AQA GCSE Physics | 8463

SPECIFICATION POINT 4.8.1.3

Orbital motion, natural and artificial satellites

Past-paper questions

Tier	**Foundation**
Question groups	**56**
Available paper years	**2003–2025**

Using this booklet

1. Answer the questions in order and show your working.
2. Original question numbers and marks are retained.
3. Print at actual size (100%) for measuring questions.
4. Use the companion answer booklet to check your work.

Name: _____ **Date:** _____

Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

4.8.1.3 Orbital motion, natural and artificial satellites

Question 01

June 2003 | 3451F | Original Q3 | Legacy

3 (a) In the box are the names of five waves.

infra red	**microwaves**	**ultrasonic**	**ultraviolet**	**X-rays**

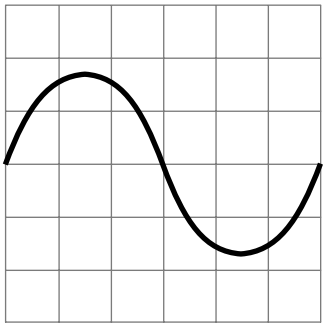
Which wave is used to:

(i) send information to a satellite, ...
(1 mark)

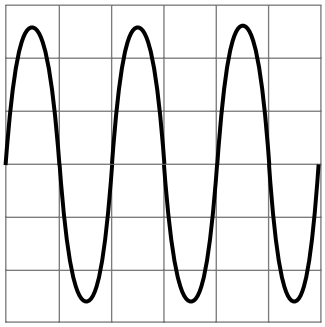
(ii) toast bread, ...
(1 mark)

(iii) clean a valuable ring? .....
(1 mark)

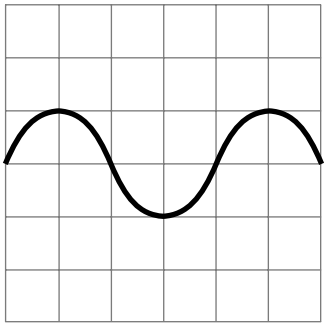
(b) The diagram shows four oscilloscope wave traces. The controls of the oscilloscope were the same for each wave trace.



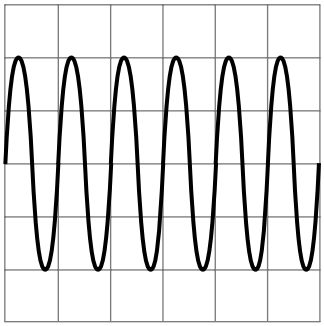
A



B



C



D

Which **one** of the waves traces, **A**, **B**, **C** or **D**, has:

(i) the largest amplitude, ...
(1 mark)

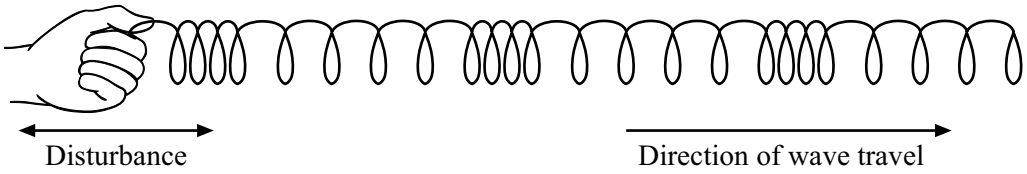
(ii) the lowest frequency? .....
(1 mark)

4.8.1.3 Orbital motion, natural and artificial satellites

Question 01 · continued

MARGIN BLANK

(c) The diagram shows a longitudinal wave in a stretched spring.



Complete the sentence. You should put only **one** word in each space.

A longitudinal wave is one in which the ..... causing the wave is in the same ..... as that in which the wave moves.

(2 marks)

(d) Which **one** of the following types of wave is longitudinal? Draw a ring around your answer.

light wave **sound wave** **water wave**

(1 mark)

8

4.8.1.3 Orbital motion, natural and artificial satellites

Question 02

June 2003 | 3451F | Original Q15 | Legacy

15 (a) The table gives information about some planets.

Name of planet	Gravitational field strength in N/kg	Diameter of planet in thousands of km	Time for 1 orbit around the sun in years
Mercury	4	4.9	0.2
Venus	9	12.0	0.6
Earth	10	12.8	1.0
Jupiter	26	143.0	12.0

(i) Write down the equation that links gravitational field strength, mass and weight.

.....

(1 mark)

(ii) An astronaut has a mass of 75 kg. Calculate the weight of the astronaut on Venus. Show clearly how you work out your answer.

.....

.....

Weight of astronaut = ...newtons

(2 marks)

(iii) Why would the astronaut weigh more on the Earth than on Venus?

.....

.....

(1 mark)

(iv) The radius of the orbit of Jupiter is greater than the radius of the orbit of Mercury, Venus or the Earth. What evidence is given in the table to show this?

.....

.....

(1 mark)

4.8.1.3 Orbital motion, natural and artificial satellites

Question 02 · continued

MARGIN BLANK

(b) *To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.*

Explain briefly how stars like the Sun are thought to have been formed.

.....

.....

.....

.....

(2 marks)

7

4.8.1.3 Orbital motion, natural and artificial satellites

Question 03

June 2003 | 3462F3 | Original Q3 | Legacy

3 (a) In the box are the names of five waves.

infra red	**microwaves**	**ultrasonic**	**ultraviolet**	**X-rays**

Which wave is used to:

(i) send information to a satellite, ...

(1 mark)

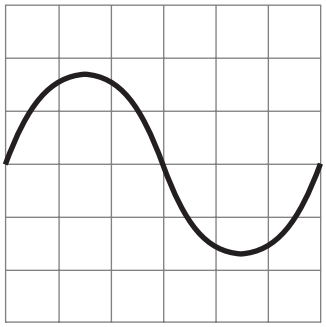
(ii) toast bread, ...

(1 mark)

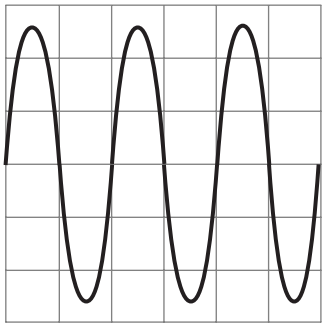
(iii) clean a valuable ring? .....

(1 mark)

(b) The diagram shows four oscilloscope wave traces. The controls of the oscilloscope were the same for each wave trace.



A



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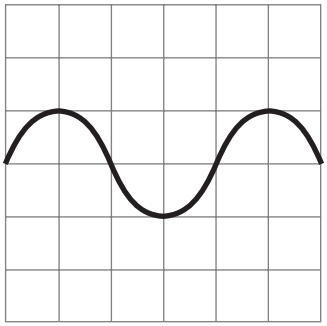
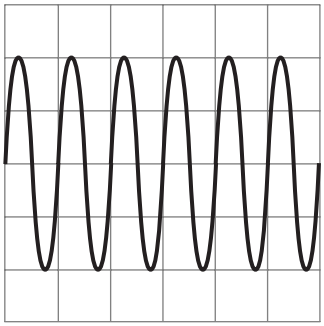


C



D

Which **one** of the waves traces, **A**, **B**, **C** or **D**, has:

(i) the largest amplitude, ...

(1 mark)

(ii) the lowest frequency? .....

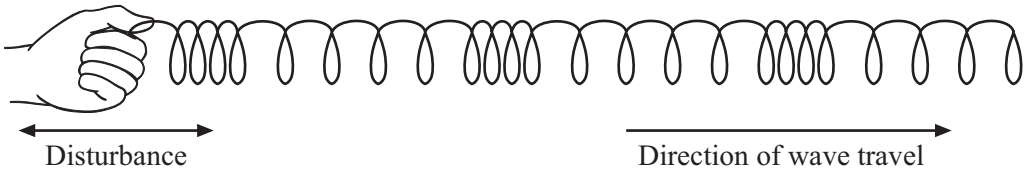
(1 mark)

4.8.1.3 Orbital motion, natural and artificial satellites

Question 03 · continued

MARGIN BLANK

(c) The diagram shows a longitudinal wave in a stretched spring.



Complete the sentence. You should put only **one** word in each space.

A longitudinal wave is one in which the ..... causing the wave is in the same ..... as that in which the wave moves.

(2 marks)

(d) Which **one** of the following types of wave is longitudinal? Draw a ring around your answer.

light wave **sound wave** **water wave**

(1 mark)

8

4.8.1.3 Orbital motion, natural and artificial satellites

Question 04

June 2003 | 3462F3 | Original Q13 | Legacy

13 (a) The table gives information about some planets.

Name of planet	Gravitational field strength in N/kg	Diameter of planet in thousands of km	Time for 1 orbit around the sun in years
Mercury	4	4.9	0.2
Venus	9	12.0	0.6
Earth	10	12.8	1.0
Jupiter	26	143.0	12.0

(i) Write down the equation that links gravitational field strength, mass and weight.

.....

(1 mark)

(ii) An astronaut has a mass of 75 kg. Calculate the weight of the astronaut on Venus. Show clearly how you work out your answer.

.....

.....

Weight of astronaut = ...newtons

(2 marks)

(iii) Why would the astronaut weigh more on the Earth than on Venus?

.....

.....

(1 mark)

(iv) The radius of the orbit of Jupiter is greater than the radius of the orbit of Mercury, Venus or the Earth. What evidence is given in the table to show this?

.....

.....

(1 mark)

4.8.1.3 Orbital motion, natural and artificial satellites

Question 04 · continued

MARGIN
BLANK

(b) *To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.*

Explain briefly how stars like the Sun are thought to have been formed.

.....

.....

.....

.....

(2 marks)

7

4.8.1.3 Orbital motion, natural and artificial satellites

Question 05

June 2004 | 3451F | Original Q1 | Legacy

1 (a) Complete the sentences by choosing the correct word or phrase from the box.

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

circular	**comet**	**elliptical**	**Milky Way**
Moon	**solar system**	**Universe**	

A planet and a ..... both move in ..... orbits around the Sun.

The Sun is part of the ..... galaxy.

The ..... contains at least a billion galaxies. *(4 marks)*

(b) The following sentences describe the stages that a star such as the Sun goes through during its life.

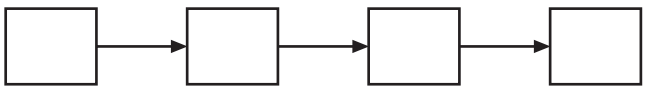
A The star is stable.

B The star contracts to a white dwarf.

C The star expands into a red giant.

D The star is formed when the force of gravity pulls dust and gases together.

(i) Arrange the sentences in the order in which the stages happen.



(3 marks)

(ii) The Sun is at which stage in its life, **A**, **B**, **C** or **D**?

.....

(1 mark)

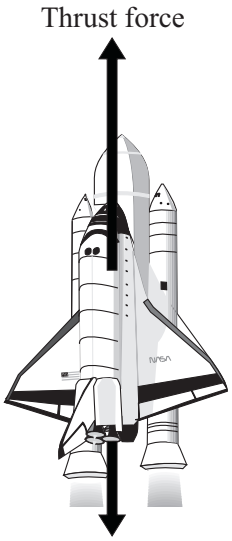
8

4.8.1.3 Orbital motion, natural and artificial satellites

Question 06

June 2004 | 3451F | Original Q12 | Legacy

12 (a) The arrows in the diagram represent the size and direction of the forces on a space shuttle, fuel tank and booster rockets one second after launch. The longer the arrow the bigger the force.



(i) Describe the upward motion of the space shuttle one second after launch.

.....

(1 mark)

(ii) By the time it moves out of the Earth's atmosphere, the total weight of the space shuttle, fuel tank and booster rockets has decreased and so has the air resistance.

How does this change the motion of the space shuttle? (Assume the thrust force does not change).

.....

(1 mark)

(b) The space shuttle takes 9 minutes to reach its orbital velocity of 8100 m/s.

(i) Write down the equation that links acceleration, change in velocity and time taken.

.....

(1 mark)

(ii) Calculate, in m/s^2, the average acceleration of the space shuttle during the first 9 minutes of its flight. Show clearly how you work out your answer.

.....

.....

average acceleration =.....m/s^2

(2 marks)

4.8.1.3 Orbital motion, natural and artificial satellites

Question 06 · continued

MARGIN BLANK

(iii) How is the velocity of an object different from the speed of an object?

.....

.....

(1 mark)

(c) The space shuttle can stay in orbit around the Earth for several weeks.



Not to scale

Explain why the space shuttle stays in orbit and does not fall to the Earth.

.....

.....

.....

.....

(2 marks)

(d) As the shuttle returns to Earth, friction causes its outside temperature to go as high as 1200ºC.

Why is the underneath of the shuttle covered with black tiles?

.....

.....

(1 mark)

9

4.8.1.3 Orbital motion, natural and artificial satellites

Question 07

June 2004 | 3462F3 | Original Q1 | Legacy

1 (a) Complete the sentences by choosing the correct word or phrase from the box.

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

circular	**comet**	**elliptical**	**Milky Way**
Moon	**solar system**	**Universe**	

A planet and a ..... both move in ..... orbits around the Sun.

The Sun is part of the ..... galaxy.

The ..... contains at least a billion galaxies. *(4 marks)*

(b) The following sentences describe the stages that a star such as the Sun goes through during its life.

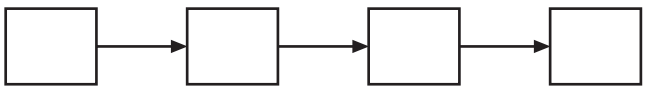
A The star is stable.

B The star contracts to a white dwarf.

C The star expands into a red giant.

D The star is formed when the force of gravity pulls dust and gases together.

(i) Arrange the sentences in the order in which the stages happen.



(3 marks)

(ii) The Sun is at which stage in its life, **A**, **B**, **C** or **D**?

.....

(1 mark)

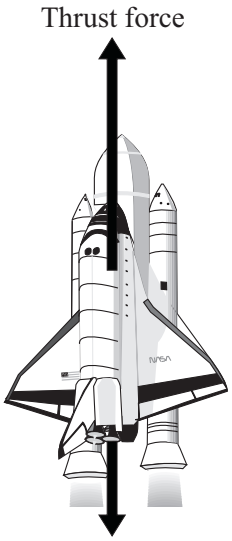
8

4.8.1.3 Orbital motion, natural and artificial satellites

Question 08

June 2004 | 3462F3 | Original Q10 | Legacy

10 (a) The arrows in the diagram represent the size and direction of the forces on a space shuttle, fuel tank and booster rockets one second after launch. The longer the arrow the bigger the force.



(i) Describe the upward motion of the space shuttle one second after launch.

.....

(1 mark)

(ii) By the time it moves out of the Earth's atmosphere, the total weight of the space shuttle, fuel tank and booster rockets has decreased and so has the air resistance.

How does this change the motion of the space shuttle? (Assume the thrust force does not change).

.....

(1 mark)

(b) The space shuttle takes 9 minutes to reach its orbital velocity of 8100 m/s.

(i) Write down the equation that links acceleration, change in velocity and time taken.

.....

(1 mark)

(ii) Calculate, in m/s^2, the average acceleration of the space shuttle during the first 9 minutes of its flight. Show clearly how you work out your answer.

.....

.....

average acceleration =.....m/s^2

(2 marks)

4.8.1.3 Orbital motion, natural and artificial satellites

Question 08 · continued

1 /

MARGIN BLANK

(iii) How is the velocity of an object different from the speed of an object?

.....

.....

(1 mark)

(c) The space shuttle can stay in orbit around the Earth for several weeks.



Not to scale

Explain why the space shuttle stays in orbit and does not fall to the Earth.

.....

.....

.....

.....

(2 marks)

(d) As the shuttle returns to Earth, friction causes its outside temperature to go as high as 1200°C.

Why is the underneath of the shuttle covered with black tiles?

.....

.....

(1 mark)

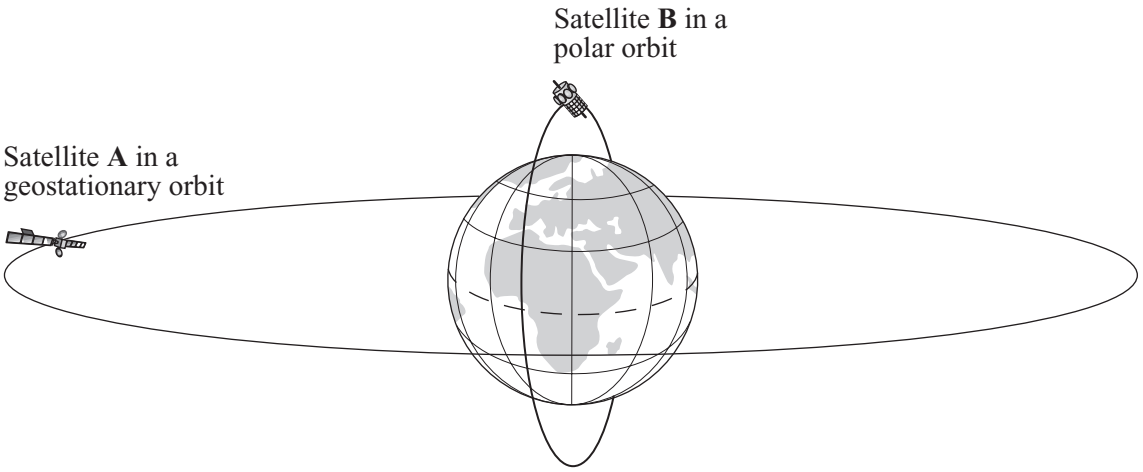
9

4.8.1.3 Orbital motion, natural and artificial satellites

Question 09

June 2005 | 3451 | Original Q1 | Legacy

1 The diagram shows two satellites orbiting the Earth.



The two satellites have the same mass.

(a) Complete the following sentences by crossing out the **two** lines in each box that are wrong.

(i) The time for one orbit by satellite **B** is

less than
the same as
more than

the time for one orbit by satellite **A**.

(1 mark)

(ii) The force of attraction between the Earth and satellite **B** is

less than
the same as
more than

the force of attraction between the Earth and satellite **A**.

(1 mark)

(b) A communication satellite is put into a *geostationary* orbit.

Describe a *geostationary* orbit.

.....

.....

.....

.....

(2 marks)

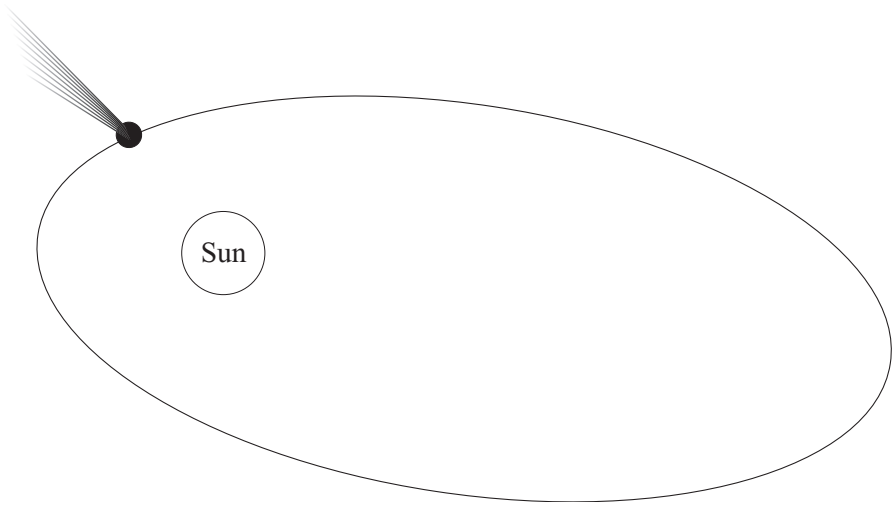
4

4.8.1.3 Orbital motion, natural and artificial satellites

Question 10

June 2005 | 3451 | Original Q2 | Legacy

2 (a) The diagram shows an object in orbit around the Sun.



Which **one** of the following is the object most likely to be?

Draw a ring around your answer.

comet **moon** **planet** **star**

(1 mark)

(b) The Sun is part of the Milky Way galaxy.
What is a galaxy?

.....

(1 mark)

(c) Complete the following sentence by choosing the correct words from the box.
Each word may be used once or not at all.

dwarf	**giant**	**neutron**	**proton**	**supernova**

If a red ..... star is large enough, it may eventually blow up in an explosion called a ....., leaving behind a very dense ..... star.

(3 marks)

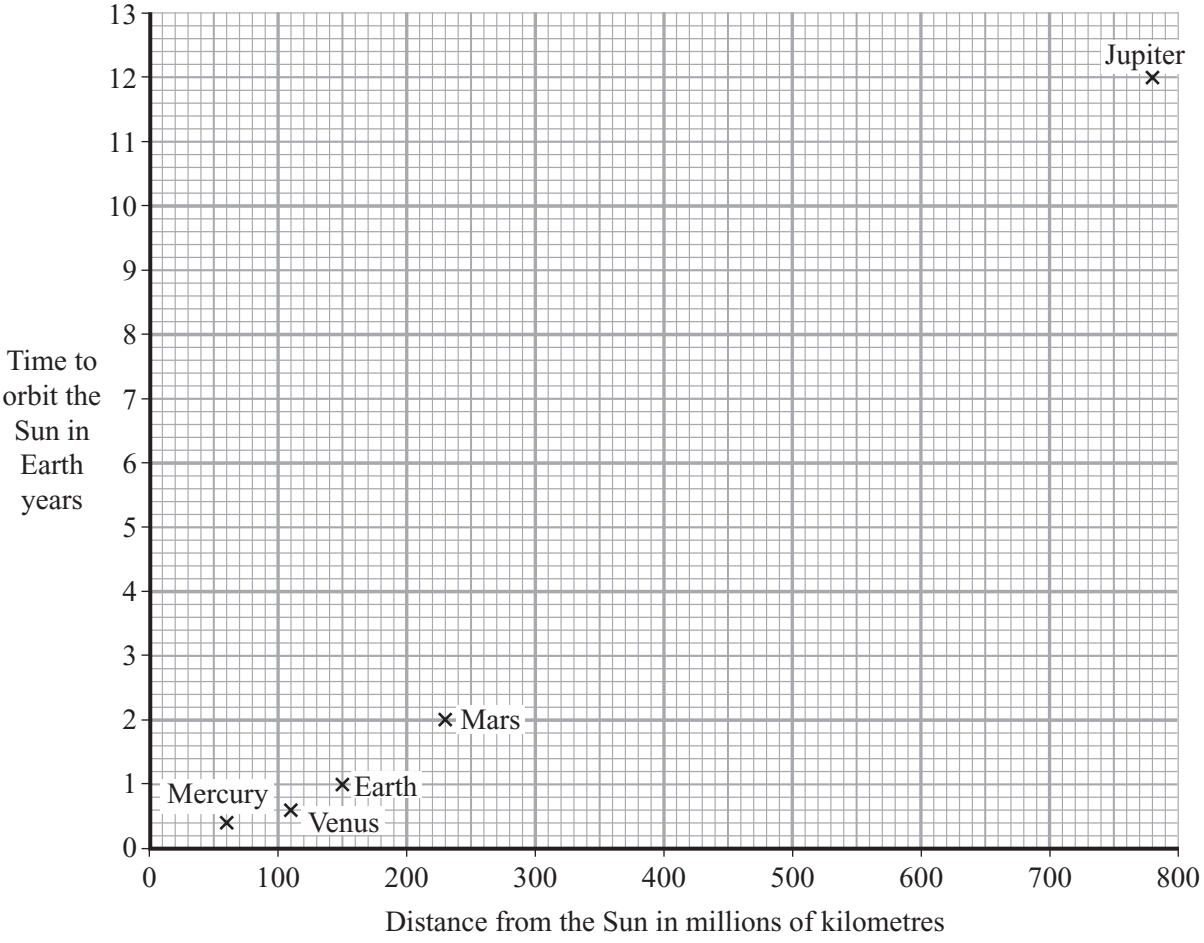
5

4.8.1.3 Orbital motion, natural and artificial satellites

Question 11

June 2005 | 3451 | Original Q12 | Legacy

12 (a) The chart shows that the time taken by a planet to orbit the Sun depends on its distance from the Sun.



(i) How does the time taken by a planet to orbit the Sun depend on the distance the planet is from the Sun?

.....

.....

(1 mark)

(ii) Asteroids orbit the Sun. One asteroid is 550 million kilometres from the Sun.

Estimate how long this asteroid takes to orbit the Sun.

Time to orbit the Sun = ... Earth years

(1 mark)

4.8.1.3 Orbital motion, natural and artificial satellites

Question 11 · continued

MARGIN BLANK

(b) The atmosphere on Venus contains a large percentage of a greenhouse gas.

	Mercury	Venus	Earth
Average surface temperature	230 °C	470 °C	20 °C

(i) Which **one** of these gases increases the greenhouse effect? Draw a ring around your answer.

argon **carbon dioxide** **nitrogen** **oxygen**

(1 mark)

(ii) Explain how the information in the table and the chart shows that the atmosphere of Venus produces a greenhouse effect.

.....

.....

.....

.....

(2 marks)

5

TURN OVER FOR THE NEXT QUESTION

4.8.1.3 Orbital motion, natural and artificial satellites

Question 12

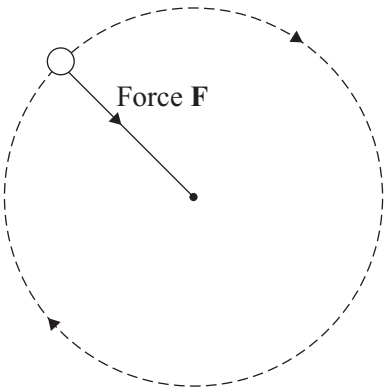
June 2005 | 3451 | Original Q15 | Legacy

15 (a) A student has fastened a ball to a piece of string and is swinging it round in a horizontal circle.



(i) The diagram below shows an overhead view of the movement of the ball.

Add an arrow, from the centre of the ball, to show the direction in which the ball would move if the string broke at this instant.



(1 mark)

(ii) Complete the table to show how force **F** changes if the student changes what he is doing. In each case, all the other factors stay the same.

If the student	Force F needs to
uses a ball with a greater mass	.....
swings the ball at a greater speed	.....
swings the ball with a shorter piece of string	.....

(3 marks)

4.8.1.3 Orbital motion, natural and artificial satellites

Question 12 · continued

MARGIN
BLANK

(b) The Moon orbits the Earth in a circular path.

Use words from the box to complete the **three** spaces in the sentence.

direction	**resistance**	**speed**	**velocity**

You may use each word once, more than once or not at all.

The Moon's ..... is constant but its ..... changes because its ..... changes.

(2 marks)

(c) When any object moves in a circular, or nearly circular, path a force must act towards the centre of the circle.

(i) What word is used to describe this force?

.....

(1 mark)

(ii) The Moon orbits the Earth. What provides the force towards the Earth?

.....

(1 mark)

(iii) In an atom, name the particles which are moving in circular paths around the nucleus.

.....

(1 mark)

(iv) In the case of an atom, what word describes the forces which keep these particles moving in circular paths around the nucleus?

.....

(1 mark)

10

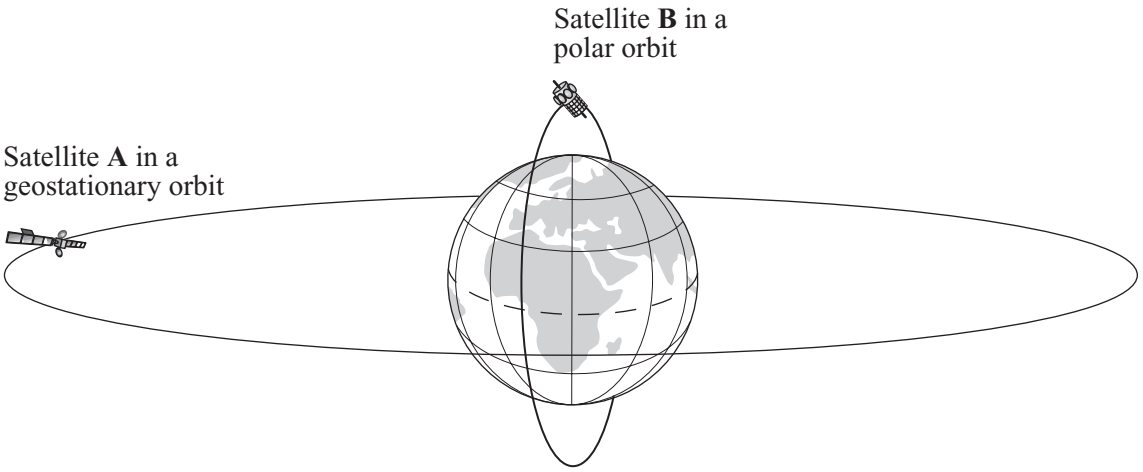
TURN OVER FOR THE NEXT QUESTION

4.8.1.3 Orbital motion, natural and artificial satellites

Question 13

June 2005 | 3462 | Original Q1 | Legacy

1 The diagram shows two satellites orbiting the Earth.



The two satellites have the same mass.

(a) Complete the following sentences by crossing out the **two** lines in each box that are wrong.

(i) The time for one orbit by satellite **B** is

less than
the same as
more than

the time for one orbit by satellite **A**.

(1 mark)

(ii) The force of attraction between the Earth and satellite **B** is

less than
the same as
more than

the force of attraction between the Earth and satellite **A**.

(1 mark)

(b) A communication satellite is put into a *geostationary* orbit.

Describe a *geostationary* orbit.

.....

.....

.....

.....

(2 marks)

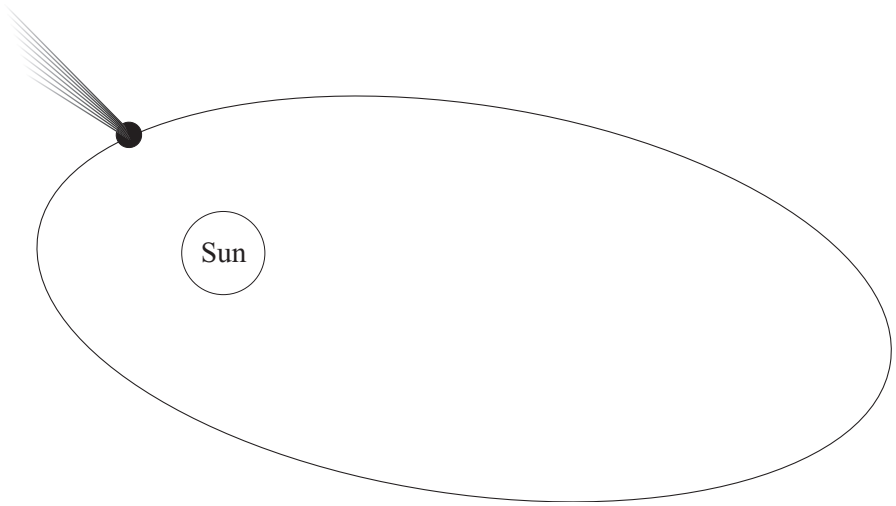
4

4.8.1.3 Orbital motion, natural and artificial satellites

Question 14

June 2005 | 3462 | Original Q2 | Legacy

2 (a) The diagram shows an object in orbit around the Sun.



Which **one** of the following is the object most likely to be?

Draw a ring around your answer.

comet **moon** **planet** **star**

(1 mark)

(b) The Sun is part of the Milky Way galaxy.
What is a galaxy?

.....

(1 mark)

(c) Complete the following sentence by choosing the correct words from the box.
Each word may be used once or not at all.

dwarf	**giant**	**neutron**	**proton**	**supernova**

If a red ..... star is large enough, it may eventually blow up in an explosion called a ....., leaving behind a very dense ..... star.

(3 marks)

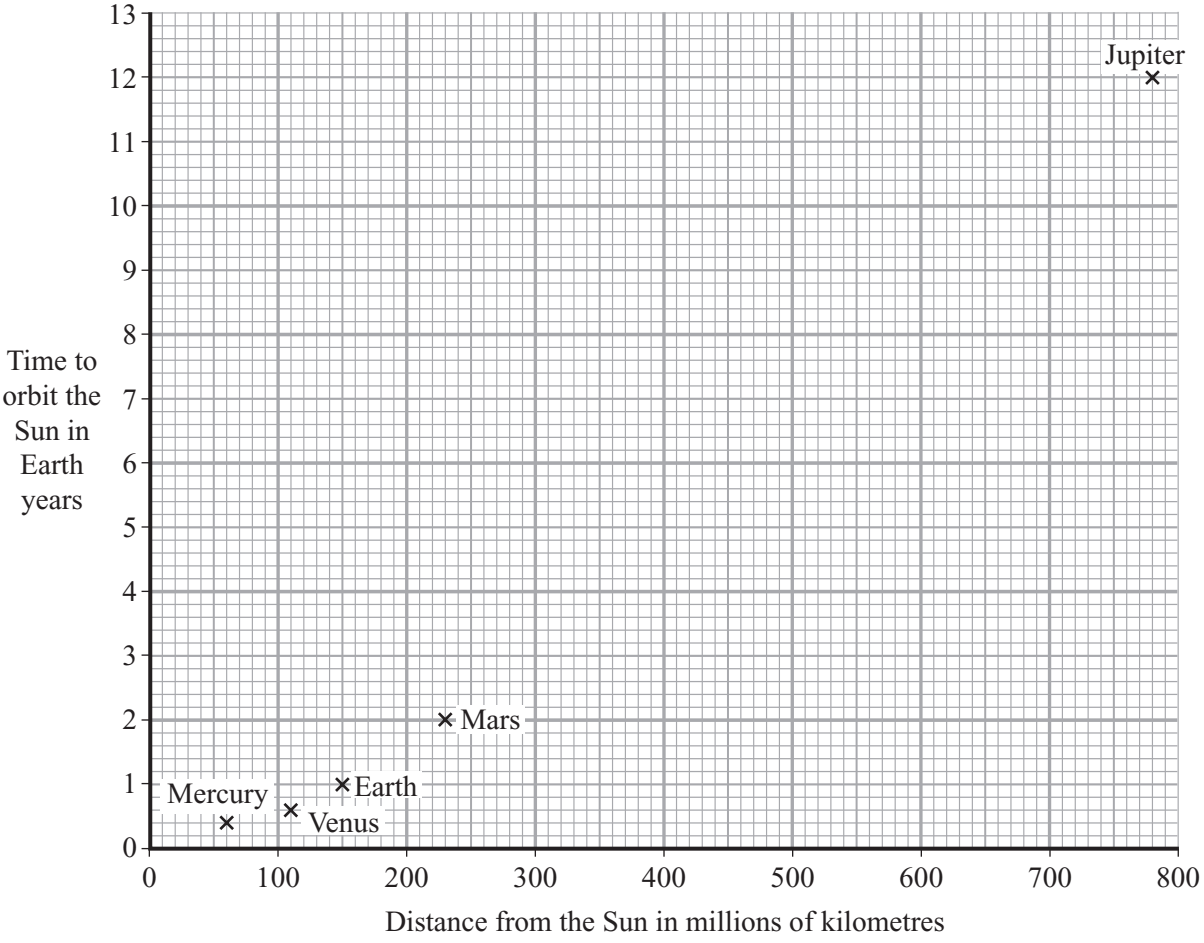
5

4.8.1.3 Orbital motion, natural and artificial satellites

Question 15

June 2005 | 3462 | Original Q10 | Legacy

10 (a) The chart shows that the time taken by a planet to orbit the Sun depends on its distance from the Sun.



(i) How does the time taken by a planet to orbit the Sun depend on the distance the planet is from the Sun?

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(1 mark)

(ii) Asteroids orbit the Sun. One asteroid is 550 million kilometres from the Sun.

Estimate how long this asteroid takes to orbit the Sun.

Time to orbit the Sun = ... Earth years

(1 mark)

4.8.1.3 Orbital motion, natural and artificial satellites

Question 15 · continued

MARGIN BLANK

(b) The atmosphere on Venus contains a large percentage of a greenhouse gas.

	Mercury	Venus	Earth
Average surface temperature	230 °C	470 °C	20 °C

(i) Which **one** of these gases increases the greenhouse effect? Draw a ring around your answer.

argon **carbon dioxide** **nitrogen** **oxygen**

(1 mark)

(ii) Explain how the information in the table and the chart shows that the atmosphere of Venus produces a greenhouse effect.

.....

.....

.....

.....

(2 marks)

5

TURN OVER FOR THE NEXT QUESTION

4.8.1.3 Orbital motion, natural and artificial satellites

Question 16

June 2006 | 3451 | Original Q3 | Legacy

3 (a) Read the following statements.

J – It is made up of at least a billion galaxies.

K – It is one of the stars in the Milky Way.

L – It is a slightly squashed circle.

M – It keeps the Moon in orbit around the Earth.

N – It is a large number of stars grouped together.

O – It is the explosion of a massive star.

Which statement, **J**, **K**, **L**, **M**, **N** or **O**, describes:

(i) the force of gravity; Letter .....
(1 mark)

(ii) the Sun; Letter .....
(1 mark)

(iii) the Universe; Letter .....
(1 mark)

(iv) a supernova? Letter .....
(1 mark)

4.8.1.3 Orbital motion, natural and artificial satellites

Question 16 · continued

BLANK

(b) The Sun is in the main stable stage of its lifecycle.

(i) How long will the Sun be in this stage of its lifecycle? Put a tick (✓) in the box next to your choice.

Hundreds of years ☐

Thousands of years ☐

Millions of years ☐

Billions of years ☐

(1 mark)

(ii) Describe what will happen to the Sun after it has reached the end of the main stable stage of its lifecycle. The answer has been started for you.

At the end of the stable stage of its lifecycle the Sun will expand

.....

.....

.....

.....

.....

.....

(3 marks)

8

4.8.1.3 Orbital motion, natural and artificial satellites

Question 17

June 2006 | 3462 | Original Q3 | Legacy

3 (a) Read the following statements.

J – It is made up of at least a billion galaxies.

K – It is one of the stars in the Milky Way.

L – It is a slightly squashed circle.

M – It keeps the Moon in orbit around the Earth.

N – It is a large number of stars grouped together.

O – It is the explosion of a massive star.

Which statement, **J**, **K**, **L**, **M**, **N** or **O**, describes:

(i) the force of gravity; Letter .....
(1 mark)

(ii) the Sun; Letter .....
(1 mark)

(iii) the Universe; Letter .....
(1 mark)

(iv) a supernova? Letter .....
(1 mark)

4.8.1.3 Orbital motion, natural and artificial satellites

Question 17 · continued

BLANK

(b) The Sun is in the main stable stage of its lifecycle.

(i) How long will the Sun be in this stage of its lifecycle? Put a tick (✓) in the box next to your choice.

Hundreds of years ☐

Thousands of years ☐

Millions of years ☐

Billions of years ☐

(1 mark)

(ii) Describe what will happen to the Sun after it has reached the end of the main stable stage of its lifecycle. The answer has been started for you.

At the end of the stable stage of its lifecycle the Sun will expand

.....

.....

.....

.....

.....

.....

(3 marks)

8

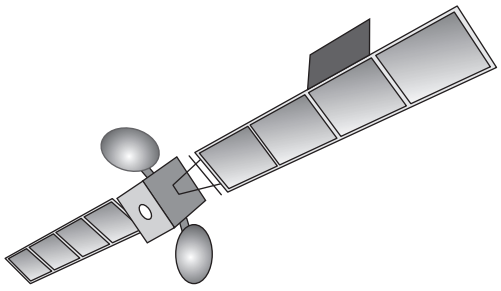
4.8.1.3 Orbital motion, natural and artificial satellites

Question 18

November 2006 | PHY1B | Original Q5 | Legacy

QUESTION FIVE

The drawing shows a satellite which carries a telescope used to observe space.



Match words, **A**, **B**, **C** and **D**, with the numbers **1–4** in the sentences.

A a distant galaxy

B a satellite

C the Earth

D the Universe

Observations of space using visible light are better from . . . **1** . . . because clouds may block observations taken from . . . **2** . . . .

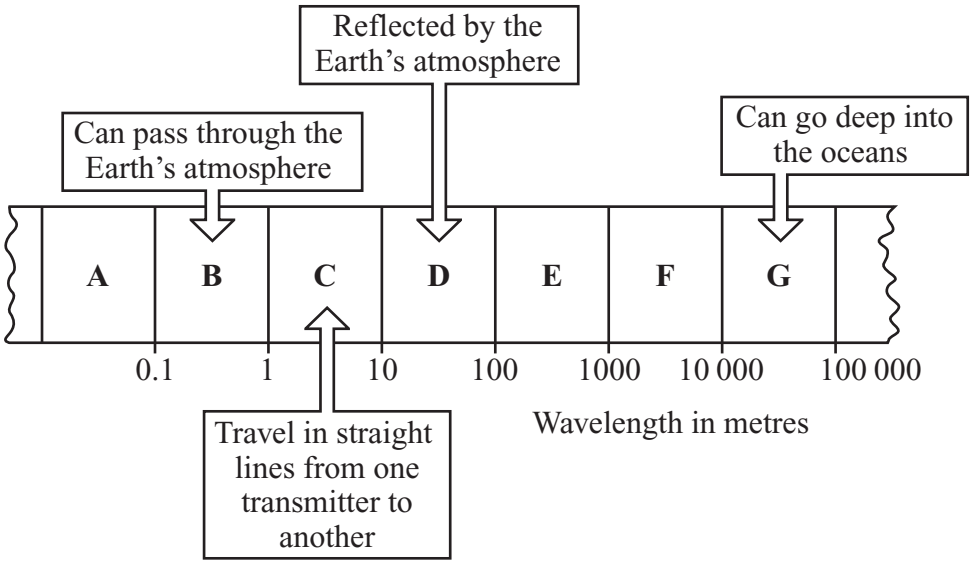
The red-shift in light from . . . **3** . . . provides evidence of the 'big bang' theory of the start of . . . **4** . . . .

4.8.1.3 Orbital motion, natural and artificial satellites

Question 19

1 The diagram shows a small part of the electromagnetic spectrum divided into seven sections.

The different properties of the waves in each section make them useful in different ways.



The waves in which section, **A**, **B**, **C**, **D**, **E**, **F** or **G**, are:

(a) used to send a signal to a satellite in space

.....

(1 mark)

(b) used to communicate with a submarine under the water

.....

(1 mark)

(c) used by a radio station to broadcast programmes around the world

.....

(1 mark)

(d) the waves with the shortest wavelength?

.....

(1 mark)

4

4.8.1.3 Orbital motion, natural and artificial satellites

Question 20

January 2007 | PHY1F | Original Q4 | Legacy

4 Light is given out by the Sun and a distant galaxy.

(a) Compared to the light from the Sun, the light from the distant galaxy has moved towards the red end of the spectrum.

(i) What name is given to this effect?

.....

(1 mark)

(ii) Complete the following sentence by drawing a ring around the line in the box that is correct.

The fact that light from a distant galaxy seems to move towards the red end of the spectrum gives scientists evidence that

galaxies are shrinking
galaxies are changing colour
the universe is expanding

.

(1 mark)

(b) Scientists have a theory that the universe began from a very small point and then exploded outwards.

(i) What name is given to this theory?

.....

(1 mark)

(ii) Which statement gives a reason why scientists think that the universe began with an explosion?

Put a tick (✓) in the box next to your choice.

At the moment it is the best way of explaining our scientific knowledge. ☐

It can be proved using equations. ☐

People felt the explosion. ☐

(1 mark)

4.8.1.3 Orbital motion, natural and artificial satellites

Question 20 · continued

BLANK

(c) Scientists use various types of telescope to obtain data from our solar system and beyond.

(i) What type of electromagnetic radiation is detected using an optical telescope?

.....

(1 mark)

(ii) The image from a telescope orbiting in space is usually clearer than the image from a telescope on the Earth.

Which statement gives a reason for this? Put a tick (✓) in the box next to your choice.

A space telescope is bigger. ☐

A space telescope is closer to the stars. ☐

The atmosphere does not block the light to a space telescope. ☐

(1 mark)

(iii) Give **one** disadvantage of having a telescope in space.

.....

.....

(1 mark)

7

4.8.1.3 Orbital motion, natural and artificial satellites

Question 21

June 2007 | PHY1B | Original Q4 | Legacy

QUESTION FOUR

Optical telescopes are used to observe space. They operate both from Earth and from satellites in space.

Match the features, **A**, **B**, **C** and **D**, with the numbers **1–4** in the table to indicate whether the feature is an advantage or a disadvantage.

A It can contain large, very heavy components.

B Maintenance is very difficult to carry out.

C The quality of data obtained from it is not affected by atmospheric gases.

D It cannot be used during the day.

Position of telescope	Advantage	Disadvantage
on Earth	**1**	**2**
on satellite in space	**3**	**4**

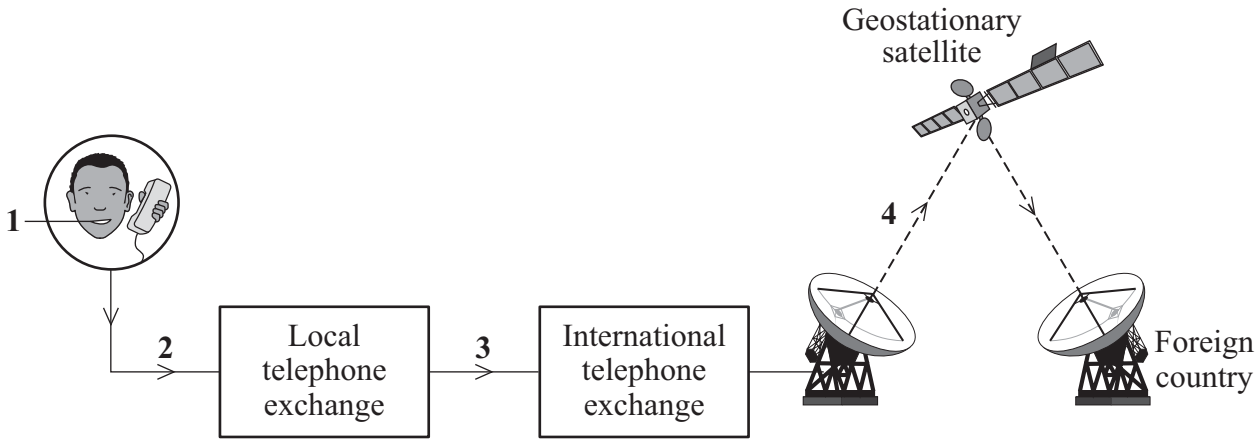
4.8.1.3 Orbital motion, natural and artificial satellites

Question 22

November 2007 | PHY1B | Original Q6 | Legacy

QUESTION SIX

The diagram shows how a telephone call can be made to a foreign country.



Match waves and signals, **A**, **B**, **C** and **D**, with the numbers **1–4** on the diagram.

A analogue electrical signal

B digital light signal

C microwaves

D sound waves

4.8.1.3 Orbital motion, natural and artificial satellites

Question 23

January 2008 | PHY1F | Original Q4 | Legacy

4 Using an optical telescope to look at stars is not always easy because:

- too many street lights often make it too light to see faint stars
- clouds reduce the light getting to the telescope
- atmospheric pollution often distorts the images.

(a) Large optical telescopes are often positioned high up a mountain.

Describe the advantages of positioning a telescope high up a mountain.

.....

.....

.....

.....

.....

.....

(3 marks)

(b) A new telescope is going to be built in Chile. It will detect electromagnetic waves with a frequency between infra red and radio waves.

What type of waves will this telescope detect?

.....

(1 mark)

(c) Telescopes that detect X-rays are always on satellites in space.

Which statement gives the reason for the telescope to be in space?

Put a tick (✓) in the box next to your choice.

The atmosphere absorbs X-rays. ☐

X-rays can harm people. ☐

X-rays have a shorter wavelength than light. ☐

(1 mark)

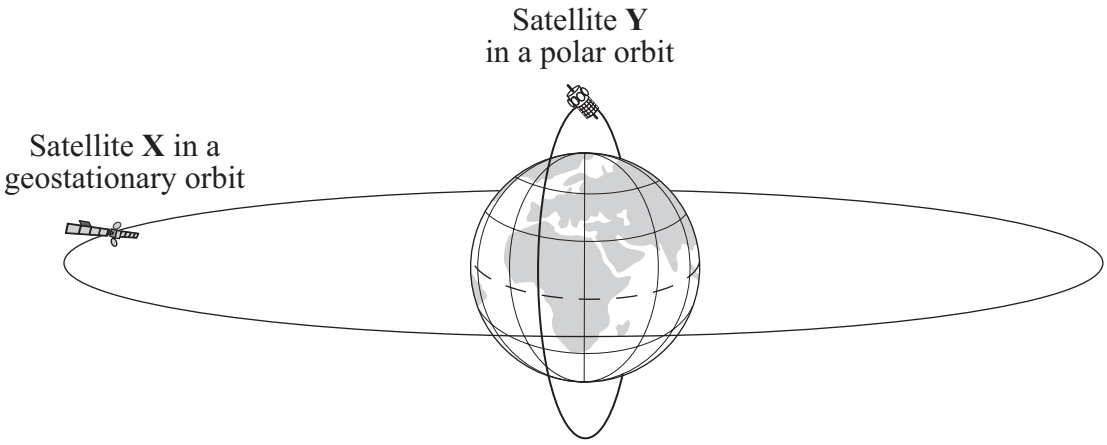
5

4.8.1.3 Orbital motion, natural and artificial satellites

Question 24

January 2008 | PHY3F | Original Q4 | Legacy

4 The diagram shows two satellites orbiting the Earth.



These satellites have the same mass.

(a) Complete the following sentences by drawing a ring around the correct words in each box.

(i) The time taken for one orbit by satellite **X** is

less than
the same as
more than

the time for one orbit by satellite **Y**.

(1 mark)

(ii) The force between the Earth and satellite **X** is

less than
the same as
more than

the force between the Earth and satellite **Y**.

(1 mark)

(b) A communication satellite is put into a geostationary orbit.

What is a geostationary orbit?

.....

.....

.....

.....

(2 marks)

4.8.1.3 Orbital motion, natural and artificial satellites

Question 24 · continued

BLANK

(c) A company plans to launch a satellite to monitor the weather.

Which type of orbit is usually used for this purpose?

Draw a ring around your answer.

geostationary **high polar** **low polar**

(1 mark)

5

Turn over for the next question

4.8.1.3 Orbital motion, natural and artificial satellites

Question 25

January 2008 | PHY3F | Original Q5 | Legacy

5 Two students collect data from the Internet about planets in the Solar System.

The table shows the data that they collect about the first six planets.

Name of planet	Distance from the Sun in arbitrary units	Time for one orbit of the Sun in years	Mean surface temperature of the planet in ºC
Mercury	0.4	0.2	+ 125
Venus	0.7	0.6	+ 465
Earth	1.0	1.0	+ 22
Mars	1.5	1.9	– 48
Jupiter	5.2	11.9	
Saturn	9.6	29.5	– 180

(a) One student says that the mean surface temperature of planets gets less the further they are from the Sun. The other student agrees but says that one planet does not fit the pattern.

Which planet does not fit the pattern?

.....

(1 mark)

(b) Estimate a value for the mean surface temperature of Jupiter.

Mean surface temperature of Jupiter = ... ºC

(1 mark)

(c) Use words from the box to complete the following conclusion reached using the data in the table.

You can use the words once, more than once or not at all.

decreases	increases	stays the same

As the distance from the Sun to a planet.....

the time taken for the planet to orbit the Sun..... .

(1 mark)

4.8.1.3 Orbital motion, natural and artificial satellites

Question 25 · continued

BLANK

(d) Hundreds of years ago, some scientists thought that Mars was a hot planet because it has a reddish colour.

Which **one** of the following statements gives the reason why scientists no longer think this?

Put a tick (✓) in the box next to your answer.

Hundreds of years ago, scientists got everything wrong. ☐

Today's scientists have new evidence about Mars. ☐

All scientific ideas change every one hundred years. ☐

(1 mark)

4

Turn over for the next question

4.8.1.3 Orbital motion, natural and artificial satellites

Question 26

March 2008 | PHY1BP | Original Q9 | Legacy

QUESTION NINE

Microwaves have many uses.

9A Microwaves can be used to cook food because they . . .

1 are at a high temperature when they leave the source in the oven.

2 travel straight through the food.

3 encourage the food to combine with oxygen.

4 transfer kinetic energy to the water molecules in the food.

9B Microwaves are used to transmit television broadcasts via a satellite because . . .

1 they can penetrate the atmosphere without significant loss of energy.

2 they do not interfere with aircraft navigation systems.

3 they have a longer wavelength than radio waves.

4 they have a lower frequency than radio waves.

9C More and more television and telephone transmissions use digital signals because digital signals . . .

1 are cheaper to use than analogue signals.

2 cause less risk to health.

3 are less prone to interference.

4 travel faster than analogue signals.

9D Some scientists think that mobile phones may be a health risk.

Their main concern is that the microwaves emitted by mobile phones . . .

1 may cause blistering of the ears.

2 may cause blindness.

3 may cause deafness.

4 may cause damage to genetic material in cells.

END OF TEST

4.8.1.3 Orbital motion, natural and artificial satellites

Question 27

June 2008 | PHY1F | Original Q4 | Legacy

4 The table gives data about two space telescopes. The Hubble telescope is already in space, but the James Webb telescope is still being built.

Name of telescope	Mirror diameter in metres	Launch Year	Orbit distance from the Earth in kilometres
Hubble	2.4	1990	575
James Webb	6.5	2013	1 500 000

4 (a) Give **one** reason why the image from an optical telescope on the Earth may not be as clear as the image produced by a space telescope.

.....

.....

(1 mark)

4 (b) Explain why it is easier for astronauts to service the Hubble telescope than it will be for astronauts to service the James Webb telescope.

.....

.....

.....

.....

(2 marks)

4 (c) The large mirror for the James Webb telescope will be folded, launched into space and then opened out. This will be a complicated process so a working scale model of the mirror system has been built.

Which statement gives a reason for building the scale model?

Put a tick (✓) in the box next to your answer.

To see what the mirror system will look like ☐

To test the design to make sure it will work ☐

To measure the power needed by the telescope ☐

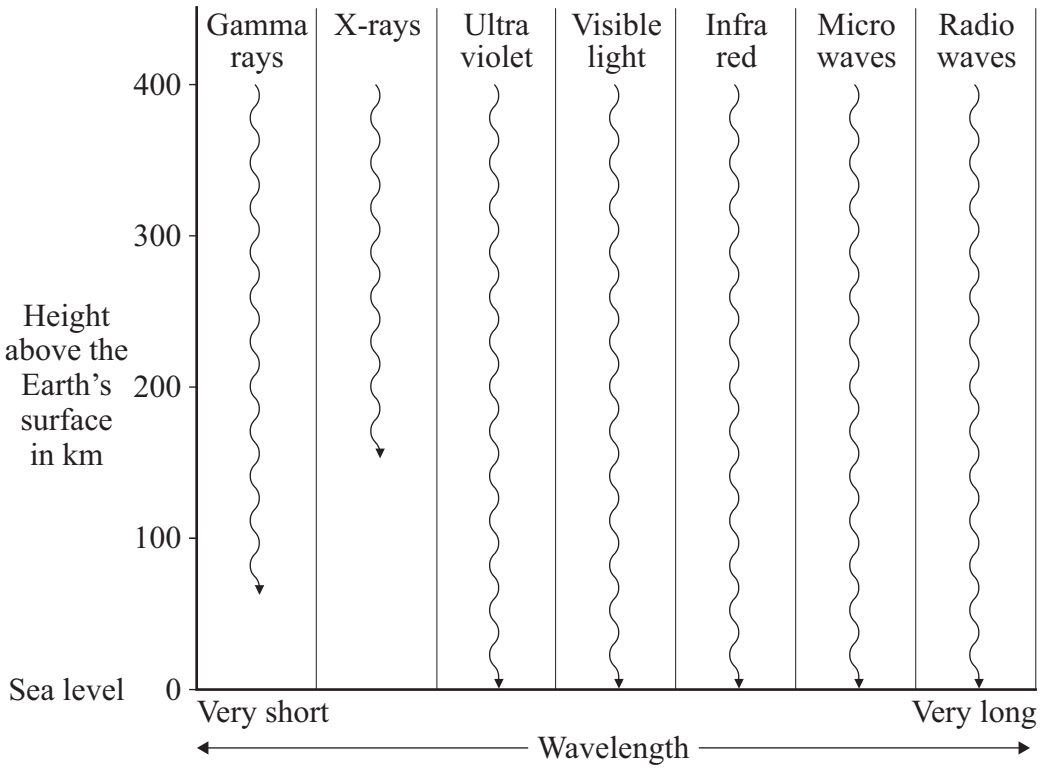
(1 mark)

4.8.1.3 Orbital motion, natural and artificial satellites

Question 27 · continued

for mark

4 (d) The diagram shows how far different types of electromagnetic wave can travel through the Earth's atmosphere before being absorbed.



Name **two** types of electromagnetic wave that can be detected by a space telescope but cannot be detected by a telescope positioned on Earth.

1 .....

2 .....

(2 marks)

4 (e) Observations of distant galaxies have given evidence to support the theory that the universe began from a very small point.

What name is given to this theory?

.....

(1 mark)

7

4.8.1.3 Orbital motion, natural and artificial satellites

Question 28

June 2008 | PHY3F | Original Q7 | Legacy

7 (a) Thousands of artificial satellites are now in orbit around the Earth. A student used the Internet to collect information about four of them.

The table shows the data that the student collected.

Satellite	Altitude (= height above the surface of the Earth) in kilometres	Period of orbit in hours
A	300	1.5
B	850	1.7
C	20 000	12.0
D	36 000	24.0

7 (a) (i) What conclusion, on the relationship between the altitude of a satellite and its period of its orbit, can the student come to from this data?

.....

.....

(1 mark)

7 (a) (ii) Any conclusion from the data in the table may not be valid for all satellites.

Give **two** reasons.

1 .....

.....

2 .....

.....

(2 marks)

7 (b) The Moon is the Earth's only natural satellite.

Explain how the Moon stays in a nearly circular orbit around the Earth.

.....

.....

.....

(2 marks)

Question 7 continues on the next page

4.8.1.3 Orbital motion, natural and artificial satellites

Question 28 · continued

for mark

7 (c) Two students see a film in which people on a spaceship hear an explosion on another spaceship.

The students think that this is not possible. What scientific evidence supports their opinion?

.....

.....

(1 mark)

7 (d) Some people say that space should not be explored.

Do you agree with them? Explain your answer.

.....

.....

.....

(2 marks)

8

4.8.1.3 Orbital motion, natural and artificial satellites

Question 29

November 2008 | PHY1BP | Original Q4 | Legacy

QUESTION FOUR

The Earth's atmosphere absorbs all electromagnetic waves except those with wavelengths longer than ultraviolet radiation.

Match the electromagnetic radiations, **A**, **B**, **C** and **D**, with the numbers **1–4** in the sentences.

A microwaves

B radio waves

C visible light

D X-rays

Three hundred years ago, many objects in the night sky were discovered by looking through hand-held telescopes. These telescopes detect . . . **1** . . . .

In the last century, distant galaxies were discovered by using large dishes and aerials on Earth which detect . . . **2** . . . .

In recent years, many discoveries have been made using telescopes mounted on satellites in space. Unlike telescopes on Earth, these telescopes can detect . . . **3** . . . .

The satellites send images back to Earth using . . . **4** . . . .

4.8.1.3 Orbital motion, natural and artificial satellites

Question 30

January 2009 | PHY1F | Original Q1 | Legacy

1 The table shows the electromagnetic spectrum.
Three types of wave have been missed out.

Gamma rays		Ultraviolet rays	Visible light		Micro-waves	

Shortest wavelength ⟷ Longest wavelength

1 (a) (i) Use words from the box to complete the table.

infra red rays	**radio waves**	**X-rays**

(2 marks)

1 (a) (ii) Which **one** of the following gives a use of gamma rays?

Put a tick (✓) in the box next to your choice.

to communicate with satellites ☐

to see objects ☐

to kill cancer cells ☐

(1 mark)

1 (a) (iii) Complete the following sentence by drawing a ring around the correct word in the box.

All electromagnetic waves move [energy / gases / particles] from one place to another.

(1 mark)

4

4.8.1.3 Orbital motion, natural and artificial satellites

Question 31

June 2009 | PHY1F | Original Q6 | Legacy

6 (a) The table lists the names of seven telescopes. Each one of the telescopes is designed to detect a different one of the seven types of electromagnetic wave.
The table is incomplete.

Name of telescope	Type of wave detected
HESS	Gamma
XMM Newton	X-ray
FUSE	Ultraviolet
William Herschel	Visible light
Spitzer	
SPT	Microwave
Lovell	Radio

6 (a) (i) Which **one** of the telescopes is designed to detect the type of wave with the shortest wavelength?

.....

(1 mark)

6 (a) (ii) What type of wave is the Spitzer telescope designed to detect?

.....

(1 mark)

6 (b) The William Herschel telescope is on the Earth's surface. Another telescope, the Hubble telescope, which also detects visible light, orbits the Earth.

How is the image produced by the Hubble telescope better than the image produced by the William Herschel telescope?

.....

Give a reason for your answer.

.....

.....

(2 marks)

4.8.1.3 Orbital motion, natural and artificial satellites

Question 31 · continued

for mark

6 (c) Some types of electromagnetic wave are absorbed by water.
The SPT telescope is located in the Antarctic, which is a dry environment.

Explain why it is better to have this type of telescope in a dry environment rather than in a wet, humid environment.

.....

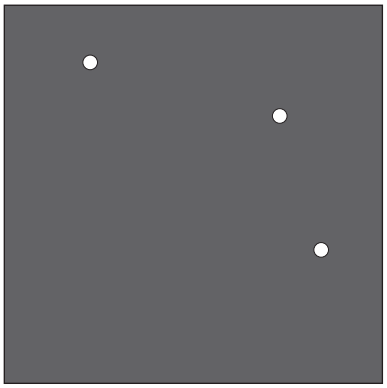
.....

.....

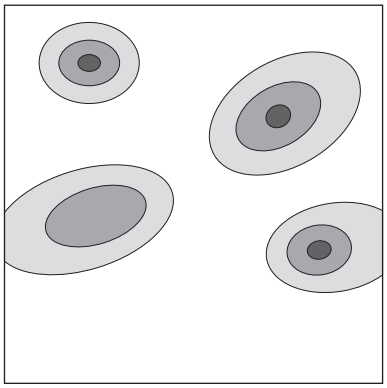
.....

(2 marks)

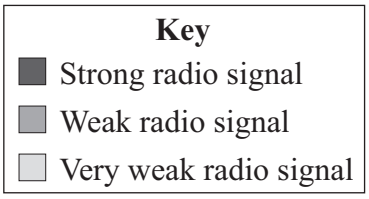
6 (d) The pictures represent the images produced using a visible light telescope and a radio telescope. Both images are of the same part of the sky. The shading on the radio telescope image represents the strength of the radio signals.



Visible light image



Radio telescope image



Suggest what extra information can be gained from the radio telescope image compared with the visible light image.

.....

.....

(1 mark)

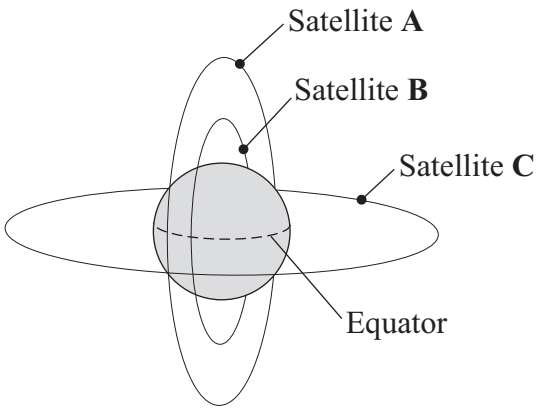
7

4.8.1.3 Orbital motion, natural and artificial satellites

Question 32

June 2009 | PHY3F | Original Q4 | Legacy

4 (a) The following diagram shows three satellites, **A**, **B** and **C**, in orbit around the Earth. The diagram is not to scale.



4 (a) (i) Complete the following table. Each letter may be used once, more than once or not at all.

Description of satellite	Is this satellite A, B or C?
It is in a low polar orbit.	
It is in a geostationary orbit.	
It is used as a monitoring satellite.	

(3 marks)

4 (a) (ii) How long does a satellite in a geostationary orbit take to complete one orbit?

..... hours
(1 mark)

4.8.1.3 Orbital motion, natural and artificial satellites

Question 32 · continued

for mark

4 (b) A rocket is used to carry a satellite into position.

Complete the following sentence by drawing a ring around the correct line in the box.

As the distance between the rocket and the Earth increases, the force of

gravity between the rocket and the Earth

decreases
stays the same
increases

.

(1 mark)

4 (c) Satellites cost many millions of pounds to build and to put into orbit. Some people think that this is a waste of money.

4 (c) (i) Suggest **one** reason why some people may have this opinion.

.....

.....

.....

(1 mark)

4 (c) (ii) Suggest **one** reason why other people may disagree with this opinion.

.....

.....

.....

(1 mark)

7

4.8.1.3 Orbital motion, natural and artificial satellites

Question 33

November 2009 | PHY1BP | Original Q6 | Legacy

QUESTION SIX

Diagram 1 shows a transmitter used to send information to a satellite. The transmitter has a microwave source in front of the dish.

Diagram 2 gives more detail of the dish and the microwave source. The dish is made of metal coated with plastic. The plastic coating prevents corrosion of the metal.

Diagram 1

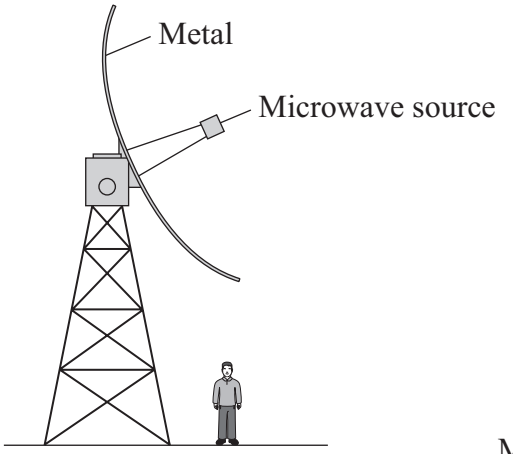
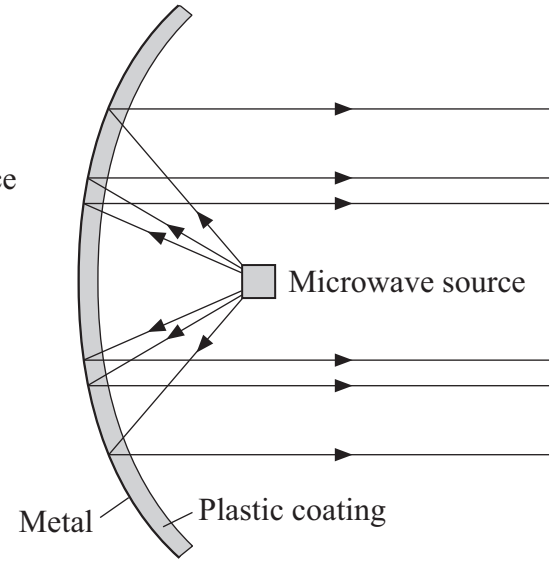


Diagram 2



6A The coating is made of plastic because microwaves are . . .

1 absorbed by plastic.

2 changed to an alternating current by plastic.

3 reflected by plastic.

4 able to pass through plastic.

4.8.1.3 Orbital motion, natural and artificial satellites

Question 33 · continued

6B The dish is made of metal because microwaves . . .

1 are absorbed by metals.

2 are reflected by metal.

3 give an alternating current with a different frequency.

4 interfere with the digital signals produced.

6C The microwave source is turned off when maintenance work is done in the dish.

This is to prevent the maintenance workers from . . .

1 becoming deaf from the analogue signals used.

2 causing interference to the digital signals used.

3 having their bodies heated by the microwaves.

4 receiving an electric shock from the alternating current, which is more dangerous than direct current.

6D Which of the following statements is correct about all microwaves?

1 As the frequency decreases, the wavelength decreases.

2 As the frequency decreases, the wavelength increases.

3 As the frequency increases, the wavelength does not change.

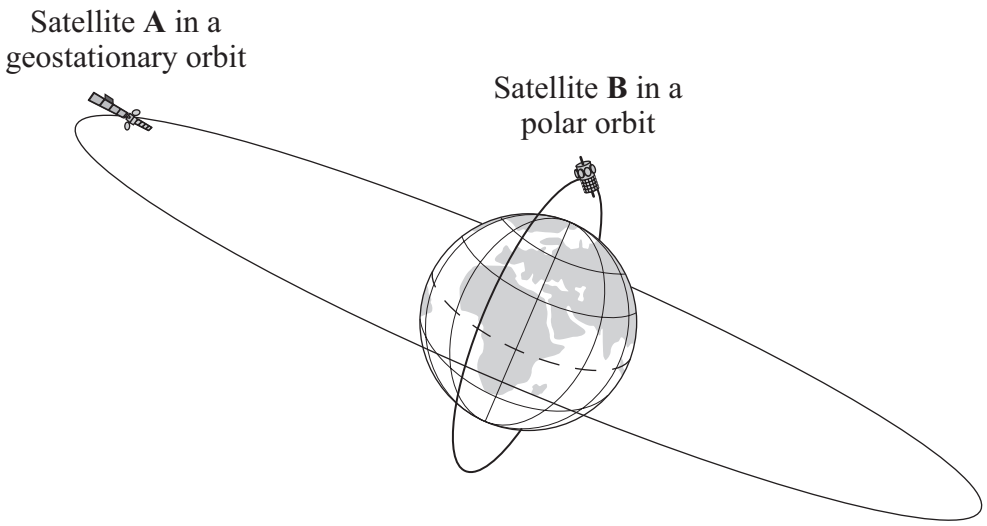
4 As the frequency increases, the wavelength increases.

4.8.1.3 Orbital motion, natural and artificial satellites

Question 34

3 The diagram shows two satellites orbiting the Earth.

Both satellites have the same mass.



3 (a) Complete the following sentences by drawing a ring around the correct line in each box.

3 (a) (i) The time taken for one orbit by satellite **A** is

less than
the same as
greater than

the time taken for one orbit by satellite **B**.

(1 mark)

3 (a) (ii) The force of attraction between the Earth and satellite **A** is

less than
the same as
greater than

the force of attraction between the Earth and satellite **B**.

(1 mark)

4.8.1.3 Orbital motion, natural and artificial satellites

Question 34 · continued

for mark

3 (a) (iii) The gravitational force of attraction between the Earth and a satellite provides a [centripetal / cosmic / friction] force.

(1 mark)

3 (a) (iv) The time taken for satellite **A** to complete one orbit is [24 hours / 1 week / 1 month / 1 year].

(1 mark)

3 (b) Use phrases from the box to complete the sentences.

geostationary orbit	**high polar orbit**	**low polar orbit**

3 (b) (i) Communications satellites are usually put in a ..... .

(1 mark)

3 (b) (ii) Monitoring satellites are usually put in a ..... .

(1 mark)

6

4.8.1.3 Orbital motion, natural and artificial satellites

Question 35

January 2010 | PHY3F | Original Q7 | Legacy

7 A student collects data from the Internet about planets in the solar system.
She arranges the data into a table.

Name of the planet	Distance from the Sun in millions of kilometres	Time taken for one orbit of the Sun in years	Time taken to spin on its axis in hours	Average temperature on the side facing the Sun in °C
Mercury	60	0.24	1400	+430
Venus	110	0.60	5800	+470
Earth	150	1	24	+20
Mars	230	2	25	–20
Jupiter	780	12	10	–150
Saturn	1400	30	10	–180
Uranus	2900	84	17	–220
Neptune	4500	160	16	–230

7 (a) Name the **two** variables in the student's table which **always** have the relationship:

As one increases, so does the other.

..... and .....

(1 mark)

7 (b) (i) Give an example of **two** variables in the student's table which **generally** have the relationship:

As one increases, the other decreases.

..... and .....

(1 mark)

7 (b) (ii) Which piece of data does not seem to fit the relationship in (b)(i)?

.....

(1 mark)

4.8.1.3 Orbital motion, natural and artificial satellites

Question 35 · continued

for mark

7 (c) Scientists plan to launch a satellite which will orbit Mars above its equator.
It will be a geostationary satellite.

How many hours will it take to orbit Mars?

..... hours
(1 mark)

7 (d) Mars has two moons.

Neither of them is in a geostationary orbit and they both take different times to orbit the planet.

Which **one** of these statements is correct.
Put a tick (✓) in the box next to your answer.

The two moons will always be above the same point on the surface of Mars. ☐

The two moons will be in different positions at different times. ☐

You can never see both moons at the same time. ☐

(1 mark)

7 (e) Use words from the box to complete the **three** spaces in the passage.

circular	**direction**	**friction**	**gravitational**	**speed**	**universal**

The moons of the planet Neptune move in circular paths around the planet.

They continuously accelerate towards the centre of Neptune.

The acceleration changes the ..... of each moon but does not change its ..... . The force causing the acceleration is a ..... force.

(2 marks)

7

4.8.1.3 Orbital motion, natural and artificial satellites

Question 36

March 2010 | PHY1BP | Original Q9 | Legacy

QUESTION NINE

There are two types of communication signal: analogue and digital.

9A Which pair of diagrams correctly shows the patterns for digital and analogue signals?

	Digital signal pattern	Analogue signal pattern
1		
2		
3		
4		

9B One reason for using digital signals rather than analogue signals for communication is that . . .

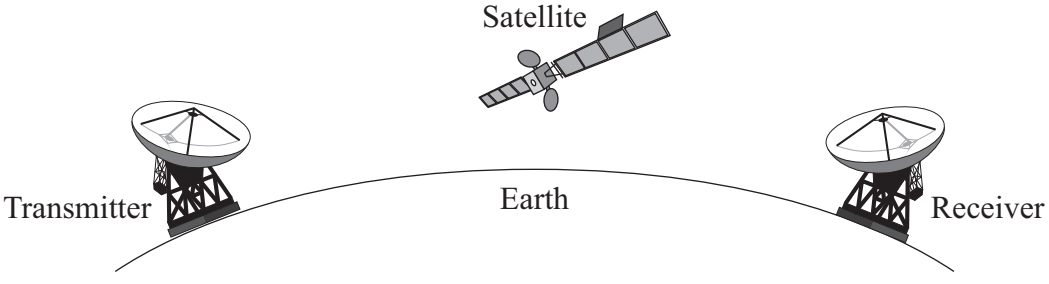
1 analogue signals are less prone to interference.

2 analogue signals can have only two values.

3 digital signals are continuously variable.

4 digital signals can be easily processed by computers.

9C Satellites in orbit around the Earth receive and transmit microwave signals for international telephone communication.



Microwaves are used because . . .

1 they are the only type of electromagnetic wave that can travel through a vacuum.

2 they are not absorbed by the Earth's atmosphere.

3 they follow the curvature of the Earth.

4 they travel faster than radio waves.

4.8.1.3 Orbital motion, natural and artificial satellites

Question 36 · continued

9D Properties of waves are often demonstrated in schools using waves on water.

wave speed (metre/second, m/s)	=	frequency (hertz, Hz)	×	wavelength (metre, m)

A wave generator with a frequency of 50 Hz produces water waves with a wavelength of 2 cm.

At what speed do the waves travel?

1 1 m/s

2 25 m/s

3 100 m/s

4 2500 m/s

END OF TEST

4.8.1.3 Orbital motion, natural and artificial satellites

Question 37

June 2010 | PHY1F | Original Q5 | Legacy

5 (a) Scientists use telescopes to observe stars and galaxies.
Some telescopes are on Earth, but some are on satellites in space.

Why do telescopes in space give better images than telescopes on the Earth?

.....

.....

(1 mark)

5 (b) Scientists have observed that the wavelengths of the light given out from galaxies that are moving away from the Earth are longer than expected.

5 (b) (i) What name is given to this observation?

Put a tick (✓) in the box next to your answer.

blue-shift ☐

green-shift ☐

red-shift ☐

(1 mark)

5 (b) (ii) Complete the following sentence by drawing a ring around the correct line in the box.

This observation gives evidence for the idea that the universe is

shrinking.

not changing.

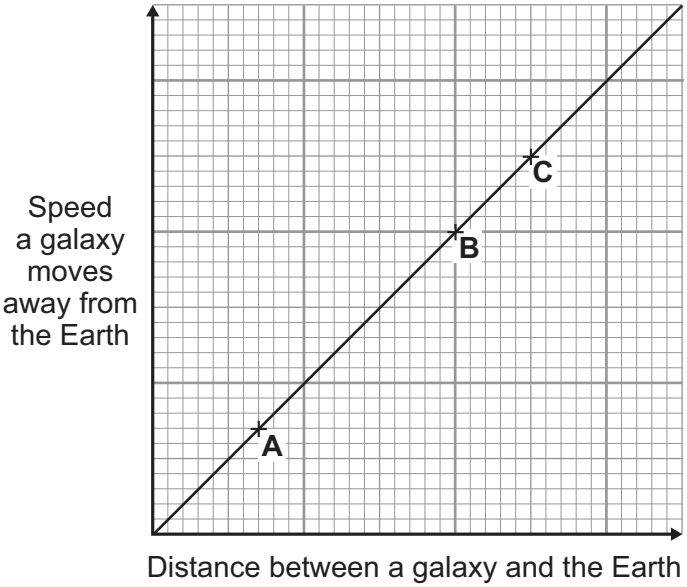
expanding.

(1 mark)

4.8.1.3 Orbital motion, natural and artificial satellites

Question 37 · continued June 2010 | PHY1F | Original Q5 | Legacy

5 (c) Use the graph to answer the following questions.



5 (c) (i) What is the link between the speed that a galaxy moves away from the Earth and the distance between the galaxy and the Earth?

.....

.....

(1 mark)

5 (c) (ii) The positions of three galaxies, **A**, **B** and **C**, are marked on the graph.

From which galaxy, **A**, **B** or **C**, would the wavelength of the light reaching the Earth seem to have changed the most?

Galaxy .....

Give a reason for your answer.

.....

.....

.....

.....

(2 marks)

6

4.8.1.3 Orbital motion, natural and artificial satellites

Question 38

June 2010 | PHY3F | Original Q6 | Legacy

6 (a) A student finds data on the Internet for her project on the Solar System.
She checks this data on other websites.

The table shows the checked data.

Name of planet	Diameter in km	Distance from Sun in millions of km	Period in days
Mercury	4840	58	87
Venus	12390	108	224
Earth	12760	149	365
Mars	6800	228	686
Jupiter	142800	778	4332
Saturn	119400	1428	10759
Uranus	47600	2870	30685
Neptune	48400	4497	60190

6 (a) (i) In the table, the period of each planet is given in days.

What is meant by the *period* of a planet?

.....

(1 mark)

6 (a) (ii) Suggest why the student checks the data on other websites.

.....

.....

(1 mark)

6 (a) (iii) What is the relationship, if any, between a planet's distance from the Sun and its period?

.....

.....

(1 mark)

4.8.1.3 Orbital motion, natural and artificial satellites

Question 38 · continued June 2010 | PHY3F | Original Q6 | Legacy

6 (a) (iv) What is the relationship, if any, between a planet's diameter and its period?

.....

.....

(1 mark)

6 (b) What is the force which provides the centripetal force to keep planets in their orbits?

.....

(1 mark)

6 (c) What is the name of the galaxy which contains the Solar System?

.....

(1 mark)

6 (d) Complete the following sentence by drawing a ring around the correct word in the box.

The universe is made up of

hundreds
thousands
millions
billions

of galaxies. *(1 mark)*

7

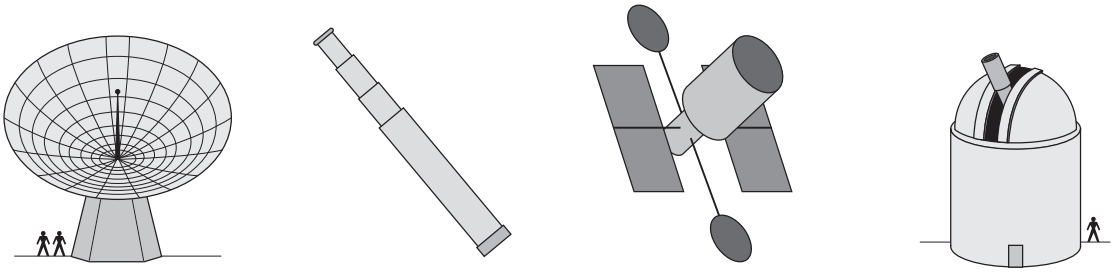
4.8.1.3 Orbital motion, natural and artificial satellites

Question 39

November 2010 | PHY1BP | Original Q2 | Legacy

QUESTION TWO

The drawings show different types of telescope. They are not drawn to scale.



1 2 3 4

Not to scale

Match descriptions, **A**, **B**, **C** and **D**, with the telescopes **1**–**4**.

A can be used by anyone to view the surface of the Moon

B in orbit around the Earth

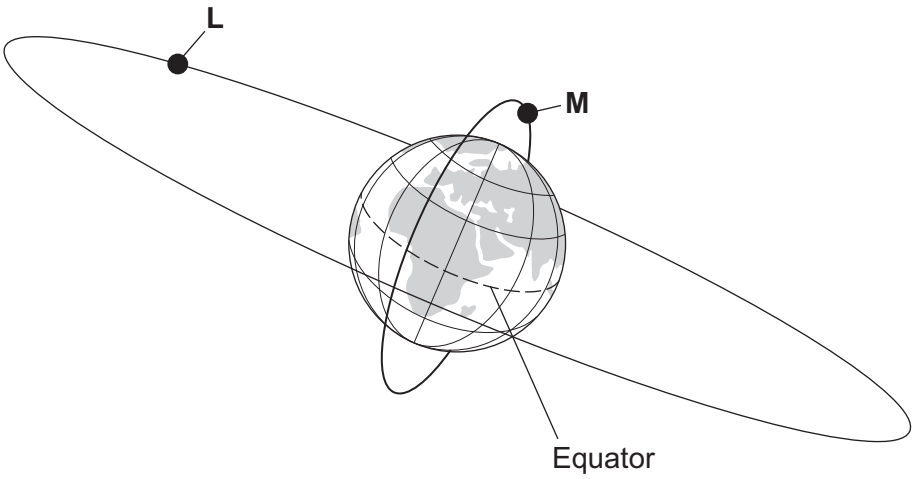
C built on the top of a mountain and can be used to view planets

D used by scientists to detect radio waves from space

4.8.1.3 Orbital motion, natural and artificial satellites

Question 40

4 The diagram, which is not to scale, shows two satellites, **L** and **M**, orbiting the Earth.



4 (a) Complete the following table.

Each letter, **L** or **M**, may be used once, more than once or not at all.

Statement about the satellite	Letter for the satellite
It is used as a monitoring satellite.	
It is a geostationary satellite.	
It takes 24 hours to complete its orbit.	

(2 marks)

4 (b) Complete the following sentence.

To stay in its present orbit around the Earth, each satellite must move at a particular ..... .

(1 mark)

4.8.1.3 Orbital motion, natural and artificial satellites

Question 40 · continued

4 (c) Thousands of satellites are now in orbit around the Earth. A student used the Internet to collect information about some of them.

Name of satellite	Average distance from the centre of the Earth in kilometres	Speed in kilometres per second	Time taken to orbit the Earth
The Moon	391 400	1.01	28 days
GEO	42 200	3.07	1 day
Navstar	26 600	3.87	12 hours
Lageos	12 300	5.70	3.8 hours
HST	7 000	7.56	97 mins
ISS	6 700	7.68	92 mins

4 (c) (i) The Moon takes a longer time than any of the other satellites to orbit the Earth.

Give **one** other way in which the Moon is different from the other satellites in the table.

.....

.....

(1 mark)

4 (c) (ii) What conclusion on the relationship between the *average distance* and *speed* can the student come to on the basis of this data?

.....

.....

(1 mark)

4 (c) (iii) What conclusion on the relationship between the *speed* and the *time taken to orbit the Earth* can the student come to on the basis of this data?

.....

.....

(1 mark)

6

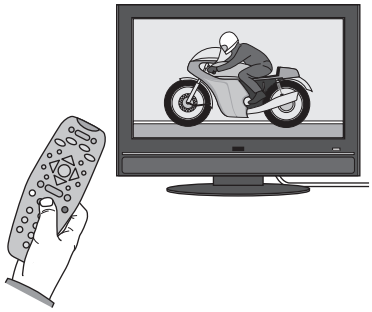
4.8.1.3 Orbital motion, natural and artificial satellites

Question 41

March 2011 | PHY1BP | Original Q1 | Legacy

QUESTION ONE

This question is about electromagnetic radiation and television.



Match types of electromagnetic radiation, **A**, **B**, **C** and **D**, with the numbers **1**–**4** in the sentences.

A infra red

B microwaves

C radio waves

D visible light

Television signals from a transmitter on Earth are carried by . . . **1** . . . .

Television signals from a satellite are carried by . . . **2** . . . .

A television remote control uses . . . **3** . . . .

A television screen is designed to produce . . . **4** . . . .

4.8.1.3 Orbital motion, natural and artificial satellites

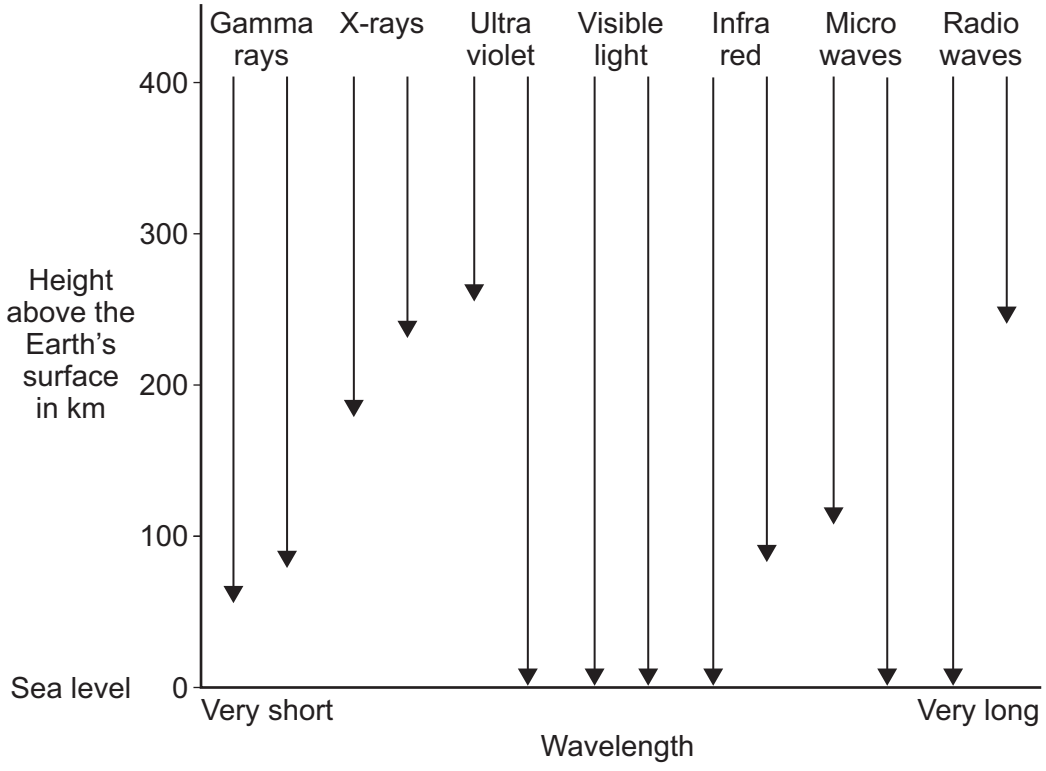
Question 42

June 2011 | PHY1BP | Original Q9 | Legacy

QUESTION NINE

Telescopes can be based on the Earth's surface or put into orbit in space.

The diagram shows how far electromagnetic waves penetrate the Earth's atmosphere. For some types of electromagnetic radiation, longer and shorter waves penetrate the atmosphere to different depths.



9A Telescopes on Earth detect **all** wavelengths of . . .

1 radio waves only.

2 visible light only.

3 radio waves and visible light.

4 visible light and X-rays.

9B Which of the following statements about the use of telescopes in space is true?

1 The atmosphere distorts the image produced by the telescope.

2 The telescopes are affected by light pollution from the Earth.

3 The telescopes can detect electromagnetic waves that cannot reach the Earth's surface.

4 The telescopes are easy to repair and maintain.

4.8.1.3 Orbital motion, natural and artificial satellites

Question 42 · continued

The table gives information about some space telescopes. Each telescope detects a different type of electromagnetic radiation.

Telescope	Wavelength detected in nanometres
INTEGRAL	less than 0.01
Chandra	0.01 – 20
FUSE	20 – 400
Hubble	400 – 700
Spitzer	1000 – 1 000 000

9C The Hubble telescope detects visible light.

Which telescope detects infra red radiation?

1 Chandra

2 FUSE

3 INTEGRAL

4 Spitzer

9D Which telescope detects X-rays?

1 Chandra

2 FUSE

3 INTEGRAL

4 Spitzer

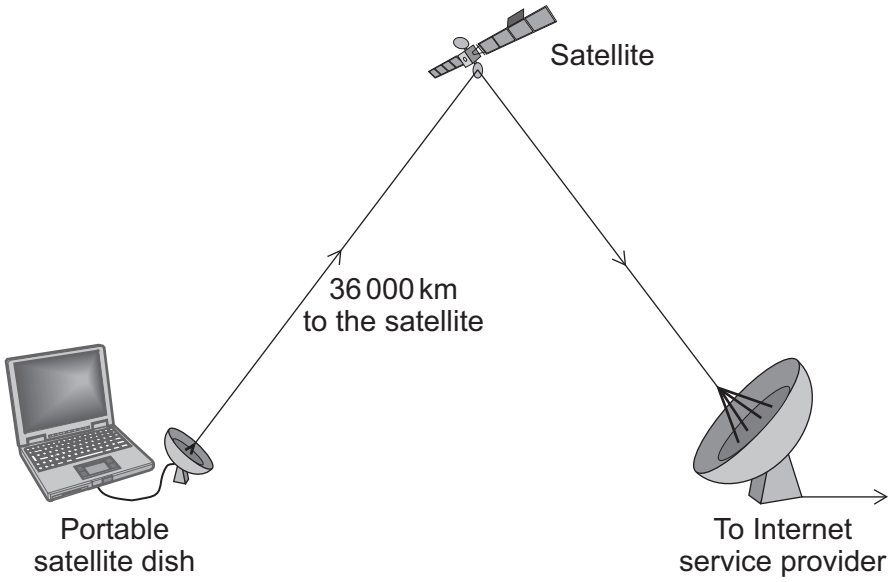
END OF TEST

4.8.1.3 Orbital motion, natural and artificial satellites

Question 43

June 2011 | PHY1F | Original Q2 | Legacy

2 (a) The diagram shows a computer connected to the Internet using a satellite link.



2 (a) (i) Which **one** of the following types of electromagnetic wave is used to send information to the satellite?

Draw a ring around your answer.

microwave **radio** **visible light**

(1 mark)

2 (a) (ii) The information is sent to the satellite using a digital signal.

Which **one** of the signals, **A**, **B**, **C** or **D**, is a digital signal?

Write your answer, **A**, **B**, **C** or **D**, in the box.



Signal ☐

(1 mark)

4.8.1.3 Orbital motion, natural and artificial satellites

Question 43 · continued

2 (a) (iii) It is better to send information as a digital signal rather than as an analogue signal.

Which **one** of the following statements explains why?

Put a tick (✓) in the box next to your answer.

Digital signals travel faster. ☐

Digital signals can be switched on and off. ☐

Digital signals are less affected by interference. ☐

(1 mark)

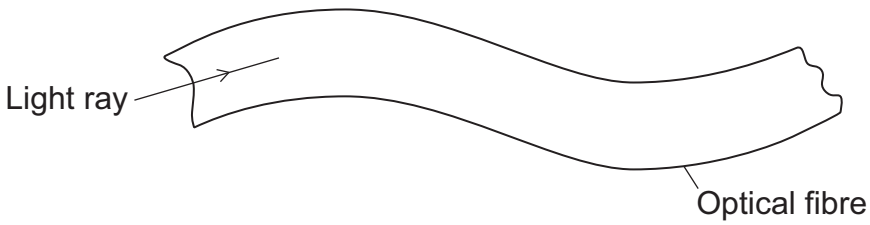
2 (b) Since 2009, people in some parts of Kenya have been able to connect to the Internet using signals sent through an optical fibre cable rather than via a satellite link.

2 (b) (i) Complete the following sentence by drawing a ring around the correct line in the box.

Visible light and [infra red / radio / ultraviolet] can be used to send signals along an optical fibre.

(1 mark)

2 (b) (ii) The diagram shows part of an optical fibre.



Complete the diagram to show how the light ray travels through the optical fibre.

(2 marks)

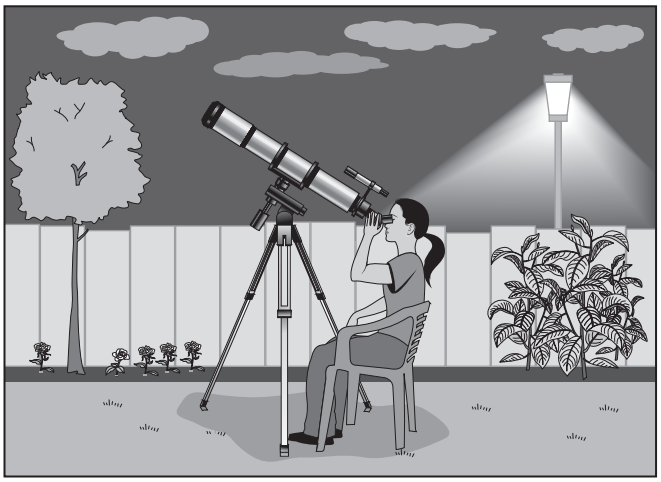
6

4.8.1.3 Orbital motion, natural and artificial satellites

Question 44

June 2011 | PHY1F | Original Q4 | Legacy

4 (a) The picture shows a person using an optical telescope to look at stars.



Give **two** reasons why it can be difficult to see distant stars using this type of telescope.

1 .....

.....

2 .....

.....

(2 marks)

4 (b) As well as optical telescopes, other types of telescope are on satellites in orbit above the Earth.

Give **one disadvantage** of having a telescope in orbit above the Earth.

.....

.....

(1 mark)

4.8.1.3 Orbital motion, natural and artificial satellites

Question 44 · continued

4 (c) In 2008, a new gamma ray telescope, called Fermi, was launched into space. The telescope orbits 560 km above the Earth.

4 (c) (i) Which statement gives a reason why gamma ray telescopes are usually in orbit above the Earth?

Put a tick (✓) in the box next to your answer.

The telescopes need to be closer to the stars. ☐

The atmosphere absorbs gamma rays. ☐

The telescopes can be used to look at the Earth. ☐

(1 mark)

4 (c) (ii) Some theories predict that particles called WIMPs exist. The theories predict that WIMPs produce a background of gamma rays in very distant galaxies.

Complete the following sentence by drawing a ring around the line in the box that is correct.

If a background of gamma rays in very distant galaxies is detected using the Fermi telescope, this will

- prove that WIMPs exist.
- support the theories that predict that WIMPs exist.
- make scientists change the existing theories.

(1 mark)

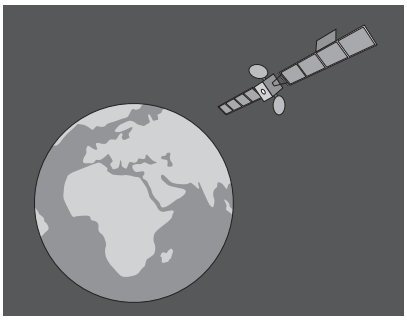
5

4.8.1.3 Orbital motion, natural and artificial satellites

Question 45

June 2011 | PHY3F | Original Q4 | Legacy

4 The satellite shown in the picture is in a geostationary orbit around the Earth.



4 (a) What is the time period of a geostationary orbit?

Draw a ring around your answer.

12 hours **24 hours** **1 year**

(1 mark)

4 (b) This satellite is in orbit above the Earth's equator.

Put a tick (✓) in the box which explains why the satellite seems to remain above one place on the Earth's equator.

The satellite and the Earth both orbit the Sun at the same rate. ☐

The satellite is attracted by the Earth's gravitational force. ☐

The satellite orbits the Earth at the same rate at which the Earth revolves. ☐

(1 mark)

4.8.1.3 Orbital motion, natural and artificial satellites

Question 45 · continued June 2011 | PHY3F | Original Q4 | Legacy

4 (c) A geostationary satellite always seems to be at the same point above the surface of the Earth.

Explain the advantage of this.

.....

.....

.....

.....

(2 marks)

4 (d) Give **one** use of a satellite in a geostationary orbit.

.....

.....

(1 mark)

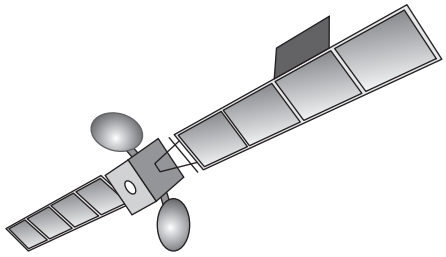
5

4.8.1.3 Orbital motion, natural and artificial satellites

Question 46

QUESTION THREE

The drawing shows a satellite that carries a telescope used to look at objects in space.



Match words, **A**, **B**, **C** and **D**, with the numbers **1**–**4** in the sentences.

A a distant galaxy

B a satellite

C the Earth

D the Universe

Observations of space using visible light are better made from . . . **1** . . . because clouds may block observations made from . . . **2** . . . .

The red-shift in light from . . . **3** . . . provides evidence of the ‘big bang’ theory of the start of . . . **4** . . . .

4.8.1.3 Orbital motion, natural and artificial satellites

Question 47

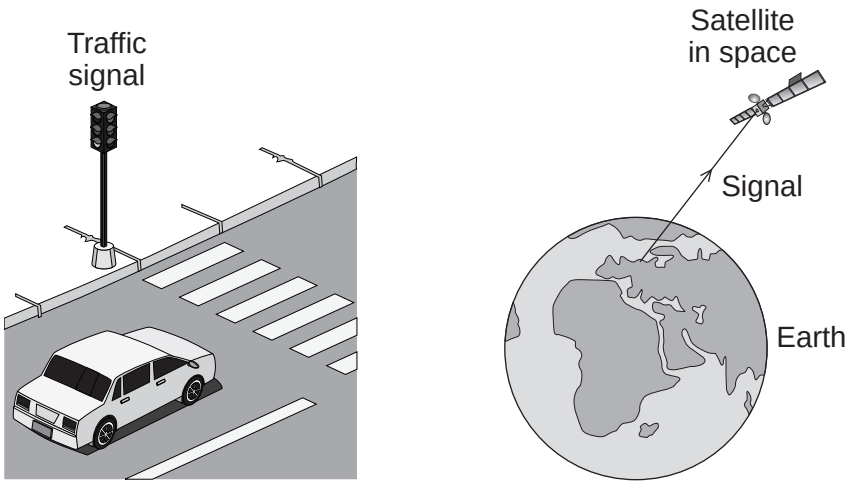
June 2013 | PH1FP | Original Q2 | Legacy

2 **Diagram 1** shows four of the seven types of wave in the electromagnetic spectrum.

Diagram 1

J	**K**	**L**	Visible light	Infrared	Microwaves	Radio waves

2 (a) The **four** types of electromagnetic wave named in **Diagram 1** above are used for communication.



2 (a) (i) Which type of electromagnetic wave is used when a traffic signal communicates with a car driver?

.....

(1 mark)

2 (a) (ii) Which type of electromagnetic wave is used to communicate with a satellite in space?

.....

(1 mark)

2 (b) Gamma rays are part of the electromagnetic spectrum.

Which letter, **J**, **K** or **L**, shows the position of gamma rays in the electromagnetic spectrum?

Draw a ring around the correct answer.

J **K** **L**

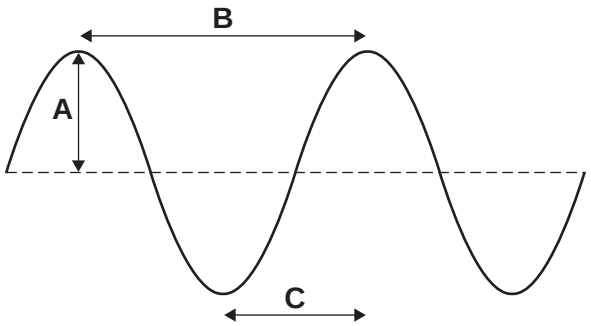
(1 mark)

4.8.1.3 Orbital motion, natural and artificial satellites

Question 47 · continued

2 (c) **Diagram 2** shows an infrared wave.

Diagram 2



2 (c) (i) Which **one** of the arrows, labelled **A**, **B** or **C**, shows the wavelength of the wave?

Write the correct answer, **A**, **B** or **C**, in the box. ☐

(1 mark)

2 (c) (ii) Draw a ring around the correct answer to complete the sentence.

The wavelength of infrared waves is [shorter than / the same as / longer than] the wavelength of radio waves.

(1 mark)

Question 2 continues on the next page

4.8.1.3 Orbital motion, natural and artificial satellites

Question 47 · continued

2 (d) Mobile phone networks send signals using microwaves. Some people think the energy a person's head absorbs when using a mobile phone may be harmful to health.

2 (d) (i) Scientists have compared the health of people who use mobile phones with the health of people who do not use mobile phones.

Which **one** of the following statements gives a reason why scientists have done this?

Tick (✓) **one** box.

To find out if using a mobile phone is harmful to health. ☐

To find out if mobile phones give out radiation. ☐

To find out why some people are healthy. ☐

(1 mark)

2 (d) (ii) The table gives the specific absorption rate (SAR) value for two different mobile phones.

The SAR value is a measure of the maximum energy a person's head absorbs when a mobile phone is used.

Mobile Phone	SAR value in W/kg
X	0.28
Y	1.35

A parent buys mobile phone **X** for her daughter.

Using the information in the table, suggest why buying mobile phone **X** was the best choice.

.....

.....

.....

.....

(2 marks)

8

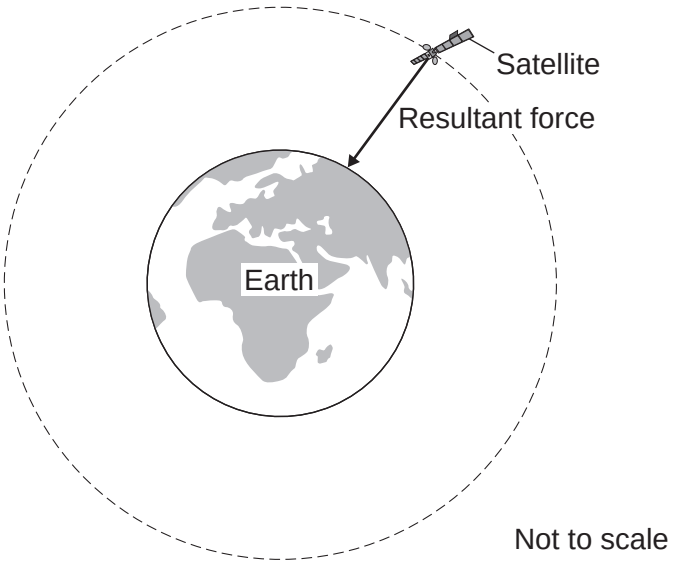
4.8.1.3 Orbital motion, natural and artificial satellites

Question 48

June 2014 | PH3FP | Original Q8 | Legacy

8 Man-made satellites can orbit the Earth, as shown in **Figure 14**.

Figure 14



The satellite experiences a resultant force directed towards the centre of the orbit.

The resultant force is called the centripetal force.

8 (a) What provides the centripetal force on the satellite?

[1 mark]

.....

8 (b) State **two** factors that determine the size of the centripetal force on the satellite.

[2 marks]

1 .....

2 .....

4.8.1.3 Orbital motion, natural and artificial satellites

Question 48 · continued

8 (c) **Table 4** gives data for five different satellites orbiting the Earth.

Table 4

Satellite	Average height above Earth's surface in kilometres	Time taken to orbit Earth once in minutes	Mass of satellite in kilograms
A	370	93	419 000
B	697	99	280
C	827	103	630
D	5 900	228	400
E	35 800	1440	2 030

8 (c) (i) State the relationship, if any, between the height of the satellite above the Earth's surface and the time taken for the satellite to orbit the Earth once.

[1 mark]

.....

.....

8 (c) (ii) State the relationship, if any, between the time taken for the satellite to orbit the Earth once and the satellite's mass.

[1 mark]

.....

.....

Question 8 continues on the next page

4.8.1.3 Orbital motion, natural and artificial satellites

Question 48 · continued

8 (d) Over 300 years ago, the famous scientist Isaac Newton proposed, with a 'thought experiment', the idea of satellites.

Newton suggested that if an object was fired at the right speed from the top of a high mountain, it would circle the Earth.

Why did many people accept Isaac Newton's idea as being possible?

Tick (✓) **one** box.

[1 mark]

Isaac Newton was a respected scientist who had made new discoveries before. ☐

Isaac Newton went to university. ☐

It was a new idea that nobody else had thought of before. ☐

6

4.8.1.3 Orbital motion, natural and artificial satellites

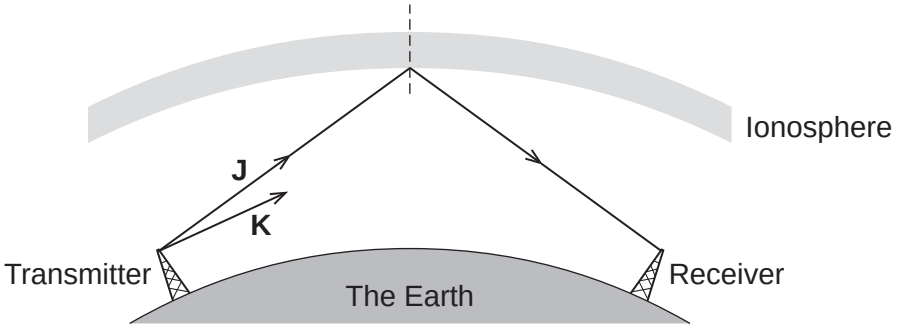
Question 49

June 2015 | PH1FP | Original Q1 | Legacy

1 Different parts of the electromagnetic spectrum are useful for different methods of communication.

1 (a) **Figure 1** shows a transmitter emitting two electromagnetic waves, **J** and **K**.

Figure 1



Wave **J** is reflected by a layer in the atmosphere called the ionosphere.

1 (a) (i) Wave **K** will also be reflected by the ionosphere.
On **Figure 1**, draw the path of wave **K** to show that it **does not** reach the receiver.

[2 marks]

1 (a) (ii) What is the name given to the dashed line in **Figure 1**?

[1 mark]

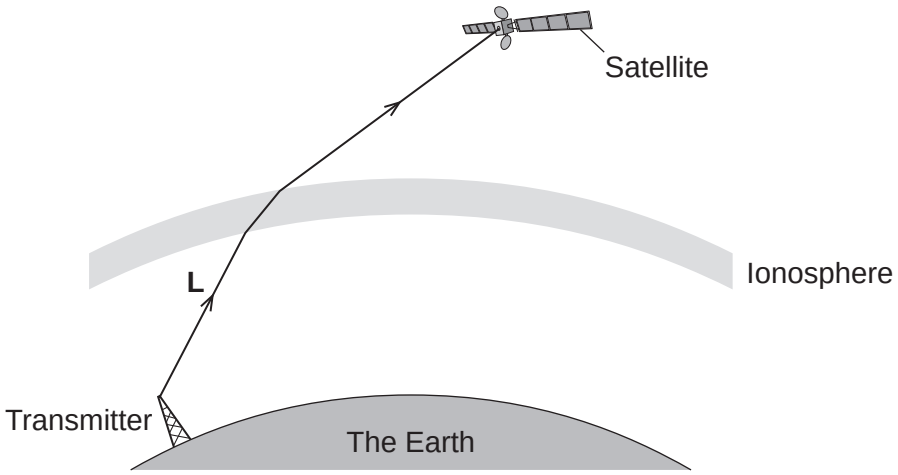
.....

4.8.1.3 Orbital motion, natural and artificial satellites

Question 49 · continued

1 (b) **Figure 2** shows a transmitter sending a signal to a satellite orbiting the Earth.

Figure 2



1 (b) (i) Which type of electromagnetic wave is used to send a signal to a satellite?

[1 mark]

Draw a ring around the correct answer.

gamma **microwave** **ultraviolet**

1 (b) (ii) What name is given to the process that occurs as wave **L** passes into the ionosphere?

[1 mark]

Draw a ring around the correct answer.

diffraction **reflection** **refraction**

Question 1 continues on the next page

4.8.1.3 Orbital motion, natural and artificial satellites

Question 49 · continued

1 (c) Waves **J**, **K** and **L** are electromagnetic waves.

What are **two** properties of **all** electromagnetic waves?

[2 marks]

Tick (✓) **two** boxes.

Property	Tick (✓)
All electromagnetic waves are longitudinal.	
All electromagnetic waves are transverse.	
All electromagnetic waves are mechanical.	
All electromagnetic waves have the same speed in a vacuum.	
All electromagnetic waves have the same frequency.	

7

4.8.1.3 Orbital motion, natural and artificial satellites

Question 50

0 1 . 1 The Sun is a star.

Which galaxy is the Sun in?

Tick **one** box.

[1 mark]

Cartwheel ☐

Milky Way ☐

Starburst ☐

Tadpole ☐

0 1 . 2 Light takes 500 seconds to travel from the Sun to the Earth.

Light travels at 300 000 kilometres per second.

Calculate the distance between the Sun and the Earth.

Use the equation:

distance = speed × time

[2 marks]

Distance = _____ kilometres

4.8.1.3 Orbital motion, natural and artificial satellites

Question 50 · continued

Table 1 gives information about some of the planets in our solar system.

The planets are in order of increasing distance from the Sun.

Table 1

Planet	Time to orbit the Sun in years
Mercury	0.2
Venus	0.6
Earth	1.0
Mars	
Jupiter	12.0

0 1 . 3 There are some planets in our solar system missing from **Table 1**.

How many planets are missing?

[1 mark]

0 1 . 4 Estimate how many years it takes Mars to orbit the Sun.

[1 mark]

_____ years

0 1 . 5 Calculate how many times Venus will orbit the Sun in 9 years.

[2 marks]

In 9 years Venus will orbit the Sun _____ times.

7

4.8.1.3 Orbital motion, natural and artificial satellites

Question 51

0 4 The ancient Greeks thought that atoms were tiny spheres that could not be divided into anything smaller.

Since then, different discoveries have led to the model of the atom changing.

Some of the discoveries are given in **Table 1**.

Table 1

The mass of an atom is concentrated in the nucleus.	**A**
Electrons orbit the nucleus at specific distances.	**B**
The nucleus contains neutrons.	**C**
The nucleus contains positively charged protons.	**D**

0 4 . 1 Which discovery was the earliest?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

0 4 . 2 Which discovery was the most recent?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

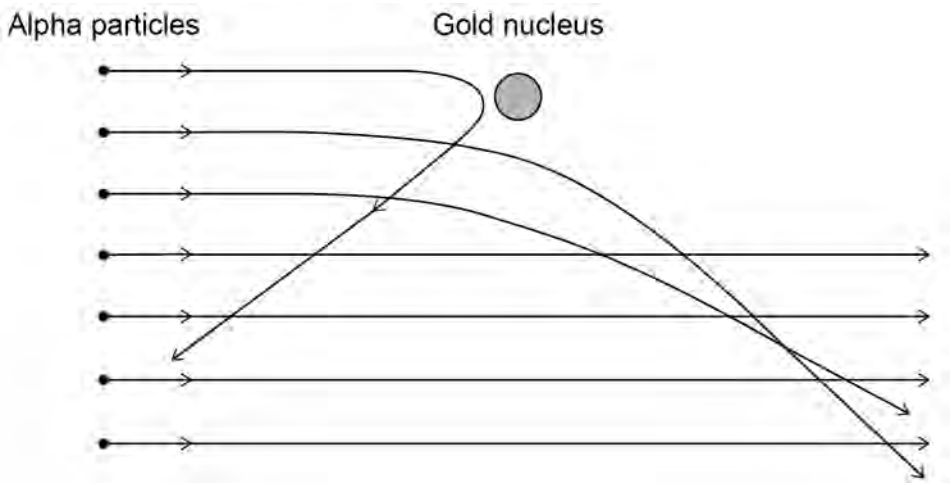
4.8.1.3 Orbital motion, natural and artificial satellites

Question 51 · continued

0 4 . 3 The alpha particle scattering experiment led to the nuclear model of the atom.

Figure 5 shows the paths of alpha particles travelling close to a gold nucleus.

Figure 5



Complete the sentences.

Choose answers from the box.

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

[3 marks]

attracts	**decreases**	**does not change**
increases	**reflects**	**repels**

Alpha particles and gold nuclei are both positively charged.

The gold nucleus _____ the alpha particles.

As the alpha particle approaches the gold nucleus, the electric field strength experienced by the alpha particle _____ .

As an alpha particle approaches the gold nucleus, the force experienced by the alpha particle _____ .

4.8.1.3 Orbital motion, natural and artificial satellites

Question 51 · continued

0 4 . 4 The results of the alpha particle scattering experiment were reproducible.

What does reproducible mean?

[1 mark]

Tick (✓) **one** box.

- Another scientist repeats the experiment and gets the same results. ☐
- Another scientist repeats the experiment and gets different results. ☐
- The same scientist repeats the experiment and gets the same results. ☐
- The same scientist repeats the experiment and gets different results. ☐

6

4.8.1.3 Orbital motion, natural and artificial satellites

Question 52

November 2020 | 8463/2F | Original Q2

0 2 Our solar system includes the Sun, planets and moons.

0 2 . 1 Complete the sentence.

Choose the answer from the box.

[1 mark]

Andromeda	**Milky Way**	**Pinwheel**	**Whirlpool**

Our solar system is part of the _____ galaxy.

0 2 . 2 Planets orbit the Sun.

What force causes planets to orbit the Sun?

[1 mark]

_____

Table 2 shows data about five planets.

Table 2

Planet	Mean distance from the Sun in millions of kilometres	Mean surface temperature in °C
Earth	150	+22
Mars	228	–48
Jupiter	778	**X**
Saturn	1430	–178
Uranus	2870	–200

0 2 . 3 How does the mean surface temperature of the planets in **Table 2** change as the mean distance from the Sun increases?

[1 mark]

_____

_____

4.8.1.3 Orbital motion, natural and artificial satellites

Question 52 · continued

0 2 . 4 Predict the mean surface temperature of Jupiter (**X**) in **Table 2**.

[1 mark]

Mean surface temperature of Jupiter = _____ °C

0 2 . 5 Five of the planets in the solar system are given in **Table 2**.

How many other planets are there in the solar system?

[1 mark]

Tick (✓) **one** box.

Two ☐

Three ☐

Four ☐

Five ☐

0 2 . 6 Our Moon is a natural satellite.

Why is the Moon classified as a satellite?

[1 mark]

Tick (✓) **one** box.

It has no atmosphere. ☐

It has no gravitational field. ☐

It is too small to be a planet. ☐

It orbits a planet. ☐

Question 2 continues on the next page

4.8.1.3 Orbital motion, natural and artificial satellites

Question 52 · continued

0 2 . 7 How are planets and moons similar?

[2 marks]

Tick (✓) **two** boxes.

- Their mass is about the same. ☐
- Their orbits are circular. ☐
- Their surfaces are the same colour. ☐
- They are similar in diameter. ☐
- They do not emit visible light. ☐

0 2 . 8 The diameter of the Earth is 13 000 km.

The diameter of the Sun is 110 times greater than the diameter of the Earth.

Calculate the diameter of the Sun.

[2 marks]

Diameter of the Sun = _____ km

10

4.8.1.3 Orbital motion, natural and artificial satellites

Question 53

June 2022 | 8463/2F | Original Q3

0 3 The Sun is at the centre of our solar system.

0 3 . 1 What type of object is the Sun?

[1 mark]

0 3 . 2 What is the name of the galaxy our solar system is part of?

[1 mark]

Tick (✓) **one** box.

- Andromeda ☐
- Milky Way ☐
- Sombrero ☐
- Tadpole ☐

4.8.1.3 Orbital motion, natural and artificial satellites

Question 53 · continued

Table 2 gives information about some of the moons in our solar system.

Table 2

Moon	Radius in kilometres
Ganymede	2630
Titan	2570
Europa	1560
Charon	606

0 3 . 3 What is a moon?

[1 mark]

0 3 . 4 A student researched the radius of some planets in the solar system.

radius of largest dwarf planet = 1190 km
radius of smallest planet = 2440 km

The student made the following conclusions:

1. dwarf planets are always smaller than moons
2. planets are always bigger than moons.

Give **one** reason why each of the student's conclusions is wrong.

Use the data given above and in **Table 2**.

[2 marks]

1

2

Question 3 continues on the next page

4.8.1.3 Orbital motion, natural and artificial satellites

Question 53 · continued

The Earth's Moon and the International Space Station both orbit the Earth.

0 3 . 5 Give **one other** similarity and **one** difference between the orbit of the Earth's Moon and the orbit of the International Space Station.

[2 marks]

Similarity _____

_____

Difference _____

_____

0 3 . 6 Very few people have been to the International Space Station.

Suggest **one** reason why very few people have been to the International Space Station.

[1 mark]

_____

_____

_____

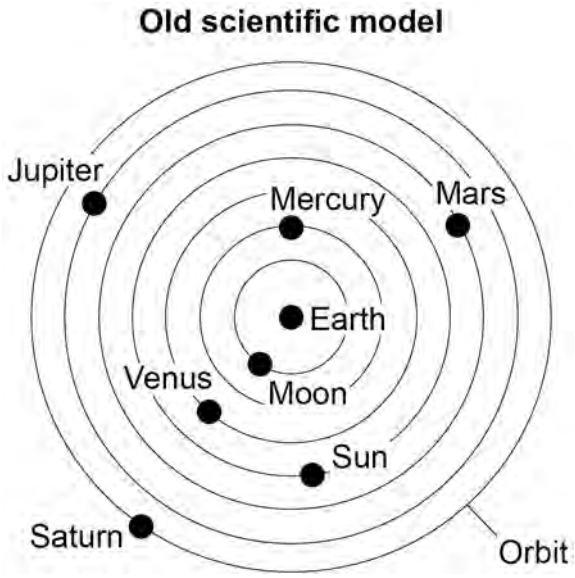
8

4.8.1.3 Orbital motion, natural and artificial satellites

Question 54

0 4 **Figure 10** shows an old scientific model of the solar system that has now been replaced.

Figure 10



0 4 . 1 Which statement is a reason for replacing an old scientific model with a newer scientific model?

[1 mark]

Tick (✓) **one** box.

The old model cannot explain new observations. ☐

The old model has been used by scientists for a long time. ☐

The old model is too simple. ☐

4.8.1.3 Orbital motion, natural and artificial satellites

Question 54 · continued

0 4 . 2 Compare the model of the solar system used now with the old model of the solar system shown in **Figure 10**.

[4 marks]

Question 4 continues on the next page

Question 54 · continued

Table 1 shows data about four planets.

Table 1

Planet	Mean distance from the Sun in millions of kilometres	Time taken for one orbit in Earth years
Mercury	58	0.25
Venus	108	0.60
Earth	150	1.00
Mars	228	1.90

0 4 . 3 How does the time taken for one orbit change as the mean distance from the Sun increases?

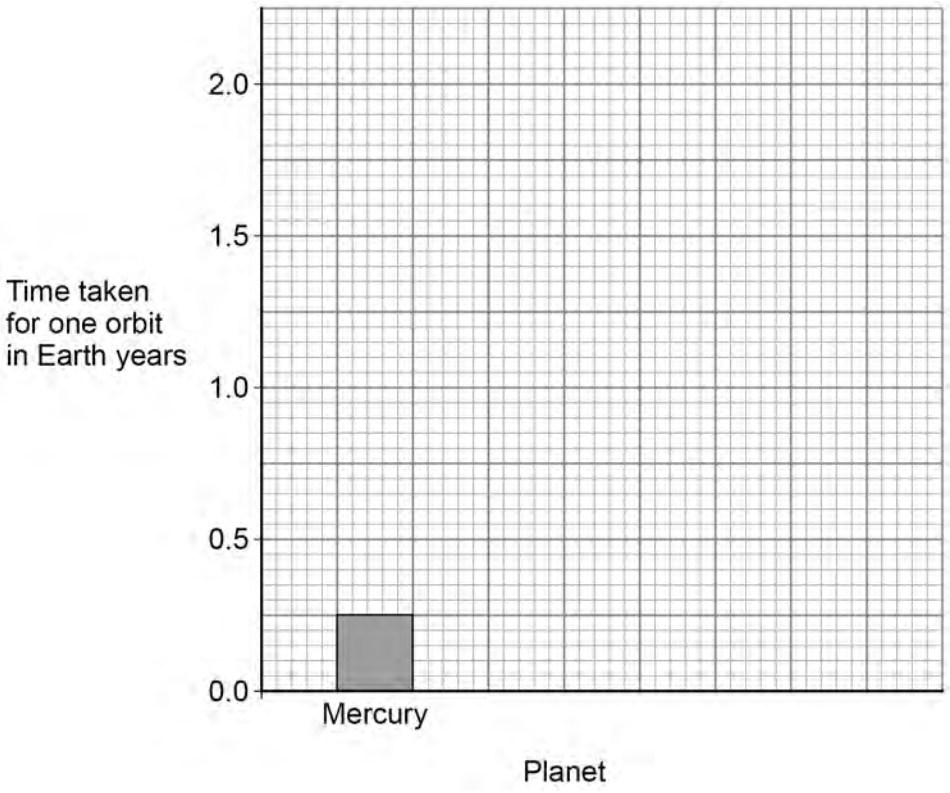
[1 mark]

4.8.1.3 Orbital motion, natural and artificial satellites

Question 54 · continued

0 4 . 4 The bar chart in **Figure 11** shows some of the data from **Table 1**.

Figure 11



Complete the bar chart.

Use data from **Table 1**.

[2 marks]

Question 4 continues on the next page

Question 54 · continued

0 4 . 5 All stars have a life cycle.

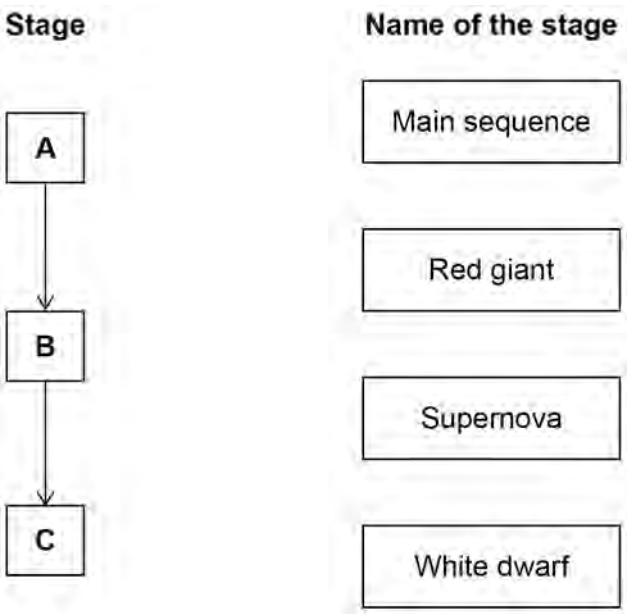
A, **B** and **C** in **Figure 12** represent three stages in the life cycle of the Sun.

The stages are in the correct order.

Draw **one** line from each stage to the name of the stage.

[2 marks]

Figure 12



0 4 . 6 Stars act like black bodies.

Which statement is true for perfect black bodies?

[1 mark]

Tick (✓) **one** box.

They are good reflectors of radiation. ☐

They are the best emitters of radiation. ☐

They easily transmit radiation. ☐

11

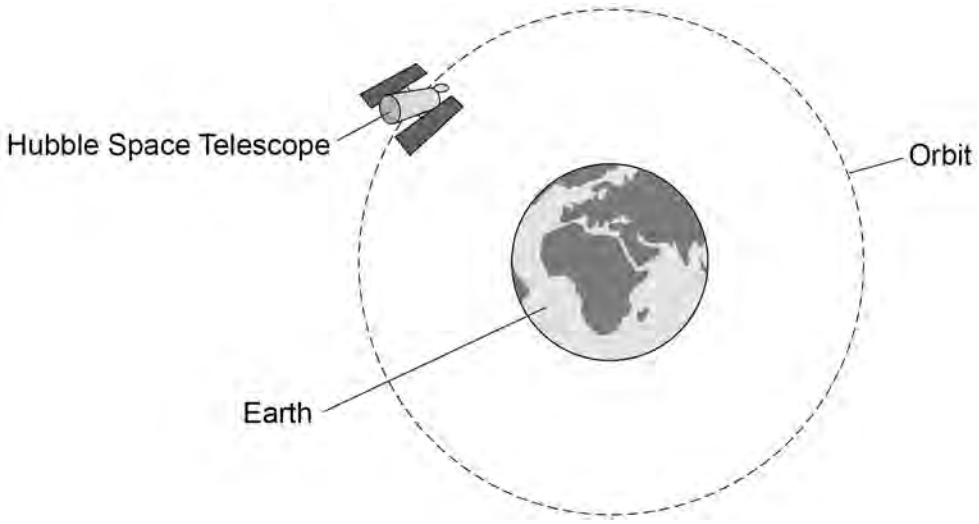
4.8.1.3 Orbital motion, natural and artificial satellites

Question 55

June 2023 | 8463/2F | Original Q7

0 7 **Figure 17** shows the Hubble Space Telescope orbiting the Earth.

Figure 17



0 7 . 1 What name is given to an object that orbits a planet?

[1 mark]

Tick (✓) **one** box.

A comet ☐

A satellite ☐

A star ☐

0 7 . 2 The Earth exerts a gravitational force on the Hubble Space Telescope.

Draw an arrow on **Figure 17** to show the gravitational force.

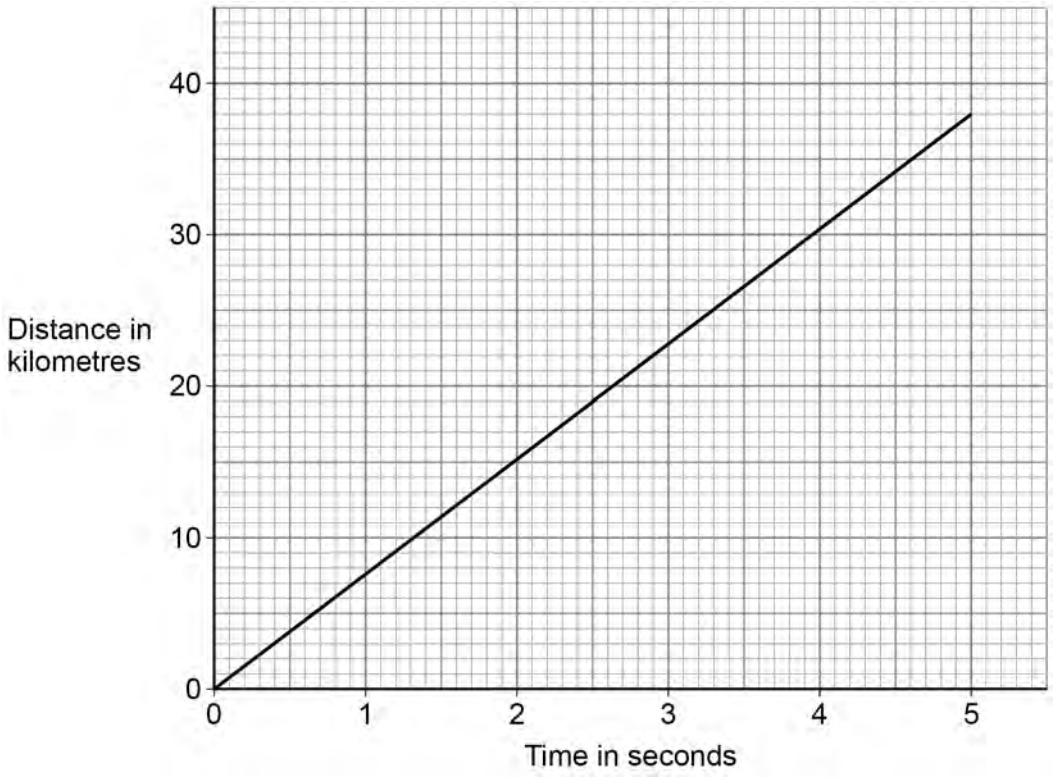
[1 mark]

4.8.1.3 Orbital motion, natural and artificial satellites

Question 55 · continued

0 7 . 3 **Figure 18** shows how the distance travelled by the Hubble Space Telescope during its orbit changes with time.

Figure 18



The gradient of the line in **Figure 18** gives the speed of the Hubble Space Telescope.

Determine the speed of the Hubble Space Telescope.

Give your answer in km/s.

[3 marks]

Speed = _____ km/s

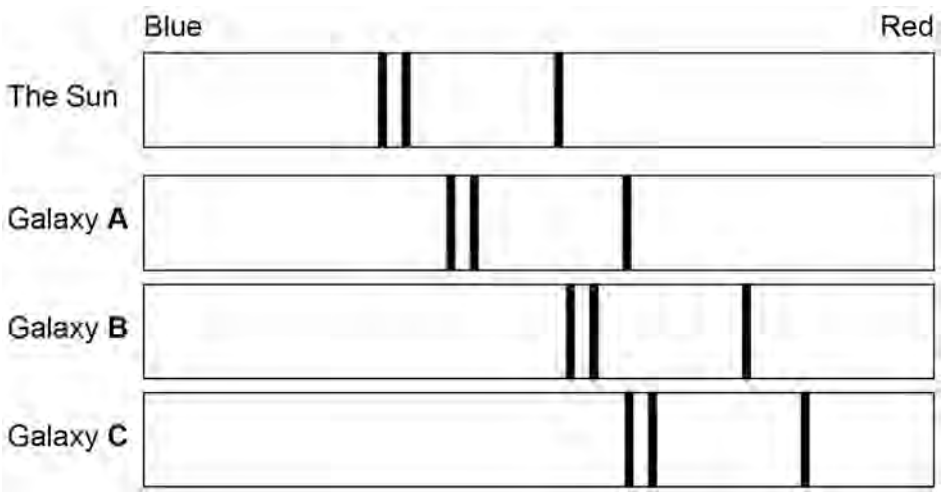
Question 55 · continued

The Hubble Space Telescope can detect the visible light spectra from distant galaxies.

The visible light spectra from stars and galaxies include dark lines at specific wavelengths.

Figure 19 shows the visible light spectra from the Sun and three galaxies.

Figure 19



0 7 . 4 Which galaxy is moving away from the Earth the fastest?

[1 mark]

Tick (✓) **one** box.

Galaxy **A** ☐

Galaxy **B** ☐

Galaxy **C** ☐

4.8.1.3 Orbital motion, natural and artificial satellites

Question 55 · continued June 2023 | 8463/2F | Original Q7

0 7 . 5 Which galaxy is the furthest away from the Earth?

[1 mark]

Tick (✓) **one** box.

Galaxy **A** ☐

Galaxy **B** ☐

Galaxy **C** ☐

0 7 . 6 New scientific observations indicate that many galaxies rotate too quickly for the known mass of the stars they contain.

Why is it important that new scientific observations are peer reviewed?

[1 mark]

Tick (✓) **one** box.

To check the observations are correct ☐

To identify control variables ☐

To provide more proof ☐

8

4.8.1.3 Orbital motion, natural and artificial satellites

Question 56

0 3 Telescopes are used to observe distant objects.

0 3 . 1 Complete the sentences.

Choose answers from the box.

[2 marks]

galaxy	**moon**	**nebula**	**star**	**universe**

A natural satellite of a planet is called a _____.

A planet orbits a _____.

0 3 . 2 What is the name of our galaxy?

[1 mark]

Tick (✓) **one** box.

- Andromeda ☐
- Centaurus ☐
- Milky Way ☐
- Whirlpool ☐

4.8.1.3 Orbital motion, natural and artificial satellites

Question 56 · continued

0 3 . 3 The Sun is our nearest star.

What will happen to the Sun at the end of its life cycle?

[1 mark]

Tick (✓) **one** box.

- It will become a black dwarf. ☐
- It will become a black hole. ☐
- It will become a neutron star. ☐

The James Webb Space Telescope is the most powerful telescope ever launched into space.

0 3 . 4 Very distant galaxies can be observed using the James Webb Space Telescope.

How does the speed of a very distant galaxy compare to the speed of a much nearer galaxy?

[1 mark]

Tick (✓) **one** box.

- A very distant galaxy moves faster. ☐
- The speeds are the same. ☐
- A very distant galaxy moves slower. ☐

Question 3 continues on the next page

4.8.1.3 Orbital motion, natural and artificial satellites

Question 56 · continued

0 3 . 5 There is an observed increase in the wavelength of light from most distant galaxies.

What name is given to this increase in the wavelength of light?

[1 mark]

Tick (✓) **one** box.

Blue-shift ☐

Green-shift ☐

Red-shift ☐

0 3 . 6 Observations from the James Webb Space Telescope support the Big Bang theory.

Complete the sentence.

Choose the answer from the box.

[1 mark]

cold	hot	large

The Big Bang theory suggests that the universe began from a region that

was extremely _____.

0 3 . 7 What does the Big Bang theory suggest is happening to the size of the universe?

[1 mark]

Tick (✓) **one** box.

The universe is getting smaller. ☐

The size of the universe is constant. ☐

The universe is getting bigger. ☐

8