe what will happen to the Sun once the hydrogen in its core has been used up.

1 the core contracts and the outer layers expand — the Sun becomes a red giant

2 helium and heavier nuclei fuse in the core, up to the mass of iron

3 the outer layers are then thrown off as a planetary nebula, leaving the hot dense core as a white dwarf

10 SUPP. DATA ANALYSIS · DISCRIMINATING · 6.2 **[12]**

Astronomers measure the speed at which distant galaxies are moving away from the Earth and the distance to each galaxy. The table gives values for four galaxies.

(a) DESCRIBE · AO2 **[2]**

Describe the relationship between the speed of recession and the distance shown by the table.

1 the speed of recession increases as the distance increases

2 and the increase is proportional — v/d is the same for all four galaxies

(b) DETERMINE · AO2 **[3]**

Determine a value for the Hubble constant H_0 from these data, and give its unit.

1 $H_0 = v / d$

2 using galaxy S: $H_0 = 20.7 \times 10^6 / 9.4 \times 10^{24}$

3 $H_0 = 2.2 \times 10^{-18}$, unit s^{-1} (per second)

Working from a single well-separated point, or from the gradient of a v–d graph, both earn full marks. Taking the mean of the four ratios is also accepted.

(c) ESTIMATE · AO2 **[2]**

Use your value of H_0 to estimate the age of the Universe. Give your answer in seconds.

1 age ≈ $1 / H_0$

2 age ≈ $1 / 2.2 \times 10^{-18} = 4.5 \times 10^{17}$ s

(d) EXPLAIN · AO2 **[3]**

Explain how the relationship in (a) supports the idea that the Universe began with the Big Bang.

1 every distant galaxy is moving away from us, and the further away it is the faster it recedes, so the Universe is expanding

2 tracing the motion backwards, all the galaxies were once much closer together

3 so the expansion began from a single point at a definite time in the past

The last mark is the one that closes the argument. Candidates who describe the expansion but never run it backwards have given evidence for expansion, not for a beginning.

(e) SUGGEST · AO3 **[2]**

The astronomers measured only four galaxies. Suggest two reasons why a value of H_0 obtained this way is less reliable than one obtained from several hundred galaxies.

1 the distance to a galaxy is very difficult to measure and carries a large uncertainty, so a value from four galaxies depends heavily on whether those four happen to be well measured

2 galaxies also have their own motion within their local cluster on top of the expansion, and averaging over many galaxies is what reduces that additional scatter

The only place on this paper where the marks are for judging data rather than using it — which is what Topic 6 offers in place of a practical, since space physics is not examined on Paper 5 or Paper 6.

THE CHEAPEST MARKS ON ANY PAPER

What the command words are asking for

Every board publishes these and marks to them. A candidate who explains where the question said state has spent four minutes earning one mark; one who states where it said explain has earned none.

Calculate	Work out from given facts, figures or information.
Define	Give the precise meaning.
Describe	State the points of a topic; give characteristics and main features.
Determine	Establish an answer using the information available.
Estimate	Suggest an approximate value.
Explain	Set out purposes or reasons; make relationships evident; give why and/or how.
Give	Produce an answer from a given source or recall.
Identify	Name, select or recognise.
Show (that)	Provide structured evidence that leads to a given result.
State	Express in clear terms.
Suggest	Apply knowledge and understanding to situations where there is a range of valid responses in order to make proposals.

WHAT IS BEING TESTED

IGCSE assessment objectives

Every candidate sits two theory papers and one practical-skills paper. Core takes Papers 1 and 3 and is capped at grade C; Extended takes Papers 2 and 4 and reaches A*. Both then take either Paper 5 (practical test) or Paper 6 (alternative to practical), which carries 20% either way. Theory papers give you no formula sheet.

A01
18 MARKS · 46%
QUALIFICATION 50%

Knowledge with understanding

Recall, describe, explain and use physics ideas, terminology, instruments and conventions.

A02
19 MARKS · 49%
QUALIFICATION 30%

Handling information and problem-solving

Locate and interpret information, translate between forms, calculate, reason, and apply physics to unfamiliar situations.

A03
2 MARKS · 5%
QUALIFICATION 20%

Experimental skills and investigations

Plan, use apparatus, record and present observations, analyse, evaluate, and suggest improvements.

> *Written by GioPhysics from the published syllabus. These are practice papers in the style of Cambridge IGCSE Physics 0625; they are not Cambridge papers, contain no past-paper questions, and the official syllabus and specimen materials remain the authority.*
>
> Cambridge IGCSE Physics 0625 syllabus — https://www.cambridgeinternational.org/Images/697209-2026-2028-syllabus.pdf