PEARSON EDEXCEL IGCSE PHYSICS · 4PH1

PHYSICS



EXAM QUESTION PACK

SECTION 8: ASTROPHYSICS (PACK 1)

SCORE	PERCENTAGE
/199	%

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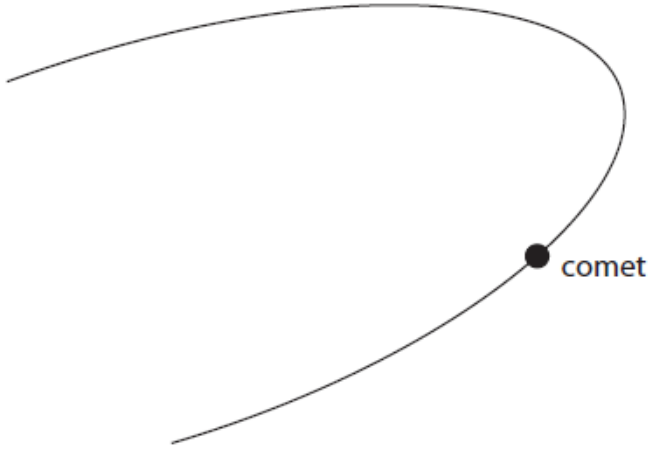
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Q1.

The diagram shows a comet as it moves through part of its orbit around the Sun.



(a)(i) Add an S to the diagram to show the position of the Sun.

(1)

(ii) Complete the diagram to show the orbit of the comet.

(2)

(iii) Add an X to the diagram to show the position where the comet is moving fastest.

(1)

(b) Describe how the orbit of a comet compares with the orbit of a planet.

(3)

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(Total for question = 7 marks)

Q2.

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross and then mark your new answer with a cross ☒.

(a) Which of these astronomical objects is the largest?

(1)

☒ **A** a comet

☒ **B** the Earth

☒ **C** the Moon

☒ **D** the Sun

(b) Which of these types of radiation is the most ionising?

(1)

☒ **A** alpha

☒ **B** beta

☒ **C** gamma

☒ **D** ultraviolet

(c) Which of these is the unit for resistance?

(1)

☒ **A** ampere

☒ **B** ohm

☒ **C** volt

☒ **D** watt

(d) Which of these parts of the electromagnetic spectrum has the shortest wavelength?

(1)

☒ **A** infrared

☒ **B** microwave

☒ **C** ultraviolet

☒ **D** x-ray

(e) Which of these temperatures is the same as 0 °C?

(1)

☒ **A** -273 K

☒ **B** 3 K

☒ **C** 273 K

☒ **D** 373 K

(Total for question = 5 marks)

Q3.

This question is about astrophysics.

(a) Which of these do planets orbit?

(1)

☒ **A** an artificial satellite

☒ **B** a comet

☒ **C** a moon

☒ **D** a star

(b) Which of these has the largest diameter?

(1)

☒ **A** a galaxy

☒ **B** the Solar System

☒ **C** the Sun

☒ **D** the universe

(c) Which of these has the smallest diameter?

(1)

☒ **A** a galaxy

☒ **B** the Moon

☒ **C** a star

☒ **D** the Solar System

(d) At the surface of the Earth, the gravitational field strength is 10 N/kg.

At the surface of the Moon, the gravitational field strength is 1.7 N/kg.

Give a reason for the difference in gravitational field strength.

(1)

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(Total for question = 4 marks)

Q4.

This question is about astrophysics.

(a) Complete the sentences by writing a suitable word or phrase in each blank space.

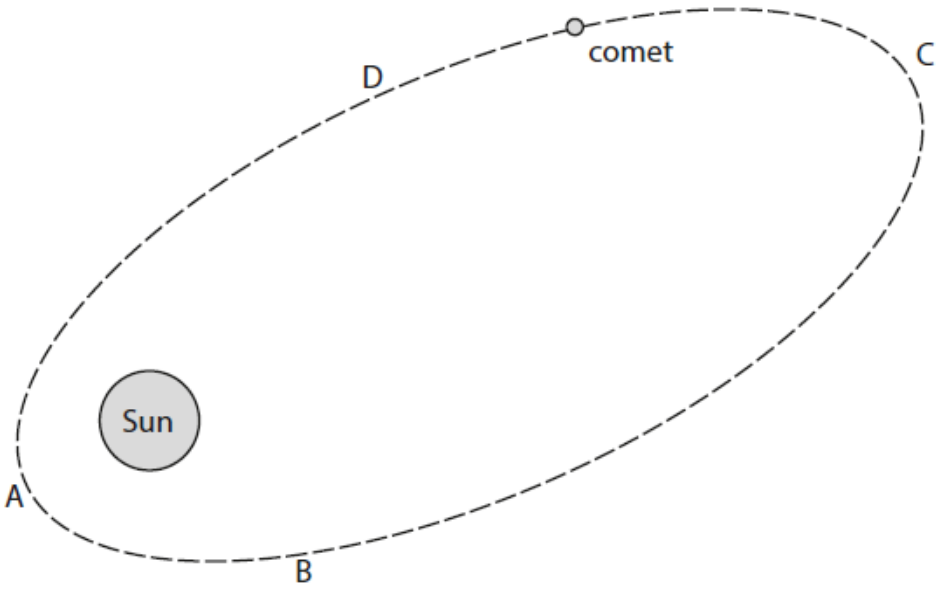
(3)

Space and all the galaxies in it is called the
.....

A large collection of billions of stars is called a
.....

The Sun and its collection of planets and moons is called the
.....

(b) The diagram shows the orbit of a comet around the Sun.



(i) At which point in its orbit is the comet moving fastest?

(1)

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(ii) Name the force that keeps the comet in orbit around the Sun.

(1)

.....

(c) The boxes give some units of time and some definitions.

Draw a straight line from each unit of time to its correct definition.

(2)

Unit of time	Definition
1 day	the time for the Moon to orbit the Earth
	the time for the Earth to rotate once
1 year	the time for the Sun to rotate once
	the time for the Earth to orbit the Sun

(Total for question = 7 marks)

Q5.

The International Space Station (ISS) is a satellite that orbits the Earth at a height of 409 km above the surface of the Earth.

The ISS has an orbital speed of 7.66 km/s and a period of 92.7 minutes.

(a) (i) Calculate the orbital radius of the ISS.

Give your answer to 3 significant figures.

(4)

orbital radius = ... km

(ii) Calculate the radius of the Earth using your value for the orbital radius.

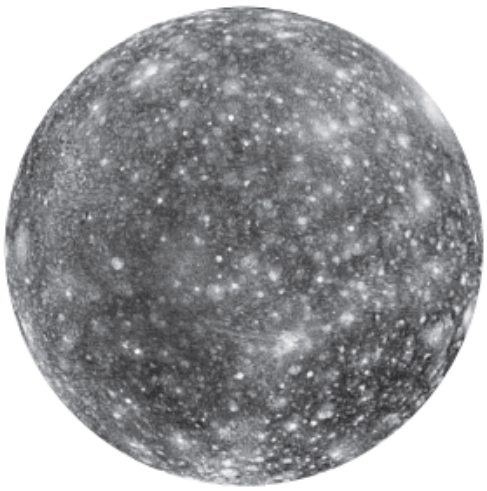
(1)

Earth radius = ... km

(Total for question = 5 marks)

Q6.

The photograph shows Callisto, a moon of the planet Jupiter.



(Source: © Elena11/Shutterstock)

(a) In the space below, draw a labelled diagram to show how Callisto orbits Jupiter.

(2)

(b) Callisto orbits Jupiter at an orbital radius of 1 880 000 km and with an orbital period of 400 hours.

Calculate the orbital speed of Callisto in km/s.

Give your answer to 3 significant figures.

(4)

orbital speed = ... km/s

(c) Callisto has a gravitational field strength of 1.2 N/kg at its surface.

The Earth's moon has a gravitational field strength of 1.6 N/kg at its surface.

(i) Callisto has a larger mass than the Earth's moon.

Suggest why Callisto has a lower gravitational field strength than the Earth's moon.

(1)

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.....

.....

(ii) An object has a weight of 59 N on the surface of the Earth's moon.

Calculate the weight of the same object if it were on the surface of Callisto.

(3)

weight = ... N

(Total for question = 10 marks)

Q7.

(a) Which of these objects orbits a planet?

(1)

☒ **A** comet

☒ **B** dwarf star

☒ **C** galaxy

☒ **D** moon

(b) What is the correct name for our galaxy?

(1)

☒ **A** Crab Nebula

☒ **B** Milky Way

☒ **C** Solar System

☒ **D** Universe

(c) Which of these objects has the largest mass?

(1)

☒ **A** artificial satellite

☒ **B** comet

☒ **C** Earth

☒ **D** Sun

(d) Which of these stars is the coolest?

(1)

☒ **A** blue star

☒ **B** orange star

☒ **C** red star

☒ **D** yellow star

(Total for question = 4 marks)

Q8.

Funcube-1 is a satellite that was launched into orbit around the Earth.



(Source: © Shutterstock)

(a) The rocket carrying Funcube-1 burns fuel to accelerate upwards.

As the rocket burns fuel, the energy in its chemical store reduces and the energy in its kinetic store and gravitational store changes.

(i) State how the kinetic store of the rocket changes as the rocket burns fuel.

(1)

.....

(ii) State how the gravitational store of the rocket changes as the rocket burns fuel.

(1)

.....

(b) The rocket engine stops burning fuel.

The rocket continues to go further away from the surface of the Earth.

The table gives some statements about the rocket's energy stores.

Add ticks (Π) to the table to show which two statements are correct.

(2)

Statement	Correct (✓)
gravitational store increases	
gravitational store stays the same	
gravitational store decreases	
kinetic store increases	
kinetic store stays the same	
kinetic store decreases	

(c) Funcube-1 goes into a circular orbit above the surface of the Earth.

(i) State the name of the force responsible for keeping Funcube-1 in orbit.

(1)

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(ii) Funcube-1 has an orbital radius of 7100 km and an orbital period of 5800 s.

Calculate the orbital speed, in km / s, of Funcube-1.

(2)

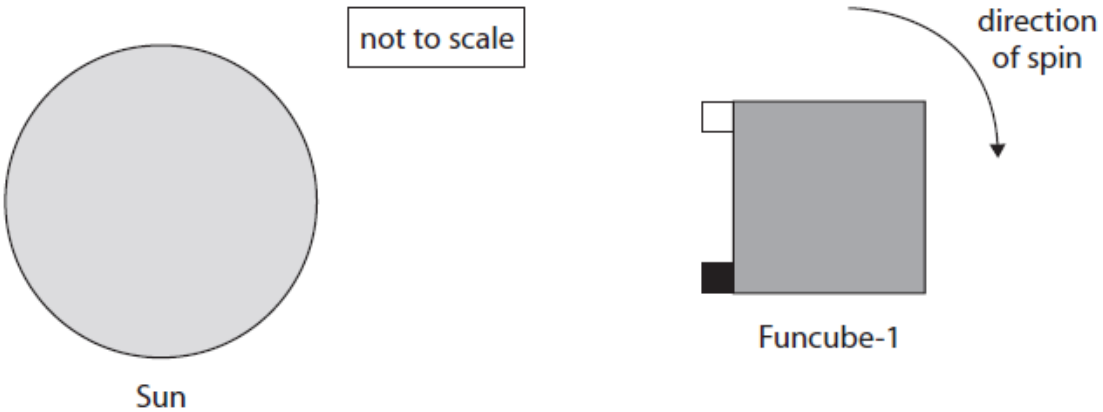
orbital speed = ... km / s

(d) Funcube-1 spins and is heated by the Sun.

The diagram shows two coloured metal bars attached to a face of Funcube-1.

The surface of one metal bar is dull and black.

The surface of the other metal bar is shiny and white.



Temperature probes measure the temperature of each metal bar.

Use ideas about thermal energy transfer to explain how the temperature of each metal bar changes as Funcube-1 spins.

(4)

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(Total for question = 11 marks)

Q9.

The passage describes the evolution of a star with a mass that is much larger than the mass of the Sun.

Use words or phrases from the box to complete the passage.

Each word or phrase may be used once, more than once, or not at all.

(6)

chemical	contract	expand	gravitational
kinetic	main sequence	neutron star	nuclear
protostar	supernova	vibrate	white dwarf

Hydrogen atoms in a nebula move towards each other due to the force of gravity.

As the atoms move towards each other, their ..... energy store increases, which increases the temperature. If the temperature becomes high enough, nuclear fusion of hydrogen will start and the star enters the ..... stage of its evolution.

When hydrogen fusion stops in the core of the star, the core of the star will start to ..... . This increases the temperature in a layer surrounding the core. Hydrogen fusion restarts in a layer surrounding the core.

This causes the star to ..... and its surface temperature decreases. The star is now a red super giant. Eventually nuclear fusion stops in the core of the star and the star explodes as a ..... .

The core of the star collapses to form either a ..... or a black hole.

(Total for question = 6 marks)

Q10.

Main sequence stars can vary in brightness, colour and mass.

Describe the evolution of both low mass stars and high mass stars after they join the main sequence.

(6)

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(Total for question = 6 marks)

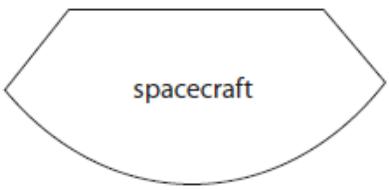
Q11.

Schiaparelli is a spacecraft that was sent to Mars in 2016.

(a) Schiaparelli slowed down as it fell vertically through the atmosphere of Mars.

(i) Draw labelled arrows on the diagram to show the forces acting on Schiaparelli as it fell.

(3)



(ii) Schiaparelli then opened a parachute to slow down.

Explain how the spacecraft reached a low terminal velocity after opening its parachute.

Use ideas about forces in your answer.

(4)

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(b) The parachute was disconnected when Schiaparelli was at a height of 2.0 m from the surface of Mars and travelling at a speed of 0.45 m/s.

Calculate the speed of the spacecraft just before it hits the surface of Mars.
[acceleration of free-fall on Mars = 3.4 m/s^2]

(4)

speed = ... m/s

(c) Suggest why Mars has a lower gravitational field strength than Earth.

(1)

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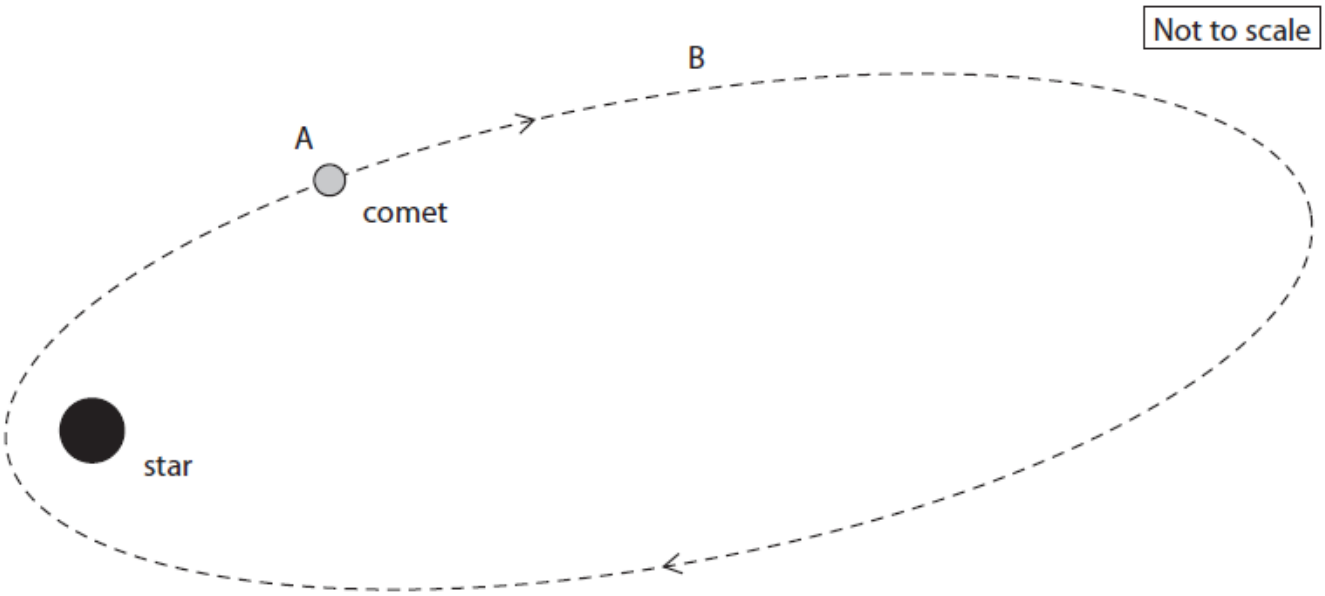
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(Total for question = 12 marks)

Q12.

A comet orbits a star because of the gravitational force between the comet and the star.



(a) Draw an arrow on the diagram to show the gravitational force acting on the comet due to the star.

(1)

(b) Weight is another term used for gravitational force.

At point A on the diagram the comet has a weight of 4.4×10^9 N.

The comet has a mass of 2.2×10^{14} kg.

Calculate the gravitational field strength at point A.

Give a suitable unit for your answer.

(4)

gravitational field strength = ... , unit = ...

(c) The comet moves from point A to point B during its clockwise orbit around the star.

Explain what happens to the gravitational force acting on the comet due to the star as the comet moves from point A to point B.

(3)

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(Total for question = 8 marks)

Q13.

(a) (i) A student investigates how current varies with voltage for a metal filament lamp.

Draw a diagram of the circuit that a student could use for this investigation.

(4)

(ii) Describe a method the student could use for their investigation.

(4)

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(b) The student extends the investigation by recording additional data for the lamp.

This is her method.

For each voltage

- switch the current on for 45 seconds
- record the current and colour of the lamp
- calculate the power and the energy transferred by the lamp

The table shows the student's results.

Voltage in V	Current	Power in W	Energy in J	Colour of lamp
0.0	0.00	0.0	0.0	off
2.0	0.40	0.8	36	red
4.0	0.90	3.6		orange
6.0	1.60	9.6	430	yellow
8.0	2.80	22.4	1000	white

(i) State the unit for current.

(1)

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(ii) Calculate the missing value of energy for the voltage of 4.0 V.

Give your answer to 2 significant figures.

(2)

energy = ... J

(iii) The colour of a star is related to its surface temperature.

The Sun is yellow.

Use the student's results to identify a colour for a star that is cooler than the Sun.

(1)

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(Total for question = 12 marks)

Q14.

This question is about Rigel, a very large star with a high surface temperature.

(a) Stars can appear as different colours because of their different surface temperatures.

Which of these colours shows the highest surface temperature for a star?

(1)

☒ **A** blue-white

☒ **B** orange

☒ **C** red

☒ **D** yellow

(b) Describe how a star is formed in a nebula.

(2)

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(c) Rigel is a main sequence star.

A star joins the main sequence when nuclear fusion of hydrogen starts in its core.

Describe the process of nuclear fusion in a star.

(3)

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(d) Astronomers think that Rigel will become a supernova in the future.

(i) Which property of a star determines whether it will become a supernova?

(1)

☒ **A** colour

☒ **B** distance from Earth

☒ **C** mass

☒ **D** temperature

(ii) Describe the evolution of Rigel after it leaves the main sequence.

(3)

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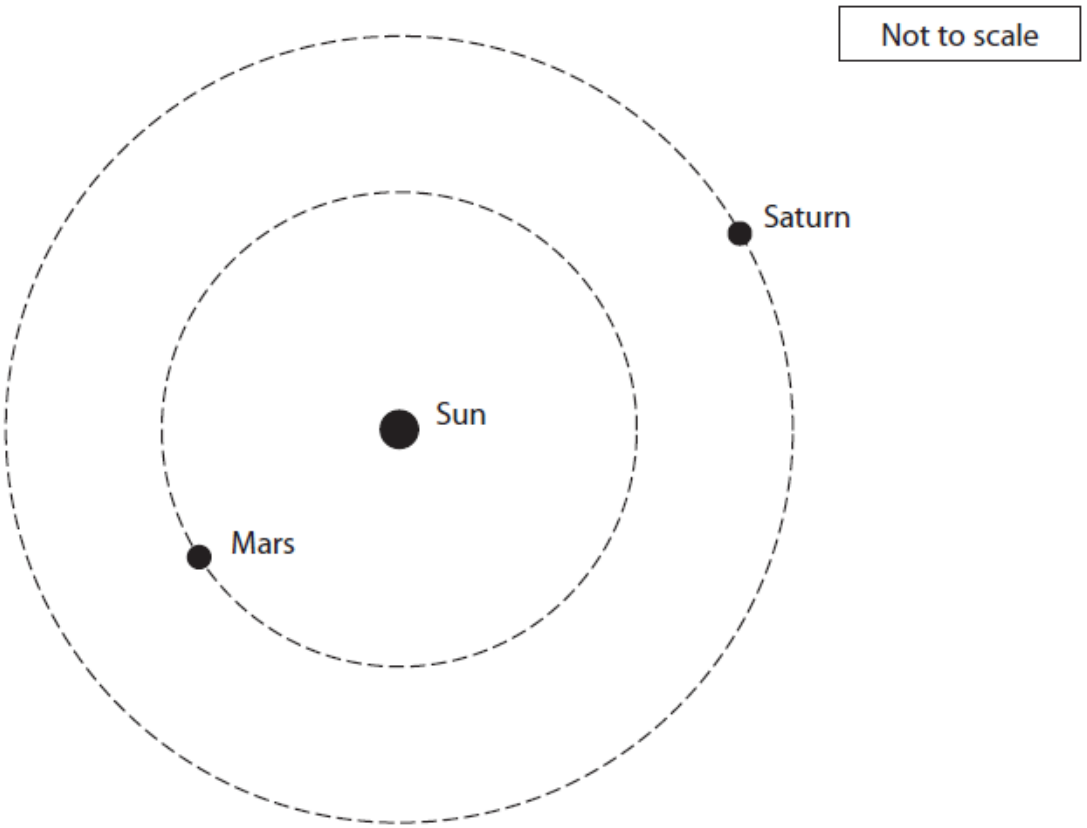
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(Total for question = 10 marks)

Q15.

The planets Mars and Saturn orbit around the same star, the Sun.

(a) The diagram shows the orbital paths of Mars and Saturn.



Draw an orbital path of a comet on the diagram.

(2)

(b) The table gives some information about the orbits of Mars and Saturn.

	Mars	Saturn
Orbital radius in km	2.28×10^8	1.43×10^9
Orbital speed in km/s	24.1	9.70

Mars completes a number of orbits in the time it takes for Saturn to complete one orbit.

Calculate the number of orbits that Mars completes in the time it takes for Saturn to complete one orbit.

(5)

number of orbits = ...

(Total for question = 7 marks)

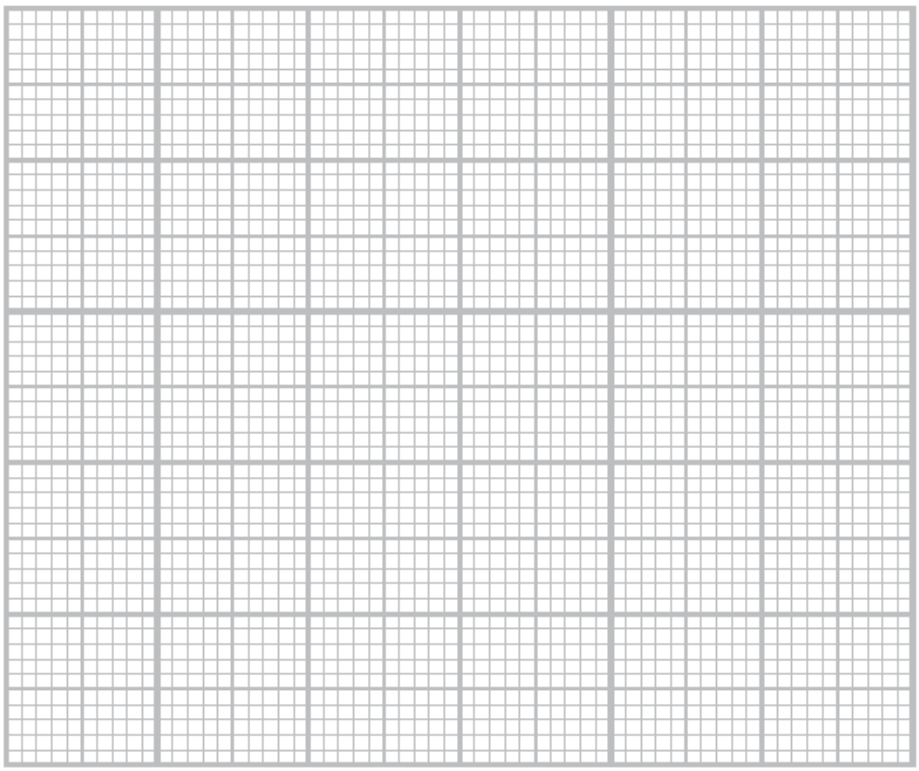
Q16.

The table gives data for some of the planets in the solar system.

Planet	Gravitational field strength at surface in N / kg	Orbital radius in km	Orbital speed in km / s
Mercury	3.7	57.9×10^6	47.4
Venus	8.9	108.2×10^6	35.0
Jupiter	23.1	778.6×10^6	13.1
Saturn	9.0	1433.5×10^6	9.7
Uranus	8.7	2872.5×10^6	6.8
Neptune	12.7	4495.1×10^6	5.4

(a) Plot a bar chart of the gravitational field strength for each planet.

(3)



(b) Suggest why planets have different gravitational field strengths at their surface.

(1)

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(c) Give the relationship shown by the data in the table between the orbital radius and the orbital speed for the planets in the solar system.

(1)

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(d) Calculate the time period of Mercury's orbit around the Sun.

(3)

time period = ... s

(Total for question = 8 marks)

Q17.

This question is about satellites and their orbits.

(a) (i) State a difference between an artificial satellite's orbit and a planet's orbit.

(1)

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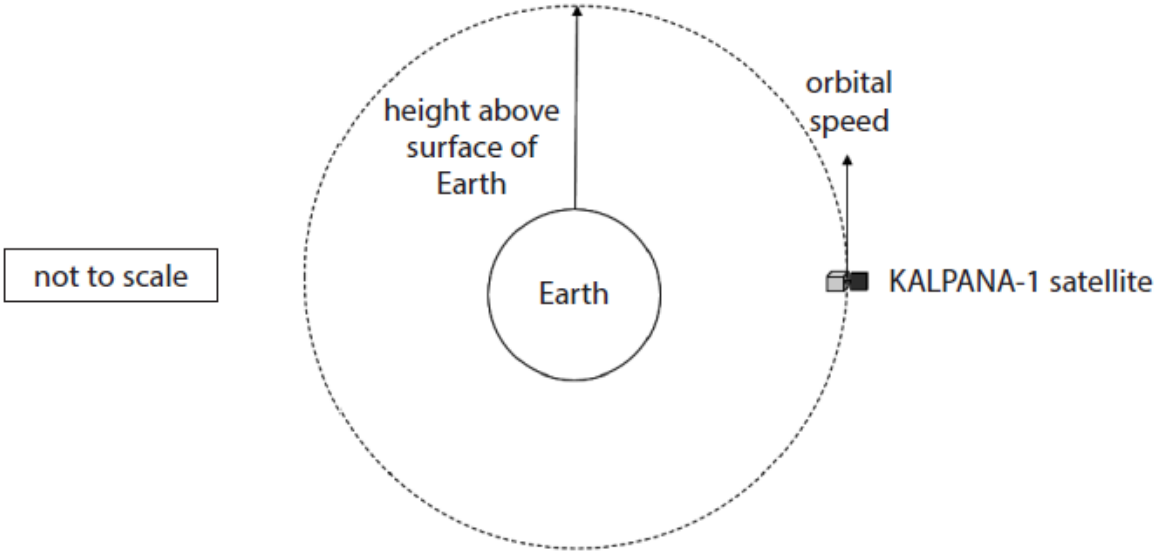
(ii) State a similarity between an artificial satellite's orbit and a moon's orbit.

(1)

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(b) KALPANA-1 was an artificial satellite used to monitor the weather.

(i) The diagram shows the orbit of the satellite.



KALPANA-1 has an orbital speed of 3.1 km/s and completes one orbit in 24 hours.

Calculate the height of KALPANA-1's orbit above the Earth's surface.

[radius of Earth = 6400 km]

(4)

height above surface = ... km

(ii) The Doppler effect occurs when there is relative motion between the source of waves and the observer of the waves.

Explain how the Doppler effect causes a change in the observed frequency of the waves.

(3)

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(iii) Suggest why the radio waves from KALPANA-1 detected on the Earth's surface are **not** affected by the Doppler effect.

(2)

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(Total for question = 11 marks)

Q18.

This question is about stars.

(a) Describe the stages in the evolution of a star similar in mass to the Sun.

(4)

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(b) The process of energy release in the core of a star is different to the process of energy release in a nuclear reactor in a power station.

Describe how these processes of energy release are different.

(3)

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(Total for question = 7 marks)

Q19.

Table 1 shows the colour of some stars.

Star	Colour
Sun	yellow
Rigel	blue
Betelgeuse	red
Arcturus	orange
Sirius	white

Table 1

(a) Complete table 2 by giving the stars in order of increasing surface temperature.

The hottest star, Rigel, has been done for you.

(3)

Coolest → Hottest				
				Rigel

Table 2

(b) A star has a much larger mass than the Sun.

Describe the evolution of this star after it has left the main sequence.

(3)

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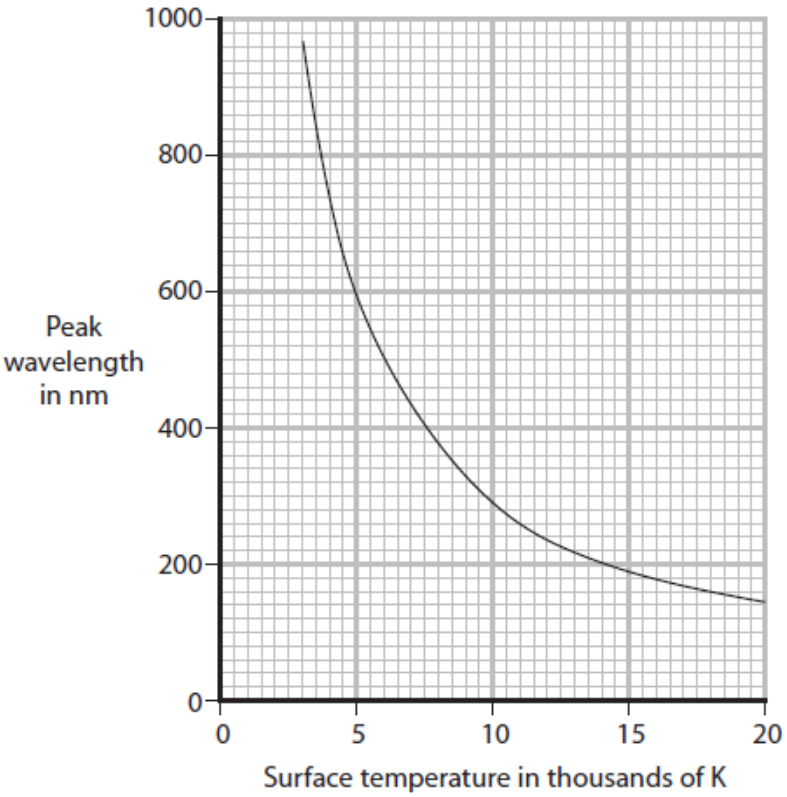
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(c) The graph shows the relationship between the peak wavelength of light emitted by a star and the surface temperature of the star.



A scientist suggests that the two variables are linked by this formula.

peak wavelength × surface temperature = constant

Use data from the graph to justify this formula.

(4)

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(Total for question = 10 marks)

Q20.

This question is about stars.

(a) Table 1 gives some information about four stars.

Star	Colour	Mass relative to the Sun
61 Cygni A	orange	0.7
Antares A	red	12
Sirius B	blue	1.0
Vega	blue-white	2.1

Table 1

(i) Stars can be classified using their surface temperature.

Complete Table 2 by giving the four stars in order of increasing surface temperature.

(3)

Coolest	→		Hottest

Table 2

(ii) Name the star in Table 1 that does **not** follow a similar evolutionary path to the Sun.

(1)

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(b) The life cycle of a star begins in a nebula.

Describe how a main sequence star is formed from a nebula.

(3)

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(c) Describe how a main sequence star becomes a white dwarf.

(4)

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(Total for question = 11 marks)

Q21.

The Sun is a low-mass star.

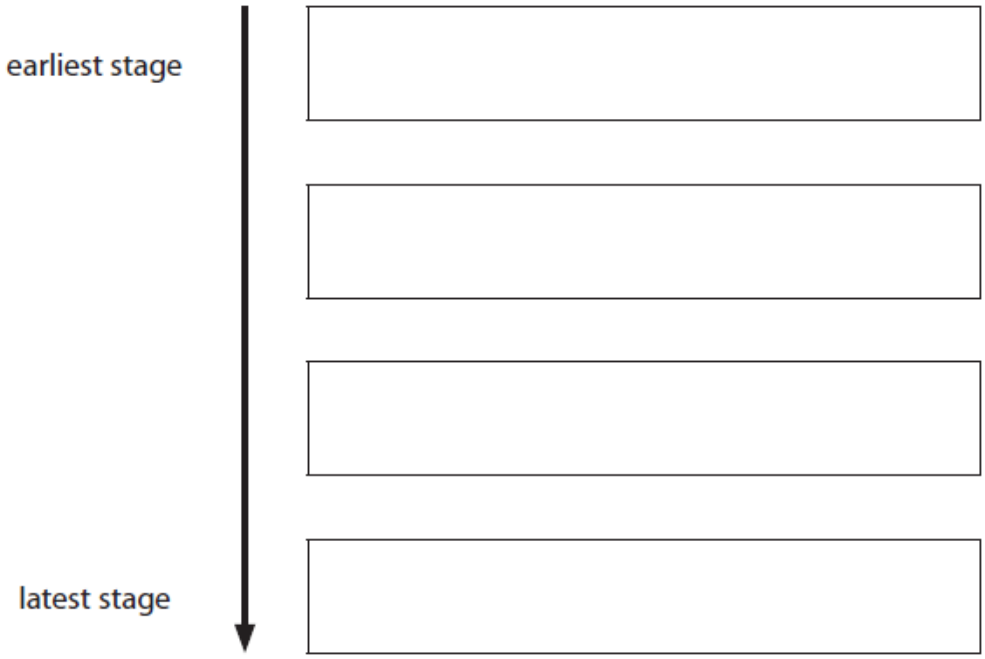
(a) The box lists some of the stages in the evolution of a low-mass star.

white dwarf	main sequence	nebula	red giant

Give these stages in the evolution of a low-mass star in the correct order.

Start with the earliest stage.

(3)



(b) State the name given to a large collection of billions of stars.

(1)

.....

(c) State the property of a star that determines its colour.

(1)

.....

(Total for question = 5 marks)

Q22.

The Sun is a main sequence star.

In the Sun, hydrogen nuclei are changed into helium nuclei, releasing energy.

(a) Name the process that changes hydrogen into helium.

(1)

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(b) Describe the evolution of the Sun when it leaves the main sequence.

(2)

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(c) The Sun's core has a mass of approximately 7×10^{29} kg.

Approximately 75% of the mass of the core is hydrogen.

(i) Calculate the approximate mass of hydrogen in the Sun's core.

(1)

mass of hydrogen = ... kg

(ii) When most of the hydrogen nuclei in the Sun's core have been changed into helium nuclei the Sun will leave the main sequence.

The Sun's core loses approximately 9×10^{19} kg of hydrogen each year.

Estimate the time until the Sun leaves the main sequence.

Give your answer to one significant figure.

(2)

time = ... years

(Total for question = 6 marks)

Q23.

(a) Give a similarity and a difference between the orbit of a planet and the orbit of a moon.

You may draw a diagram to support your answer.

(2)

similarity

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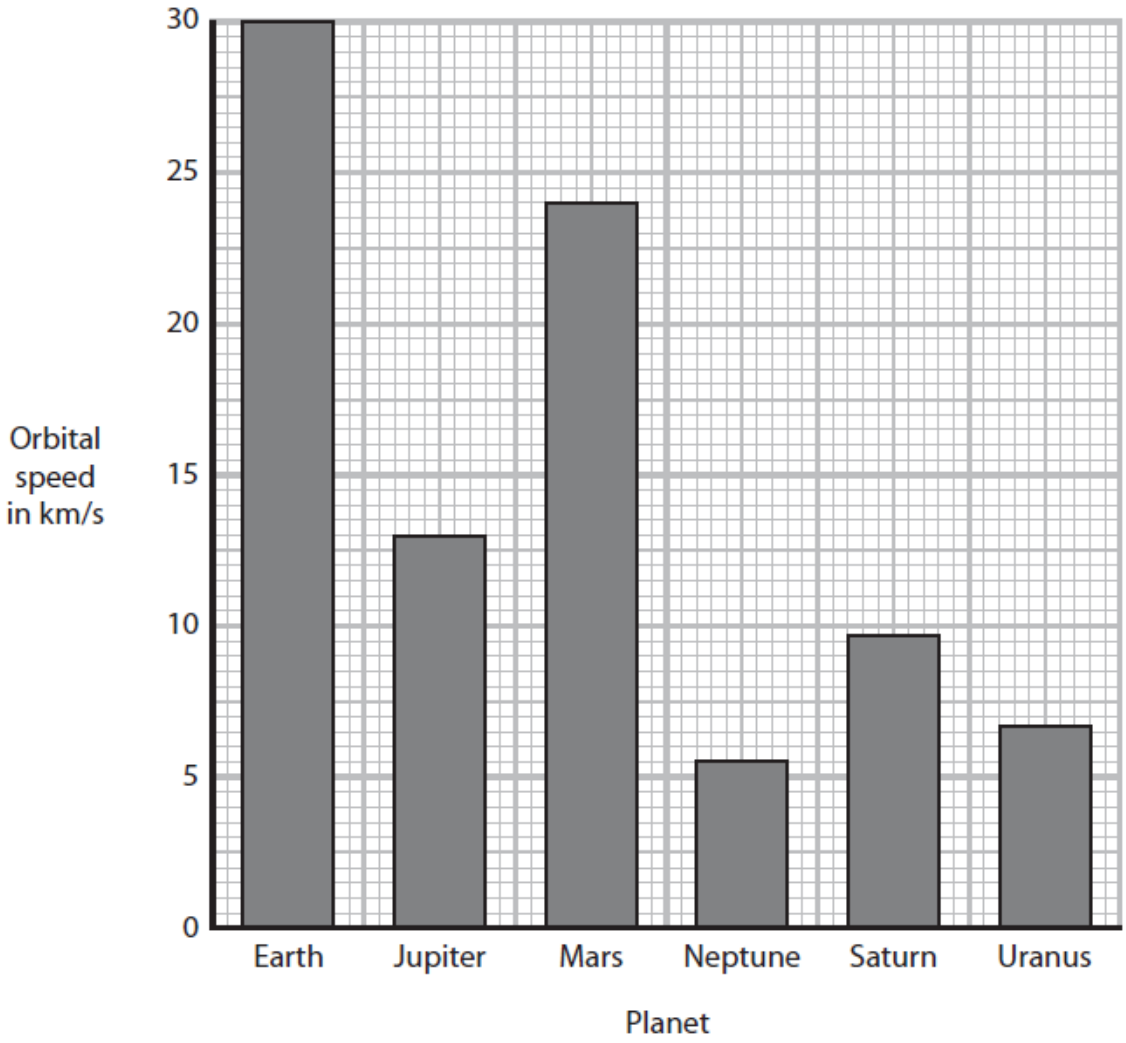
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difference

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(b) The bar chart shows the mean orbital speed for six planets in the solar system.



(i) Give a reason why a bar chart is used to show this data.

(1)

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(ii) Using information from the bar chart, determine the ratio of the orbital speed of Jupiter to the orbital speed of Uranus.

(3)

ratio = ...

(iii) Suggest a reason why Earth has the largest orbital speed, for the planets shown.

(1)

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(Total for question = 7 marks)

Q24.

(a) (i) Which of these coloured stars has the highest surface temperature?

(1)

☒ **A** orange

☒ **B** red

☒ **C** white

☒ **D** yellow

(ii) Which of these is a stage in the life cycle of the Sun?

(1)

☒ **A** black hole

☒ **B** neutron star

☒ **C** supernova

☒ **D** white dwarf

(iii) Which of these is the stage nearest the end of the life cycle of a star with a mass much greater than the Sun?

(1)

☒ **A** main sequence

☒ **B** protostar

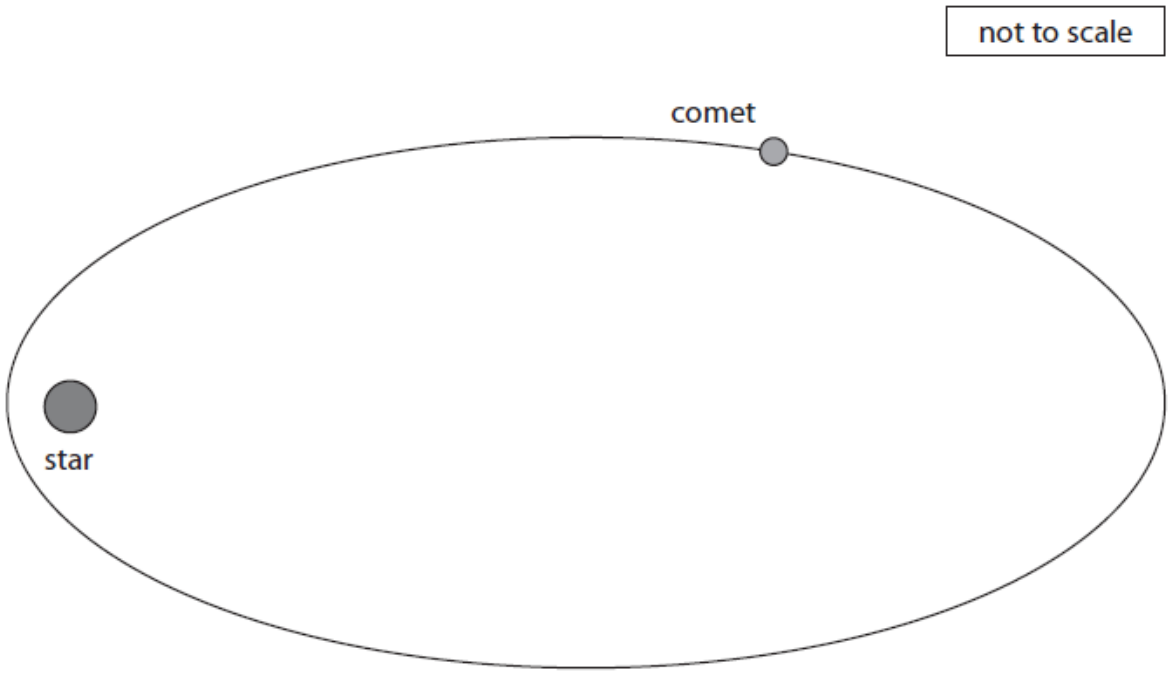
☒ **C** supernova

☒ **D** white dwarf

(b) The diagram shows the orbit of a comet around a star.

Draw a labelled arrow to show the force acting on the comet due to the star.

(2)

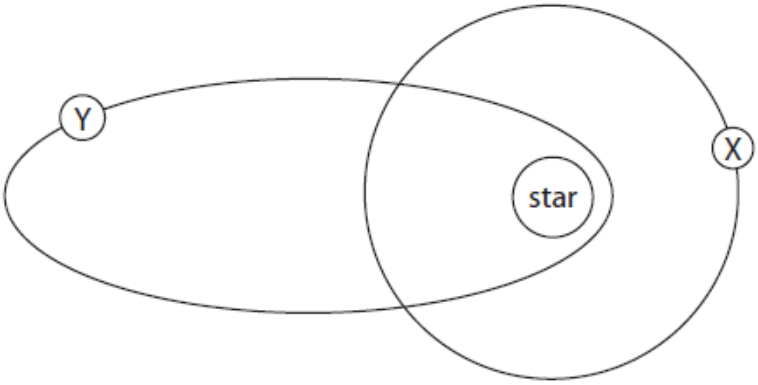


(Total for question = 5 marks)

Q25.

The diagram shows two objects orbiting a star.

not to scale



(a) Object X has a circular orbit around the star.

State the type of object that has a circular orbit around a star.

(1)

.....

(b) Object Y has an elliptical orbit around the star.

State the type of object that has an elliptical orbit around a star.

(1)

.....

(c) Object X completes an orbit of the star in 35 days.

The radius of its orbit is 1.5×10^{11} m.

Calculate the orbital speed of object X.

(3)

orbital speed = ... m/s

(Total for question = 5 marks)

Q26.

This question is about the Sun.

(a) The Solar System consists of the Sun and other astronomical objects.

Complete the diagram to show how a planet and a comet orbit the Sun.

(2)



(b) The Sun is a yellow main sequence star.

(i) Name the evolutionary stage of the Sun before it became a main sequence star.

(1)

.....

(ii) The colour of a star is related to its surface temperature.

Explain what will happen to the colour of the Sun after it leaves the main sequence.

(2)

.....

.....

.....

.....

(c) The Sun emits a stream of charged particles called the solar wind.

The solar wind contains high-energy alpha and beta particles.

(i) Describe three differences between alpha and beta particles.

(3)

1 .....

.....

.....

2 .....

.....

.....

3 .....

.....

.....

(ii) A spacecraft travels through the Sun's solar wind on its journey from Earth to Mars.

Explain why the solar wind does not make the spacecraft radioactive.

(2)

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.....

(Total for question = 10 marks)