INTUITION EDUCATION

HSC 2026 · PREDICTED PRACTICE PAPER

2026 HSC Physics

Original practice material — not a NESA paper

Total marks: 100

GENERAL INSTRUCTIONS

- Reading time — 5 minutes
- Working time — 3 hours
- Write using black pen
- Draw diagrams using pencil
- Calculators approved by NESA may be used
- A data sheet, formulae sheet and Periodic Table are provided at the back of this paper
- Section I — 20 marks. Attempt Questions 1–20. Allow about 35 minutes for this section
- Section II — 80 marks. Attempt Questions 21–36. Allow about 2 hours and 25 minutes for this section

Where needed, take g = 9.8 m s ^{2}, G = 6.67 × 10 ^{11} N m^{2} kg ^{2}, c = 3.0 × 10^{8} m s ^{1}, h = 6.626 × 10 ^{34} J s, b = 2.898 × 10 ^{3} m K, q_e = 1.602 × 10 ^{19} C, m_e = 9.109 × 10 ^{31} kg, m = 1.673 × 10 ^{27} kg, 1 u = 931.5 MeV/c^{2}.

HOW THIS PAPER WAS BUILT

This full-length practice paper was built from the consensus of a six-model AI panel (fable, opus, gpt-5.6-sol, gemini-3.1-pro, grok, deepseek), each of which independently predicted the 2026 examination from the 2019–2025 papers and NESA marking feedback. The 151 question-level predictions were clustered; every cluster with consensus probability ≥ 0.55 is realised in this paper, the remainder is drawn from the panel's watch list, and deep matter (Standard Model / accelerators) is deliberately light in line with the panel's rested call — as is a second relativity extended response after 2025's 8-marker. Each Section II question is tagged with the consensus cluster it realises and the probability that a question of that kind appears in 2026. Every question is original — none is copied from a past paper.

Answers and marking notes are published as a separate PDF — sit the paper first, then download the solutions from intuitioneducation.com.au/hsc-2026/physics.

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Section I

20 marks — Attempt Questions 1–20 — Allow about 35 minutes for this section

Use the multiple-choice answer sheet for Questions 1–20.

Question 1

A ball is launched as a projectile from level ground and lands at the same height. Air resistance is negligible.

Which change would increase the ball's time of flight?

A. Increasing the horizontal component of the launch velocity

B. Increasing the vertical component of the launch velocity

C. Decreasing the launch angle at the same launch speed

D. Increasing the mass of the ball

Question 2

An object moves in a horizontal circle of fixed radius at constant speed. The period of the motion is then halved.

What happens to the net force on the object?

A. It is halved

B. It doubles

C. It increases by a factor of 4

D. It is unchanged

Question 3

Two identical satellites, P and Q, are in circular orbits around Earth. The orbital radius of Q is twice that of P.

Which row of the table is correct?

	Greater orbital speed	Greater total mechanical energy
A.	P	P
B.	P	Q
C.	Q	P
D.	Q	Q

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Question 4

The escape velocity from Earth's surface is 11.2 km s $^{-1}$. Planet X has twice the mass of Earth and half the radius.

What is the escape velocity from the surface of Planet X?

A. 5.6 km s $^{-1}$

B. 11.2 km s $^{-1}$

C. 15.8 km s $^{-1}$

D. 22.4 km s $^{-1}$

Question 5

Two long, straight, parallel wires carry currents in the same direction and attract each other with a force F. The current in ONE wire is then reversed, with the currents and separation otherwise unchanged.

What is the force between the wires now?

A. Attractive, magnitude F

B. Repulsive, magnitude F

C. Repulsive, magnitude 2F

D. Zero

Question 6

A DC motor is operating at constant speed when its shaft is suddenly jammed so that it cannot rotate.

What happens to the current in the motor coil, and why?

A. It falls to zero, because the coil no longer rotates

B. It decreases, because the back emf increases

C. It increases, because the back emf falls to zero

D. It is unchanged, because the supply voltage is unchanged

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Question 7

A coil rotating at constant rate in a uniform magnetic field produces a sinusoidal emf of peak value ε_0 and frequency f.

The rotation rate of the coil is doubled. Which row describes the new output?

	Peak emf	Frequency
A.	ε_0	2f
B.	$2\varepsilon_0$	f
C.	$2\varepsilon_0$	2f
D.	$4\varepsilon_0$	2f

Question 8

A charged particle travels undeflected at velocity v through a region containing perpendicular electric and magnetic fields.

A second, identical particle enters the region along the same line at speed 2v.

Which statement describes the motion of the second particle?

A. It also passes through undeflected

B. It deflects in the direction of the electric force, which now exceeds the magnetic force

C. It deflects in the direction of the magnetic force, which now exceeds the electric force

D. It slows to speed v and then passes through undeflected

Question 9

Unpolarised light of intensity I_0 passes through two ideal polarising filters. The transmission axis of the second filter is at 45° to that of the first.

What is the intensity of the transmitted light?

A. $I_0/8$

B. $I_0/4$

C. $I_0/2$

D. $3I_0/4$

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Question 10

A spacecraft moves away from Earth at 0.60c while sending radio pulses back to Earth.

Which quantity has the same value when measured by an observer on the spacecraft and an observer on Earth?

A. The speed of the radio pulses

B. The time interval between the pulses

C. The length of the spacecraft

D. The momentum of the spacecraft

Question 11

Which statement about a particle of non-zero rest mass is correct according to special relativity?

A. Its momentum is given by $p = mv$ at all speeds

B. Its momentum increases without limit as its speed approaches c, so it cannot reach c

C. It can reach the speed of light if a constant force acts for long enough

D. Its momentum decreases as its speed approaches c

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Question 12

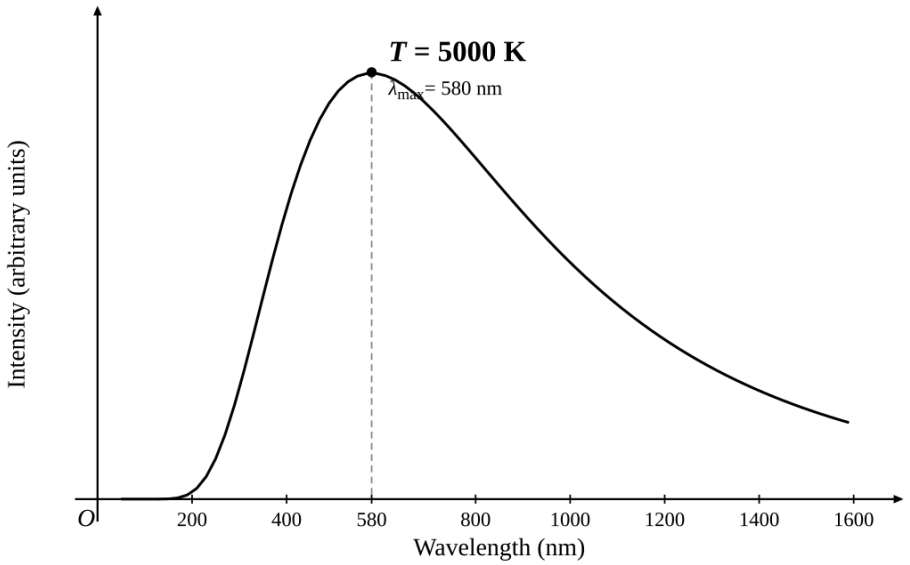

DIAGRAM PROVIDED IN THE EXAM

The temperature of the object falls to 4000 K.

Compared with the curve shown, the new curve has

A. a higher peak at a shorter wavelength.

B. a higher peak at a longer wavelength.

C. a lower peak at a shorter wavelength.

D. a lower peak at a longer wavelength.

Question 13

Which of the following was a prediction of Maxwell's theory of electromagnetism?

A. Electromagnetic waves travel at different speeds depending on their frequency

B. The electric and magnetic fields of an electromagnetic wave oscillate parallel to each other

C. There exists a spectrum of electromagnetic waves extending beyond visible light, all travelling at c

D. Electromagnetic waves require a medium in order to propagate

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Question 14

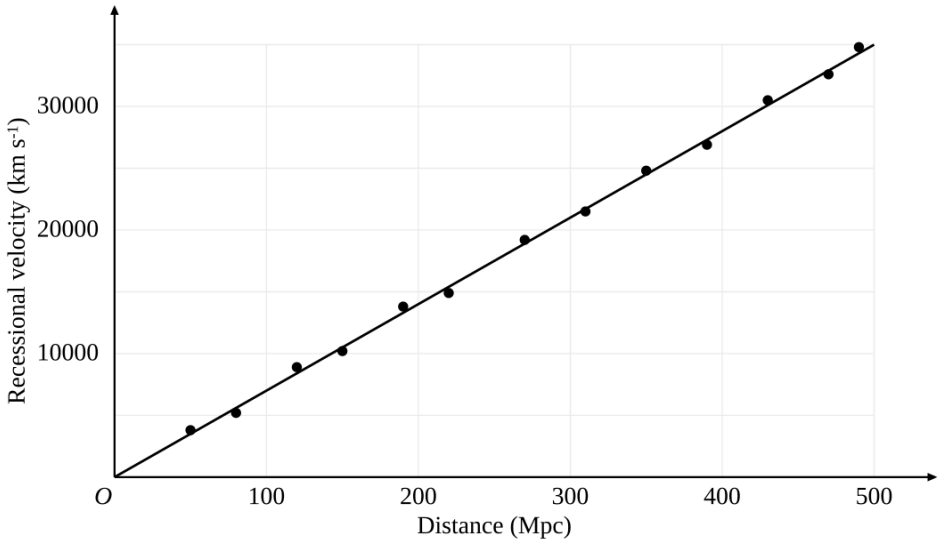

DIAGRAM PROVIDED IN THE EXAM

What does the graph provide evidence for?

A. Galaxies orbit a common centre of mass

B. The universe is expanding, with more distant galaxies receding faster

C. All galaxies are moving at the same speed

D. The universe is contracting

Question 15

A proton has quark composition uud and a neutron udd.

Which quark transformation occurs in beta-minus decay?

A. u → d

B. d → u

C. u → s

D. s → d

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Question 16

In the Geiger–Marsden experiment, most alpha particles passed through the gold foil with little or no deflection.

What did this observation indicate about the atom?

A. The atom's positive charge is spread evenly throughout its volume

B. Electrons occupy most of the atom's volume

C. The atom is mostly empty space

D. Alpha particles have no charge

Question 17

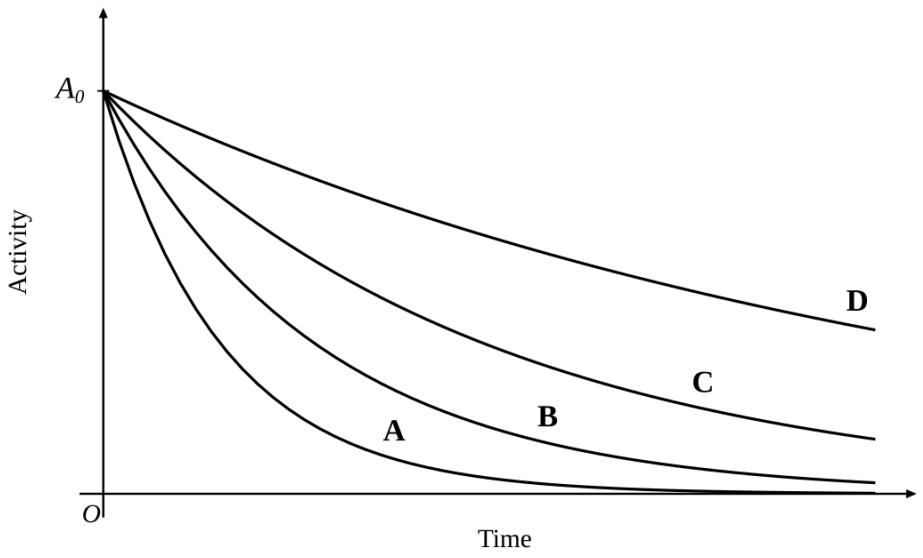

DIAGRAM PROVIDED IN THE EXAM

Which curve represents the isotope with the smallest decay constant?

A. Curve A

B. Curve B

C. Curve C

D. Curve D

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Question 18

Which nuclear process is the dominant source of the Sun's energy while it is on the main sequence?

A. Fission of heavy nuclei into lighter nuclei

B. The proton–proton chain, fusing hydrogen into helium

C. The triple-alpha process, fusing helium into carbon

D. Radioactive decay of uranium and thorium

Question 19

In a hydrogen atom, transition P is from n = 3 to n = 2 and transition Q is from n = 4 to n = 2.

Which statement is correct?

A. P emits a photon of longer wavelength than Q

B. P emits a photon of shorter wavelength than Q

C. P and Q emit photons of the same wavelength

D. P absorbs a photon while Q emits one

Question 20

The Sun radiates energy at 3.8×10^{26} W.

At what rate does the Sun lose mass as a result?

A. 1.3×10^{18} kg s ^{1}

B. 4.2×10^{9} kg s ^{1}

C. 1.3×10^{9} kg s ^{1}

D. 4.2×10^{6} kg s ^{1}

Section II

80 marks — Attempt Questions 21–36 — Allow about 2 hours and 25 minutes for this section

Answer the questions in the spaces provided. Show all relevant working in questions involving calculations.

Question 21 *(3 marks)*

A square coil of 50 turns and side length 4.0 cm lies flat on a bench, entirely within a uniform magnetic field of 0.25 T directed vertically downwards through the coil.

The coil is slid horizontally completely out of the field region in 0.20 s.

(a) Calculate the average emf induced in the coil during this time. **(2)**

(b) Viewed from above, the field points away from the observer (into the bench). State the direction of the induced current in the coil as seen from above, and justify your answer using Lenz's law. **(1)**

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Question 22 *(4 marks)*

A rectangular coil of 20 turns measures 5.0 cm × 8.0 cm and carries a current of 1.5 A. It sits in a uniform magnetic field of 0.30 T, mounted on an axle so it can rotate. In the position shown, the plane of the coil is parallel to the field.

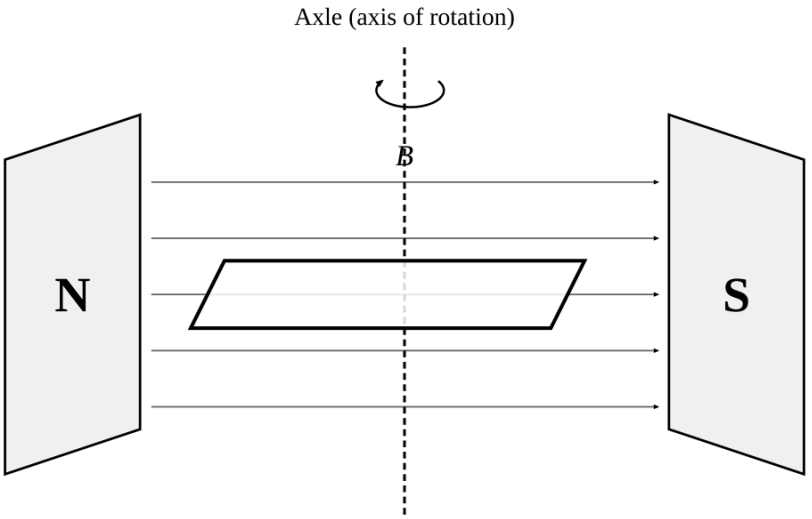

DIAGRAM PROVIDED IN THE EXAM

(a) Calculate the magnitude of the torque on the coil in the position shown. **(2)**

(b) On the axes provided, sketch how the magnitude of the torque varies as the coil rotates 180° from the position shown. Mark the angles at which the torque is zero and maximum. **(2)**

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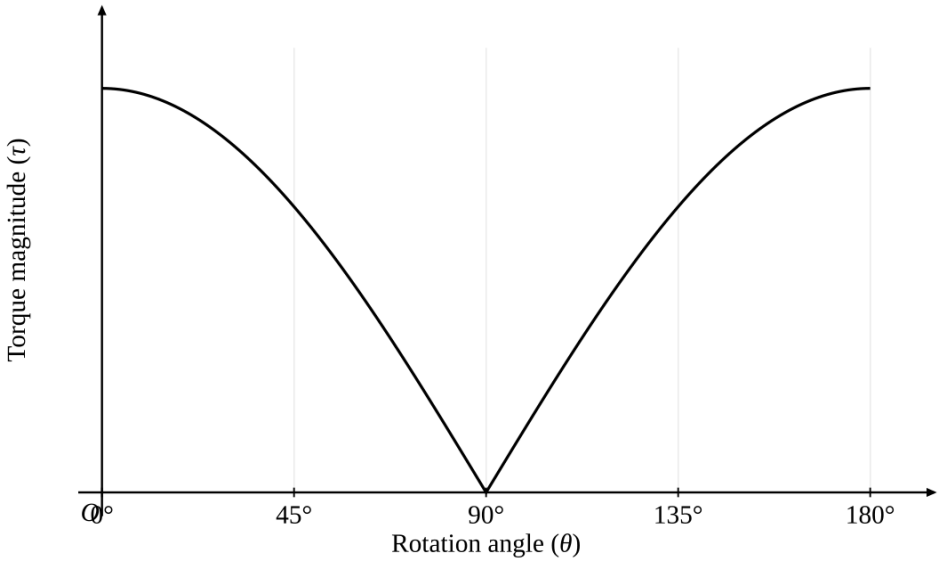

DIAGRAM PROVIDED IN THE EXAM

Question 23 *(6 marks)*

A ball is launched from the edge of a 25 m high vertical cliff with an initial velocity of 20 m s ^{1} at 30° above the horizontal. It lands on the level ground at the base of the cliff. Air resistance is negligible.

(a) Show that the time of flight of the ball is approximately 3.5 s. **(2)**

(b) Calculate the horizontal distance from the base of the cliff to the landing point. **(2)**

(c) Calculate the magnitude and direction of the ball's velocity as it lands. **(2)**

Question 24 *(5 marks)*

(a) For a moon in a circular orbit of radius r and period T about a planet of mass M, use the expressions for gravitational force and circular motion to show that

$r^3/T^2 = GM/4\pi^2$ **(2)**

(b) A moon of planet Z orbits at a radius of 3.8×10^8 m with an orbital period of 2.0 days.

Calculate the mass of planet Z. **(3)**

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Question 25 *(5 marks)*

The work functions of two metals are shown.

DATA PROVIDED IN THE EXAM

table — caesium: work function 2.1 eV; zinc: work function 4.3 eV.

Monochromatic light of frequency 6.5×10^{14} Hz is shone on each metal in turn.

(a) Show by calculation that photoelectrons are emitted from only one of the two metals. **(2)**

(b) Calculate the maximum kinetic energy, in joules, of the photoelectrons emitted from that metal. **(1)**

(c) The intensity of the light is doubled with its frequency unchanged. Using the photon model of light, explain the effect of this change on the number of photoelectrons emitted per second and on their maximum kinetic energy. **(2)**

Question 26 *(6 marks)*

Laser light passes through a pair of narrow slits separated by 2.5×10^{-5} m, producing an interference pattern on a distant screen. The second-order maximum (m = 2) is observed at an angle of 3.0° from the central maximum.

(a) Calculate the wavelength of the laser light. **(2)**

(b) The laser is replaced with one of wavelength 450 nm. Using the interference equation, explain how the angular positions of the maxima change. **(2)**

(c) State TWO separate changes to the apparatus, other than changing the laser again, that would each restore the original spacing of the fringes on the screen, and justify one of them. **(2)**

Question 27 *(5 marks)*

Muons are created 15 km above Earth's surface and travel directly downwards at 0.995c. The average lifetime of a muon in its own rest frame is 2.2 μs. At 0.995c, the Lorentz factor is 10.0.

(a) Calculate the time taken for a muon to reach the surface, as measured in Earth's frame. **(1)**

(b) Calculate the average lifetime of the muons as measured by an observer on Earth. **(2)**

(c) A far greater fraction of muons reaches the surface than classical physics predicts. Explain this observation from the muons' frame of reference. Support your answer with a calculation. **(2)**

Question 28 *(3 marks)*

A proton travels in a straight line at constant velocity through a region containing an electric field of 4.0×10^{4} V m^{-1} perpendicular to a magnetic field of 0.20 T.

(a) Calculate the speed of the proton. **(1)**

(b) The electric field is switched off. Calculate the radius of the proton's resulting circular path in the magnetic field. **(2)**

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Question 29 *(5 marks)*

An electron is accelerated from rest through a potential difference of 500 V.

(a) Show that the final speed of the electron is approximately 1.3×10^{7} m s $^{-1}$. **(2)**

(b) The electron then enters a uniform magnetic field of 1.5×10^{-3} T, moving perpendicular to the field. Calculate the radius of its circular path. **(2)**

(c) A proton travelling at the same speed enters the same field. Compare the radius and sense of curvature of its path with those of the electron's path. **(1)**

Question 30 *(4 marks)*

An ideal transformer steps 240 V mains down to operate a 24 W lamp. The primary coil has 20 times as many turns as the secondary coil. A switch allows a second, identical lamp to be connected in parallel with the first.

(a) Calculate the voltage across the lamp and the current in the primary coil when one lamp is operating. **(2)**

(b) The switch is closed so that both lamps operate at normal brightness. Using conservation of energy, explain what happens to the current in the primary coil. **(2)**

Question 31 *(5 marks)*

The spectrum of star Q is analysed.

DATA PROVIDED IN THE EXAM

intensity–wavelength plot for star Q: a smooth continuum peaking at 580 nm, crossed by dark absorption lines; an inset compares one hydrogen absorption line at 656.3 nm in a laboratory reference spectrum with the same line in star Q's spectrum, where it appears at 657.6 nm and is noticeably broader than the laboratory line.

(a) Calculate the surface temperature of star Q. **(2)**

(b) What does the shift of the hydrogen line from 656.3 nm to 657.6 nm indicate about the motion of star Q? **(1)**

(c) The star's absorption lines are broader than the corresponding laboratory lines. Explain how the star's rotation produces this broadening. **(2)**

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Question 32 *(5 marks)*

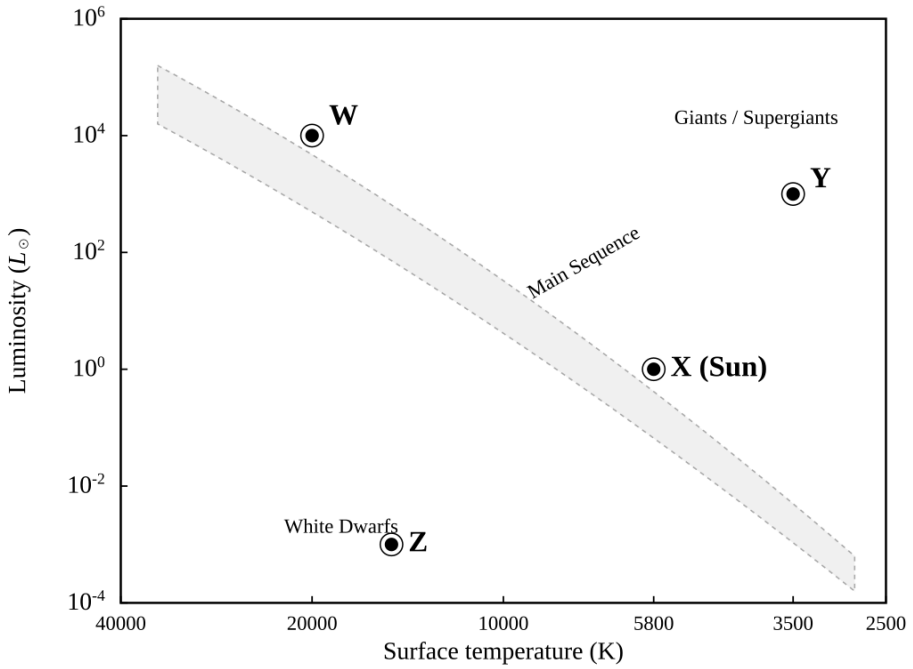

DIAGRAM PROVIDED IN THE EXAM

(a) Identify the evolutionary stage of star Y and the evolutionary stage of star Z. **(2)**

(b) Compare the nuclear processes occurring in the cores of stars X and Y. **(2)**

(c) Star Z is hotter than star X, yet far less luminous. Explain this. **(1)**

Question 33 *(5 marks)*

A sample initially contains 100 g of a radioactive isotope.

DATA PROVIDED IN THE EXAM

graph of mass of isotope remaining (g) against time (days), from 0 to 40 days — a smooth exponential decay through the readable points (0, 100), (8.0, 50), (16, 25) and (24, 12.5).

(a) Using the graph, determine the half-life of the isotope. **(1)**

(b) Calculate the decay constant of the isotope, in s $^{-1}$. **(2)**

(c) Calculate the time at which 5.0 g of the isotope remains. **(2)**

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Question 34 *(7 marks)*

A stationary polonium-210 nucleus undergoes alpha decay:

$^{210}Po \rightarrow {}^{206}Pb + {}^{4}He$

DATA PROVIDED IN THE EXAM
atomic masses — Po-210: 209.98286 u; Pb-206: 205.97446 u; He-4: 4.00260 u.

(a) Calculate the energy released in one decay, in MeV and in joules. **(3)**

(b) Almost all of the released energy appears as the kinetic energy of the alpha particle rather than of the lead nucleus.

(i) Explain this, using conservation of momentum. **(2)**

(ii) Calculate the kinetic energy of the alpha particle, in MeV. **(2)**

Question 35 *(5 marks)*

An 800 kg satellite is in a circular orbit of radius 7.0×10^6 m around Earth (mass 6.0×10^{24} kg).

(a) Calculate the total mechanical energy of the satellite in this orbit. **(2)**

(b) The satellite is moved to a circular orbit of radius 1.4×10^7 m. Calculate the energy that must be supplied to make this change. **(2)**

(c) In the higher orbit the satellite moves more slowly, yet energy had to be supplied. Explain this. **(1)**

Question 36 *(7 marks)*

An eddy-current brake consists of a solid aluminium disc of radius 0.10 m mounted on a frictionless axle, with a strong magnet fixed close to one face of the disc near its rim. The disc is spun to 12 revolutions per second and released at t = 0.

The experiment is repeated with an otherwise identical disc that has narrow radial slots cut through it.

DATA PROVIDED IN THE EXAM
graph of rotation rate (rev s $^{-1}$) against time (s) for both discs, each starting at 12 rev s $^{-1}$. The solid disc's curve falls steeply at first — reaching 6 rev s $^{-1}$ at about 2 s — then flattens progressively, approaching zero with an ever-decreasing gradient. The slotted disc's curve falls only slightly over the same interval, remaining above 10 rev s $^{-1}$ at 8 s.

(a) Calculate the speed of a point on the rim of the solid disc at the instant it is released. **(1)**

(b) Explain why the solid disc slows down. In your answer, identify the complete chain of cause and effect, including the energy transformation involved. **(4)**

(c) Using the graph, describe how the retarding effect on the solid disc changes as the disc slows, and explain why this occurs. **(1)**

(d) Explain why the slotted disc slows far less than the solid disc. **(1)**

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