AQA GCSE Physics | 8463

SPECIFICATION POINT 4.7.2.1

Electromagnetism

Past-paper questions

Tier	**Higher**
Question groups	**85**
Available paper years	**2004–2025**

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.

4.7.2.1 Electromagnetism

Question 01

June 2004 | 3451H | Original Q2 | Legacy

2 The diagram represents the electromagnetic spectrum.

Gamma rays	X-rays	Ultraviolet	Visible light	Infra red	Microwaves	Radio waves

(a) Name the type of electromagnetic radiation that is used:

(i) to sterilise surgical instruments;

.....

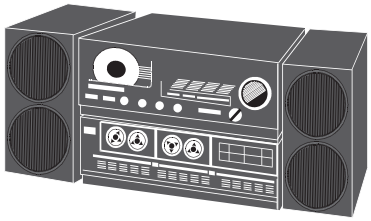
(1 mark)

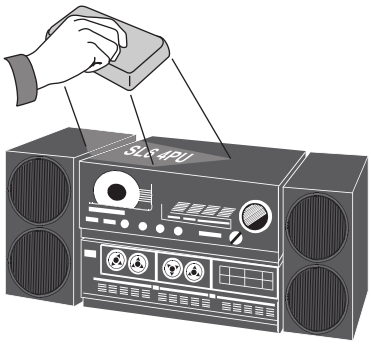
(ii) to send a signal to a TV from a remote control.

.....

(1 mark)

(b) Valuable items can be security marked using special ink. The ink can only be seen in ultraviolet radiation.





Explain what happens to make the ink visible.

.....

.....

.....

.....

(2 marks)

4.7.2.1 Electromagnetism

Question 01 · continued

MARGIN BLANK

(c) Explain why skin cells need to be protected from ultraviolet radiation.

.....

.....

.....

.....

(2 marks)

(d) The following information is from an oven that combines a microwave and a grill.

Voltage	230 V
Microwave power	0.65 kW
Grill power	1.15 kW

(i) Name the **two** types of electromagnetic radiation that the oven can use to cook food.

..... and .....

(1 mark)

(ii) A joint of meat is cooked using both the microwave and the grill. Both are switched on at full power for half an hour.

Use the following equation to calculate the energy transferred, in kilowatt-hours, by the oven. Show clearly how you obtain your answer.

energy transferred = power × time

.....

.....

.....

energy transferred =.....kWh

(2 marks)

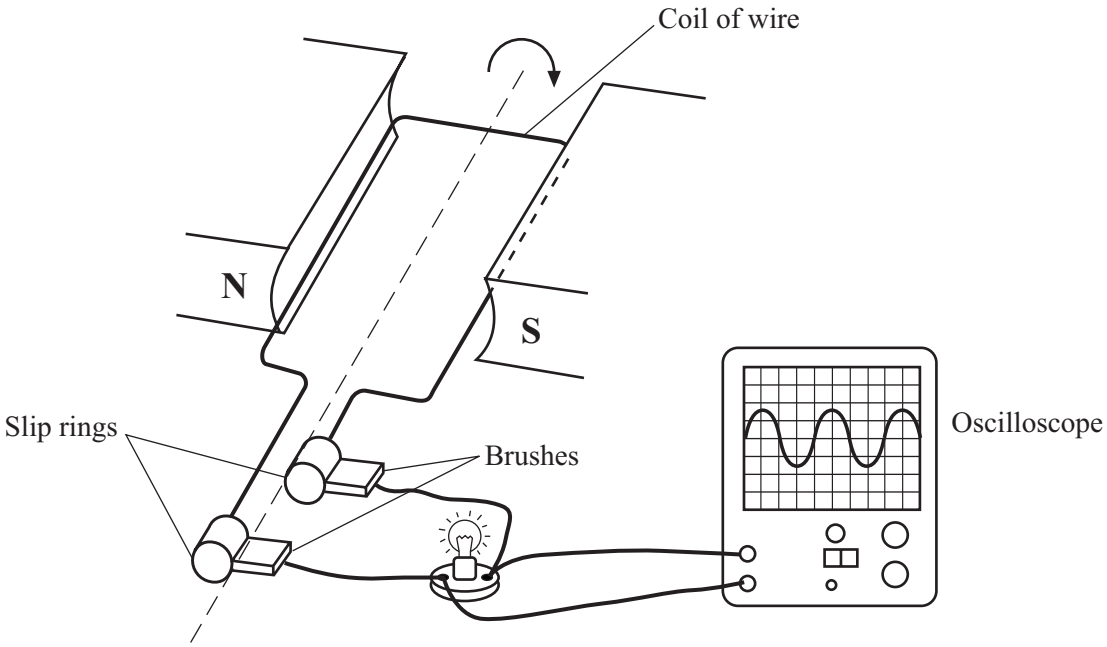
9

4.7.2.1 Electromagnetism

Question 02

June 2004 | 3451H | Original Q11 | Legacy

11 (a) The diagram shows a simple generator. The trace on the oscilloscope shows that the generator produces an alternating current.



(i) Explain how the generator works. Include in your answer the reasons why the slip rings and brushes are needed.

.....

.....

.....

.....

.....

.....

.....

.....

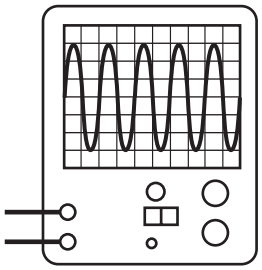
(4 marks)

4.7.2.1 Electromagnetism

Question 02 · continued

MARGIN BLANK

(ii) What should be done to make the generator give the oscilloscope trace drawn below? Assume the controls on the oscilloscope are unchanged.



.....

.....

.....

.....

(2 marks)

(b) Explain why electricity is transmitted through the National Grid as alternating current (a.c.) rather than direct current (d.c.).

.....

.....

.....

.....

.....

.....

(3 marks)

9

4.7.2.1 Electromagnetism

Question 03

June 2004 | 3462H3 | Original Q2 | Legacy

2 The diagram represents the electromagnetic spectrum.

Gamma rays	X-rays	Ultraviolet	Visible light	Infra red	Microwaves	Radio waves

(a) Name the type of electromagnetic radiation that is used:

(i) to sterilise surgical instruments;

.....

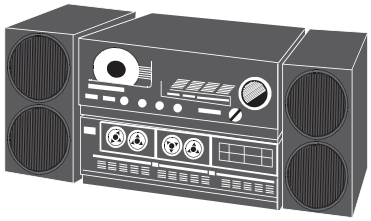
(1 mark)

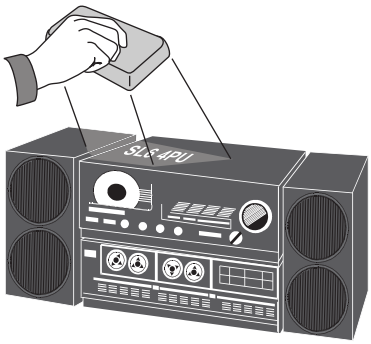
(ii) to send a signal to a TV from a remote control.

.....

(1 mark)

(b) Valuable items can be security marked using special ink. The ink can only be seen in ultraviolet radiation.





Explain what happens to make the ink visible.

.....

.....

.....

.....

(2 marks)

4.7.2.1 Electromagnetism

Question 03 · continued

MARGIN BLANK

(c) Explain why skin cells need to be protected from ultraviolet radiation.

.....

.....

.....

.....

(2 marks)

(d) The following information is from an oven that combines a microwave and a grill.

Voltage	230 V
Microwave power	0.65 kW
Grill power	1.15 kW

(i) Name the **two** types of electromagnetic radiation that the oven can use to cook food.

..... and .....

(1 mark)

(ii) A joint of meat is cooked using both the microwave and the grill. Both are switched on at full power for half an hour.

Use the following equation to calculate the energy transferred, in kilowatt-hours, by the oven. Show clearly how you obtain your answer.

energy transferred = power × time

.....

.....

.....

energy transferred =.....kWh

(2 marks)

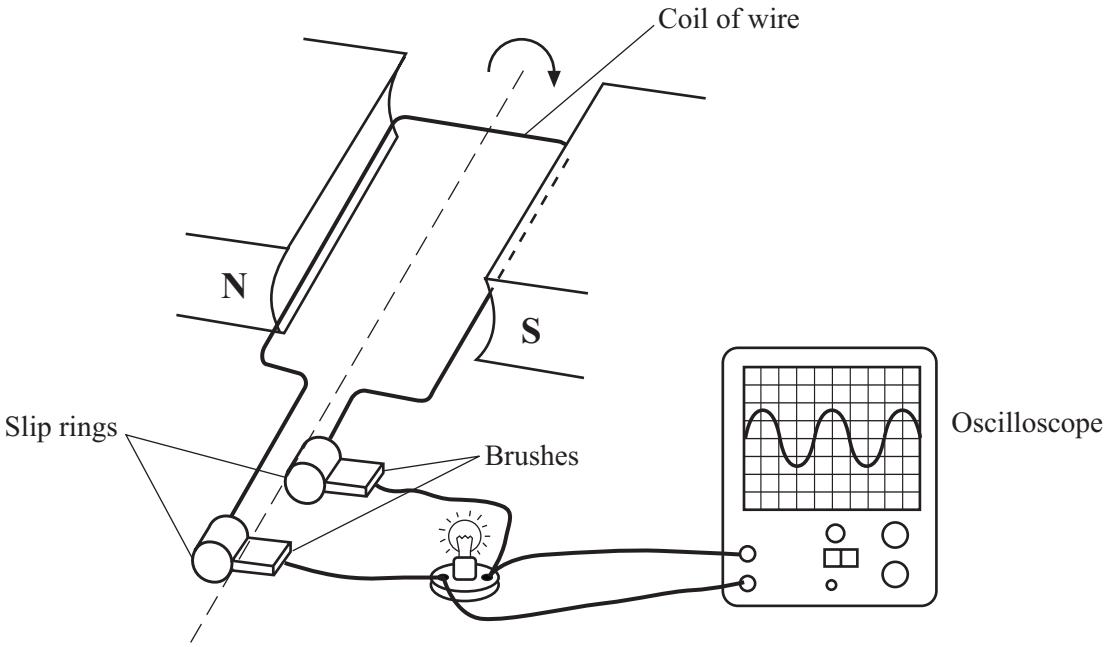
9

4.7.2.1 Electromagnetism

Question 04

June 2004 | 3462H3 | Original Q9 | Legacy

9 (a) The diagram shows a simple generator. The trace on the oscilloscope shows that the generator produces an alternating current.



(i) Explain how the generator works. Include in your answer the reasons why the slip rings and brushes are needed.

.....

.....

.....

.....

.....

.....

.....

.....

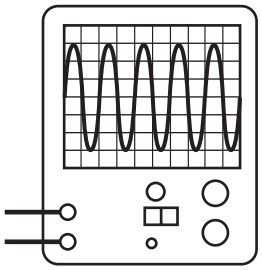
(4 marks)

4.7.2.1 Electromagnetism

Question 04 · continued

MARGIN BLANK

(ii) What should be done to make the generator give the oscilloscope trace drawn below? Assume the controls on the oscilloscope are unchanged.



.....

.....

.....

.....

(2 marks)

(b) Explain why electricity is transmitted through the National Grid as alternating current (a.c.) rather than direct current (d.c.).

.....

.....

.....

.....

.....

.....

(3 marks)

9

4.7.2.1 Electromagnetism

Question 05

June 2005 | 3451 | Original Q10 | Legacy

10 (a) Information transmitted through an optical fibre communications system is sent as a digital signal.

(i) Name **one** type of electromagnetic wave, other than visible light, used to carry information through an optical fibre.

.....

(1 mark)

(ii) What is a digital signal?

.....

.....

(1 mark)

(b) Information can be sent as an analogue signal. The signals weaken with distance and need to be amplified.
Explain why this causes the quality of the signal to deteriorate.

.....

.....

.....

.....

.....

.....

(3 marks)

(c) Microwaves are used to send information within mobile phone networks.

Explain how microwaves could be harmful to living cells.

.....

.....

.....

.....

(2 marks)

7

4.7.2.1 Electromagnetism

Question 06

June 2005 | 3462 | Original Q8 | Legacy

8 (a) Information transmitted through an optical fibre communications system is sent as a digital signal.

(i) Name **one** type of electromagnetic wave, other than visible light, used to carry information through an optical fibre.

.....

(1 mark)

(ii) What is a digital signal?

.....

.....

(1 mark)

(b) Information can be sent as an analogue signal. The signals weaken with distance and need to be amplified.
Explain why this causes the quality of the signal to deteriorate.

.....

.....

.....

.....

.....

.....

(3 marks)

(c) Microwaves are used to send information within mobile phone networks.

Explain how microwaves could be harmful to living cells.

.....

.....

.....

.....

(2 marks)

7

4.7.2.1 Electromagnetism

Question 07

November 2006 | PHY1B | Original Q2 | Legacy

QUESTION TWO

Electromagnetic radiation is often absorbed.

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

A current

B energy

C frequency

D substance

When electromagnetic radiation is absorbed, the . . . **1** . . . which absorbs it becomes hotter. This is because the radiation carries . . . **2** . . . . The radiation may create an alternating . . . **3** . . . with the same . . . **4** . . . as the radiation itself.

Turn over for the next question

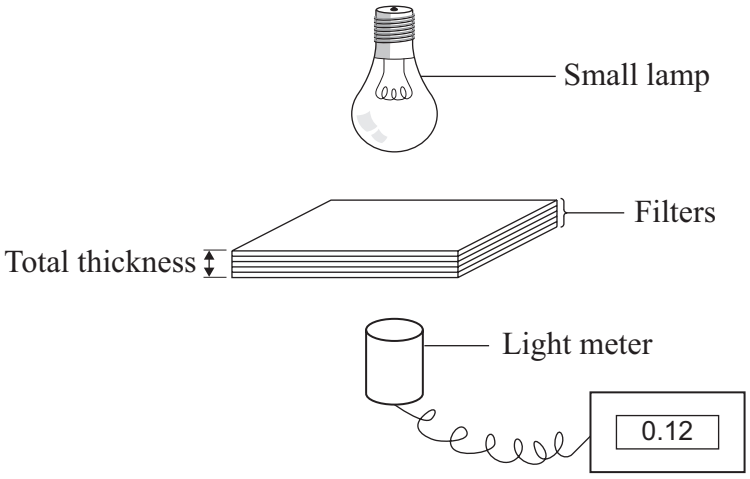
4.7.2.1 Electromagnetism

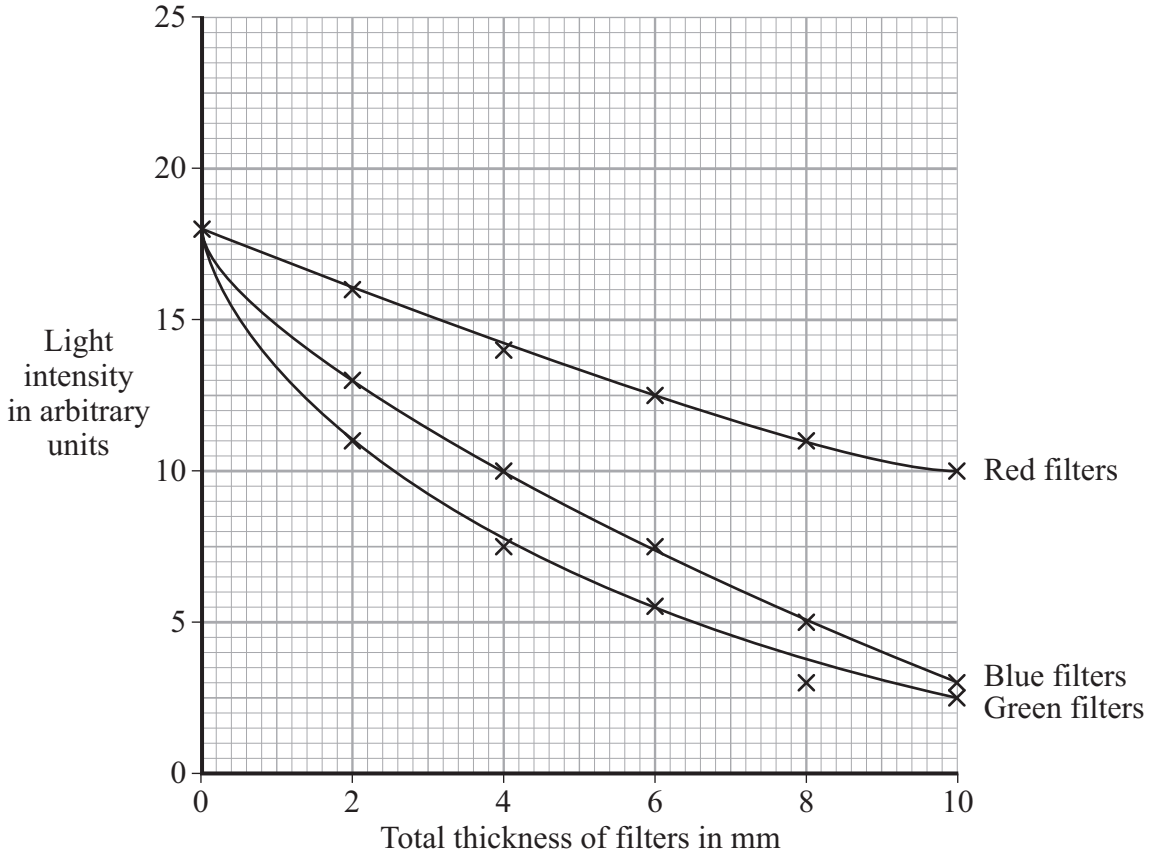
Question 08

November 2006 | PHY1B | Original Q7 | Legacy

QUESTION SEVEN

The graph shows the light intensity readings when different numbers of coloured filters were placed between a small lamp and a light meter. Each filter was 1 mm thick.





4.7.2.1 Electromagnetism

Question 08 · continued

7A What is the light intensity reading when seven blue filters are used?

1 4.5

2 6.2

3 6.5

4 6.6

7B Which is the best description of the pattern for all the coloured filters shown on the graph?

1 As the total thickness of the filters increases, the light intensity transmitted decreases.

2 As the total thickness of the filters increases, the light intensity transmitted increases.

3 The light intensity transmitted is directly proportional to the total thickness of the filters.

4 The light intensity transmitted is inversely proportional to the total thickness of the filters.

7C Which types of electromagnetic radiation can be used to send signals along optical fibres?

1 infra red rays and ultraviolet rays

2 infra red rays and visible light

3 infra red rays, ultraviolet rays and visible light

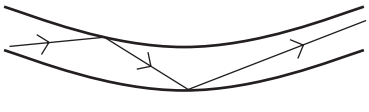
4 visible light and ultraviolet rays

7D Which diagram shows the path of electromagnetic radiation along an optical fibre?

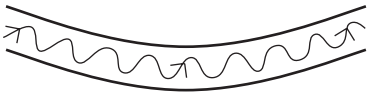
1



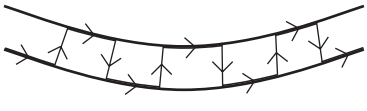
2



3



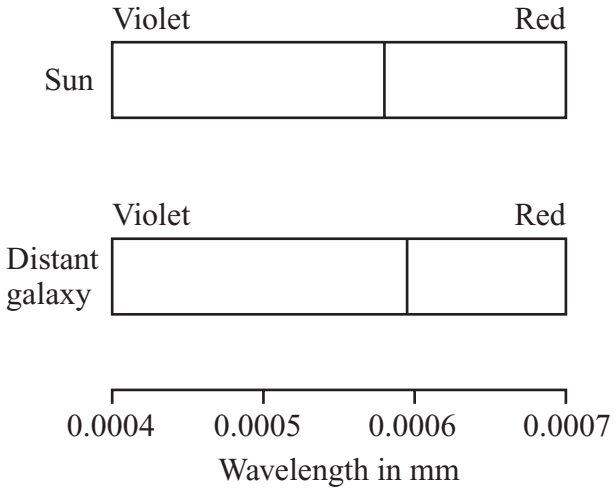
4



4.7.2.1 Electromagnetism

Question 09

3 The visible part of the electromagnetic spectrum from a star includes a dark line. This line is at a specific wavelength. The diagram shows the position of the dark line in the spectrum from the Sun and in the spectrum from a distant galaxy.



(a) Explain how the spectrum 'shift' of the dark line supports the theory that the Universe began from a very small point.

.....

.....

.....

.....

.....

.....

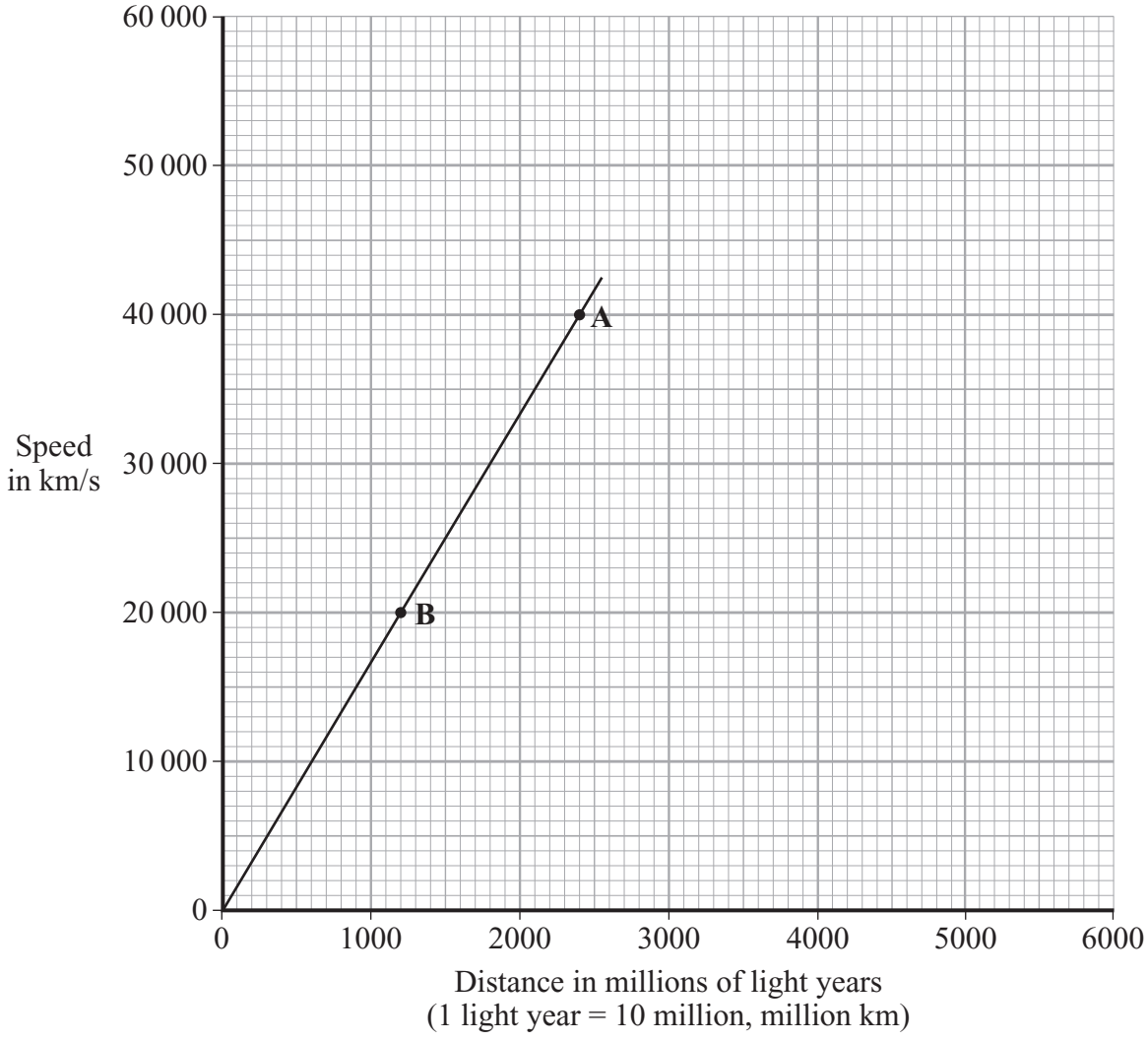
(3 marks)

Question 3 continues on the next page

Question 09 · continued

BLANK

(b) From data collected, a graph can be drawn that links the speed of a galaxy with the distance of the galaxy from the Earth.



(i) How does the visible light spectrum from galaxy **A** look different from the visible light spectrum from galaxy **B**?

.....

.....

(1 mark)

4.7.2.1 Electromagnetism

Question 09 · continued

BLANK

(ii) A third galaxy, **C**, seems to be travelling away from the Earth at about 60 000 km/s.

Estimate how far galaxy **C** might be from the Earth, showing how you use the graph to do this.

.....

.....

Distance between galaxy **C** and the Earth = ... million light years

(2 marks)

(c) Astronomers use telescopes to observe distant galaxies. Since 1990 the Hubble optical telescope has been in orbit around the Earth.

Explain why an optical telescope in space allows astronomers to see further and more clearly than an optical telescope on Earth.

.....

.....

.....

.....

(2 marks)

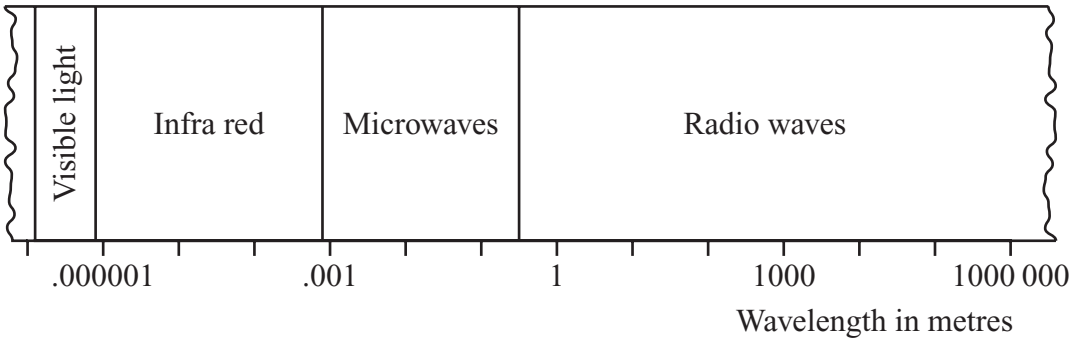
8

4.7.2.1 Electromagnetism

Question 10

January 2007 | PHY1H | Original Q5 | Legacy

5 (a) The diagram represents part of the electromagnetic spectrum.



(i) Visible light travels through air at 300 000 000 m/s.

Why can we assume that radio waves travel through air at the same speed as light?

.....

(1 mark)

(ii) A radio station broadcasts at a frequency of 200 kHz.

Use the following equation to calculate the wavelength of the waves broadcast by this radio station. Show clearly how you work out your answer.

wave speed = frequency × wavelength

.....

.....

Wavelength = ... m

(2 marks)

(iii) Draw a vertical line on the diagram above to show the position of this radio wave in the electromagnetic spectrum.

(1 mark)

(b) Many radio stations now broadcast digital signals instead of *analogue* signals.

(i) What is an *analogue* signal?

.....

(1 mark)

4.7.2.1 Electromagnetism

Question 10 · continued

BLANK

(ii) Give **one** reason why a radio station would broadcast digital signals instead of analogue signals.

.....

.....

(1 mark)

(c) A student thinks that because energy cannot be destroyed it is not possible to waste energy. So he leaves his radio, TV and computer on all the time, even when there is no one in the house.

Explain why he is wrong about not being able to waste energy.

.....

.....

.....

.....

(2 marks)

8

4.7.2.1 Electromagnetism

Question 11

March 2007 | PHY1B | Original Q2 | Legacy

QUESTION TWO

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

A gamma rays

B microwaves

C ultraviolet rays

D X-rays

	Properties of radiation
1	do not penetrate human tissue below skin depth but can cause severe burns
2	penetrate only a few centimetres into human tissue but produce a lot of heat
3	pass through all types of human tissue, including bones, and can kill all types of cell
4	pass easily through soft human tissue without much absorption

4.7.2.1 Electromagnetism

Question 12

March 2007 | PHY1B | Original Q4 | Legacy

QUESTION FOUR

A student has been learning about the electromagnetic spectrum.

4A Which part(s) of the electromagnetic spectrum can be used for communication?

1 radio waves only

2 radio waves and microwaves only

3 radio waves, microwaves and infra red rays only

4 radio waves, microwaves, infra red rays and visible light

4B Waves of the electromagnetic spectrum travel through space.

When they do, which property is the same for all of them?

1 energy

2 penetration

3 power

4 speed

4C The frequency of a radio signal is increased.

Which is correct?

1 Its speed decreases.

2 Its speed increases.

3 Its wavelength decreases.

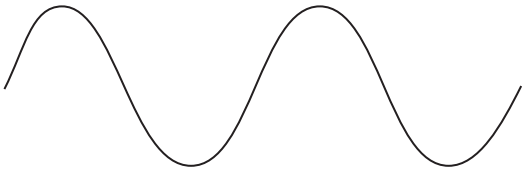
4 Its wavelength increases.

4.7.2.1 Electromagnetism

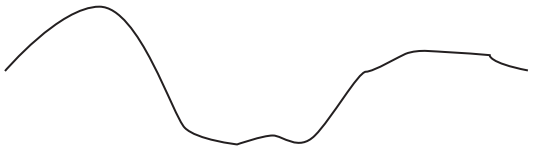
Question 12 · continued

4D Communication signals are often digital. The diagrams show four signals.

E



F



G



H

Which two could be digital?

1 **E** and **F**

2 **F** and **G**

3 **G** and **H**

4 **H** and **E**

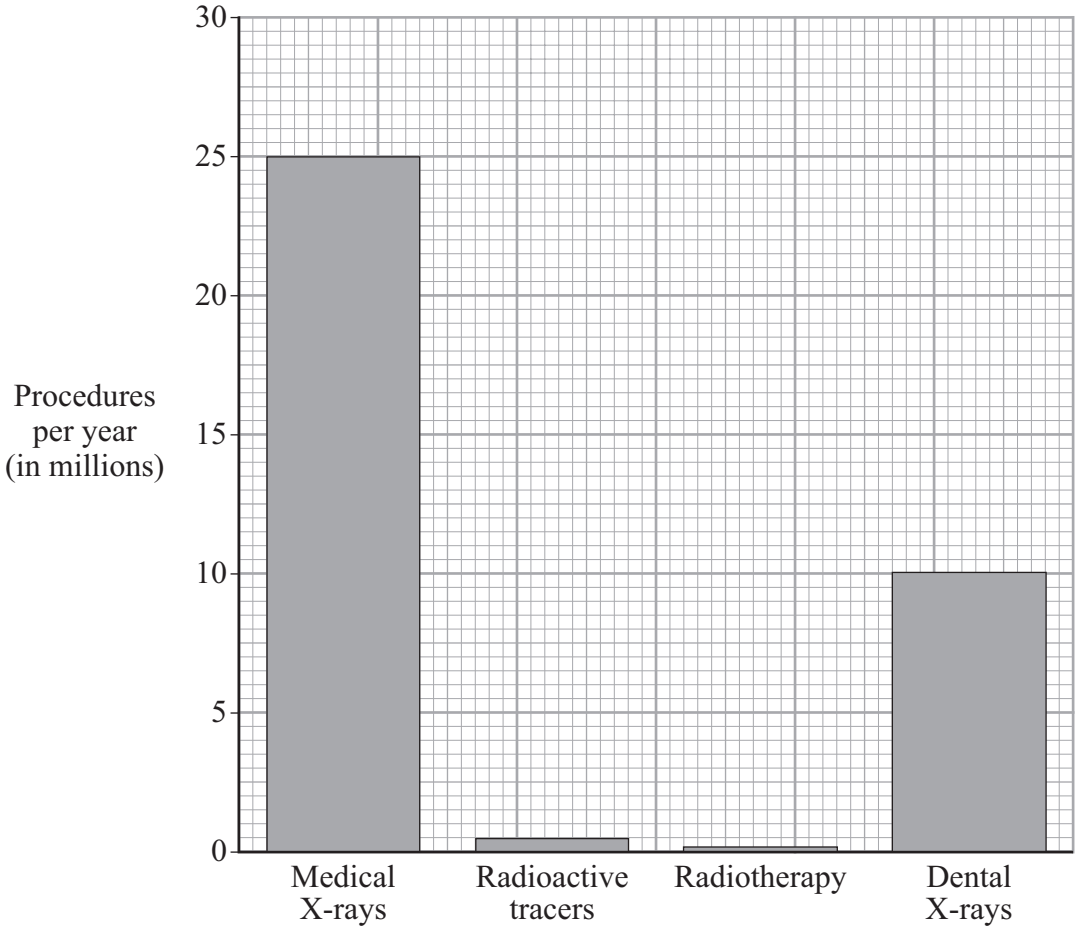
4.7.2.1 Electromagnetism

Question 13

June 2007 | PHY1B | Original Q5 | Legacy

QUESTION FIVE

The bar chart shows the number of medical procedures per year in the UK that involve exposure to electromagnetic and nuclear radiation.



5A In how many procedures were radioactive tracers used?

1 100 000

2 500 000

3 1 000 000

4 2 000 000

5B Which type of procedure is used to treat patients?

1 dental X-rays

2 medical X-rays

3 radioactive tracers

4 radiotherapy

4.7.2.1 Electromagnetism

5C What is the approximate total number of X-rays taken in the UK each year?

1 10 000

2 25 000

3 35 000

4 35 000 000

5D Medical X-rays are dangerous because . . .

1 they can pass through the body.

2 they cause burns to the skin.

3 they cause water inside cells to heat up.

4 they cause ionisation inside cells.

Turn over for the next question

4.7.2.1 Electromagnetism

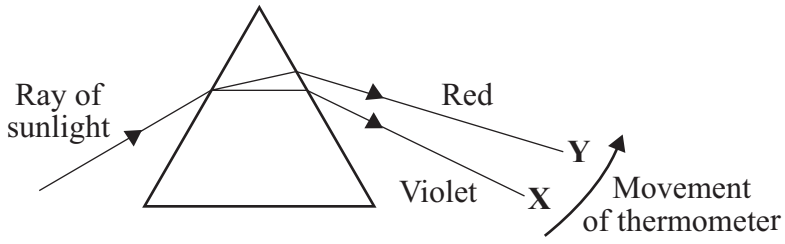
Question 14

June 2007 | PHY1B | Original Q6 | Legacy

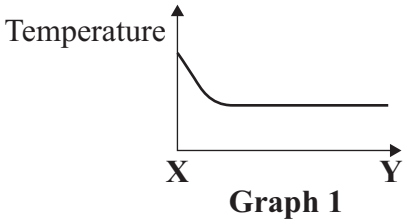
QUESTION SIX

When electromagnetic radiation is absorbed, the energy it carries makes the substance which absorbs it hotter and may create an alternating current of electricity.

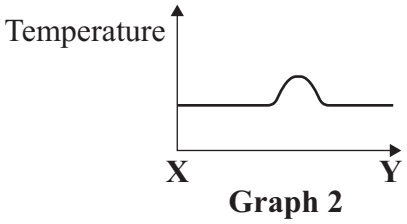
6A When sunlight passes through a prism, a visible spectrum forms. A thermometer is moved slowly from **X** to **Y**.



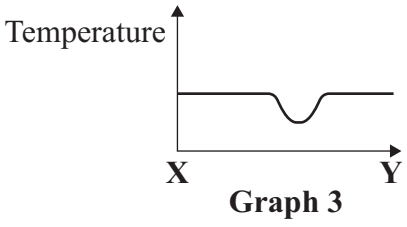
Which sketch graph shows the temperature change as the thermometer moves from **X** to **Y**?



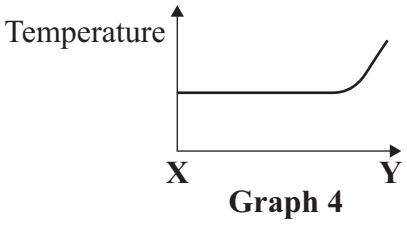
Graph 1



Graph 2



Graph 3



Graph 4

6B The absorption of electromagnetic radiation can create an alternating current in a wire.

This alternating current will have . . .

1 the same frequency as the electromagnetic radiation.

2 the same ionising power as the electromagnetic radiation.

3 the same speed as the electromagnetic radiation.

4 the same wavelength as the electromagnetic radiation.

4.7.2.1 Electromagnetism

Question 14 · continued

6C Which factors most affect the absorption of electromagnetic radiation by living cells?

1 speed and wavelength

2 speed, wavelength and size of dose

3 wavelength and size of dose

4 size of dose

6D During the solar eclipse of 2001, four students shared their observations.

Which student's observation was correct?

Student	Observation
1	"It went both cold and dark at the same time."
2	"It went cold, then it went dark."
3	"It went cold, then warm again, then dark."
4	"It went dark, then light again, then cold."

4.7.2.1 Electromagnetism

Question 15

June 2007 | PHY1B | Original Q7 | Legacy

QUESTION SEVEN

This question is about the transmission of light by optical fibres.

7A Optical fibres can bend light around corners without loss of signal.

This is because . . .

1 absorption of the signal occurs in the optical fibre.

2 following signals push the signals around the corners.

3 reflection of the signal occurs inside the optical fibre.

4 light signals are digital signals.

7B Infra red and visible light are used to send signals along optical fibres.

Compared with other electromagnetic radiations, infra red and visible light . . .

1 have similar frequencies and wavelengths.

2 have very high frequencies and very high wavelengths.

3 have very low frequencies and very low wavelengths.

4 travel at different speeds.

7C Communication by electromagnetic radiation may be by analogue signals.

Which row of the table correctly describes the characteristics of these analogue signals?

	Speed	Signal type
1	constant	continuously varying
2	constant	only on or off
3	varies	continuously varying
4	varies	only on or off

4.7.2.1 Electromagnetism

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

7D An infra red wave has a wavelength of 0.001 m and a wave speed of 300 000 000 m/s.

The frequency of this wave is:

1 3 Hz

2 30 Hz

3 30 000 Hz

4 300 000 000 000 Hz

Turn over for the next question

4.7.2.1 Electromagnetism

Question 16

June 2007 | PHY1H | Original Q4 | Legacy

4 (a) A student listens to the sound waves produced by a car siren. When the car is stationary, the student hears a constant frequency sound.

Describe how the wavelength and frequency of the sound waves heard by the student change when the car is driven away from the student.

.....

.....

.....

.....

(2 marks)

(b) Satellites fitted with various telescopes orbit the Earth. These telescopes detect different types of electromagnetic radiation.

Why are telescopes that detect different types of electromagnetic waves used to observe the Universe?

.....

.....

(1 mark)

(c) In 2005 a space telescope detected a star that exploded 13 billion years ago. The light from the star shows the biggest *red-shift* ever measured.

(i) What is *red-shift*?

.....

.....

(1 mark)

(ii) What does the measurement of its red-shift tell scientists about this star?

.....

.....

(1 mark)

4.7.2.1 Electromagnetism

Question 16 · continued

BLANK

(d) Red-shift provides evidence for the 'big bang' theory.

(i) Describe the 'big bang' theory.

.....

.....

.....

.....

(2 marks)

(ii) Suggest what scientists should do if new evidence were found that did not support the 'big bang' theory.

.....

.....

.....

(1 mark)

8

4.7.2.1 Electromagnetism

Question 17

November 2007 | PHY1B | Original Q2 | Legacy

QUESTION TWO

The table gives typical frequencies for different types of electromagnetic radiation.

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

A infra red radiation

B ultraviolet radiation

C visible light

D X-rays

Type of electromagnetic radiation	Typical frequency in Hz
1	100 000 billion
2	1 000 000 billion
3	10 000 000 billion
4	100 000 000 billion

4.7.2.1 Electromagnetism

Question 18

November 2007 | PHY1B | Original Q5 | Legacy

QUESTION FIVE

There are different types of electromagnetic radiation and nuclear radiation.

5A Which one of the following types of radiation is **not** used for communication?

1 infra red radiation

2 microwaves

3 visible light

4 X-rays

5B Which one of the following types of radiation has the longest wavelength?

1 infra red radiation

2 microwaves

3 visible light

4 X-rays

5C Which one of the following statements is **not** true of **both** ultraviolet radiation and infra red radiation?

1 They can be seen by the human eye.

2 They are members of the electromagnetic spectrum.

3 Each can have a range of different wavelengths and frequencies.

4 They travel at the same speed in a vacuum.

5D Which type of radiation is emitted by the nucleus of an atom of a radioactive isotope?

1 gamma radiation

2 X-rays

3 microwave radiation

4 ultraviolet radiation

4.7.2.1 Electromagnetism

Question 19

5 (a) The wavelengths of four different types of electromagnetic wave, including visible light waves, are given in the table.

Type of wave	Wavelength
Visible light	0.0005 mm
A	1.1 km
B	100 mm
C	0.18 mm

Which of the waves, **A**, **B** or **C**, is an infra red wave? .....

(1 mark)

(b) A TV station broadcasts at 500 000 kHz. The waves travel through the air at 300 000 000 m/s.

Use the equation in the box to calculate the wavelength of the waves broadcast by this station.

wave speed = frequency × wavelength

Show clearly how you work out your answer.

.....

.....

Wavelength = ... m

(2 marks)

(c) What happens when a metal aerial absorbs radio waves?

.....

.....

.....

.....

(2 marks)

4.7.2.1 Electromagnetism

Question 19 · continued

BLANK

(d) Stars emit all types of electromagnetic waves. Telescopes that monitor X-rays are mounted on satellites in space.

Why would an X-ray telescope based on Earth not be able to detect X-rays emitted from distant stars?

.....

.....

(1 mark)

6

Turn over for the next question

4.7.2.1 Electromagnetism

Question 20

March 2008 | PHY1BP | Original Q2 | Legacy

QUESTION TWO

The electromagnetic spectrum is continuous but the wavelengths within it can be grouped into types.

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

A gamma rays

B radio waves

C ultraviolet waves

D visible light

The type of electromagnetic radiation which can be used to send signals along optical fibres is . . . **1** . . . .

The type of electromagnetic radiation which has the highest frequency is . . . **2** . . . .

The type of radiation that has the longest wavelength is . . . **3** . . . .

The type of electromagnetic radiation used in sunbeds for tanning is . . . **4** . . . .

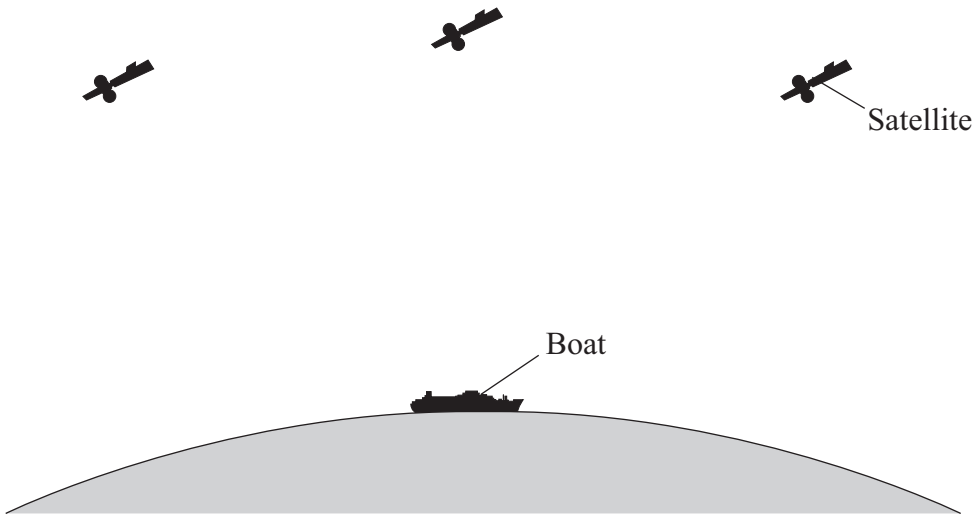
4.7.2.1 Electromagnetism

Question 21

March 2008 | PHY1BP | Original Q6 | Legacy

QUESTION SIX

Geostationary satellites can be used for navigation. These satellites remain in the same position above the Earth as the Earth spins on its axis. For accurate navigation, the signals from three satellites are needed.



6A Electromagnetic radiation is used to communicate with the satellites.

Here are two statements about electromagnetic radiation.

X All electromagnetic radiation travels as waves.

Y All forms of electromagnetic radiation travel at the same speed through space.

The correct statements are . . .

1 **X** only.

2 **Y** only.

3 both **X** and **Y**.

4 neither **X** nor **Y**.

Question 21 · continued March 2008 | PHY1BP | Original Q6 | Legacy

6B What effect will signals from the satellite have on the metal aerial on the boat?

1 heat up the metal and destroy some of its atoms

2 heat up the metal and set up an alternating electric current

3 produce microwaves which carry the information to be displayed

4 produce microwaves which set up an alternating electrical current

6C The electromagnetic radiation has a speed of 300 000 000 m/s and a wavelength of 0.1 m.

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

What is its frequency?

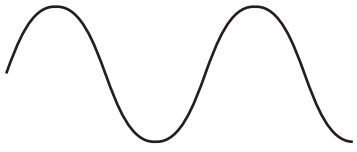
1 3.33 Hz

2 30 000 000 Hz

3 33 000 000 Hz

4 3 000 000 000 Hz

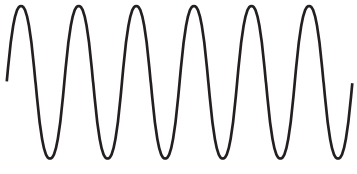
6D Which of these signals could be processed by a computer within the navigation system?



1



2



3



4

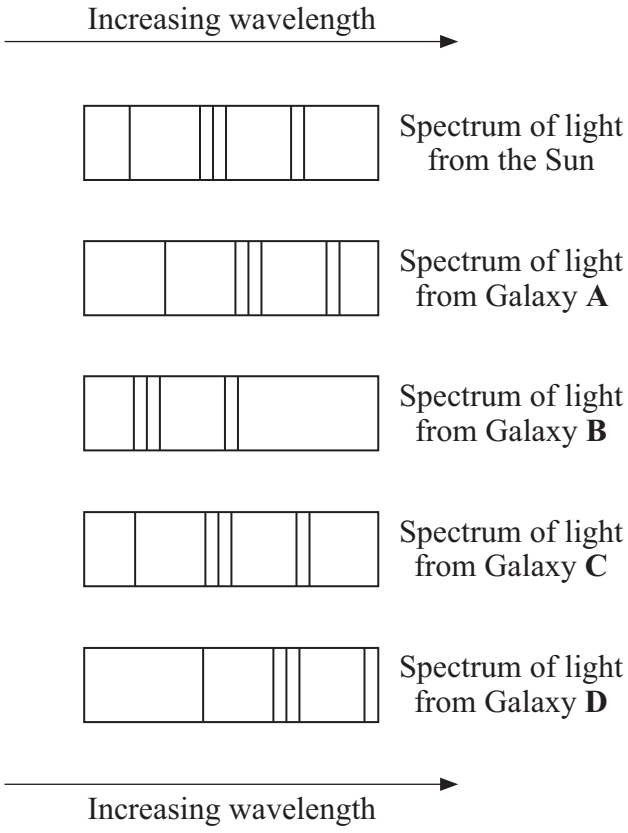
4.7.2.1 Electromagnetism

Question 22

March 2008 | PHY1BP | Original Q7 | Legacy

QUESTION SEVEN

The visible part of the electromagnetic spectrum from galaxies includes dark lines. These lines are at specific wavelengths. The diagram shows the position of the dark lines in the spectrum from the Sun and in the spectra from four distant galaxies **A**, **B**, **C** and **D**.



7A What is the name of the phenomenon shown in the spectrum from Galaxy **A**?

1 blue shift

2 green shift

3 yellow shift

4 red shift

7B Which one of the galaxies is furthest away from Earth?

1 Galaxy **A**

2 Galaxy **B**

3 Galaxy **C**

4 Galaxy **D**

4.7.2.1 Electromagnetism

7C Which galaxy is moving towards the observer?

1 Galaxy **A**

2 Galaxy **B**

3 Galaxy **C**

4 Galaxy **D**

7D Data from similar investigations shows that . . .

1 most galaxies are moving towards Earth.

2 the further away a galaxy is from Earth, the faster it is moving away from Earth.

3 all galaxies move at a constant speed.

4 all galaxies were created at the same time.

Turn over for the next question

4.7.2.1 Electromagnetism

Question 23

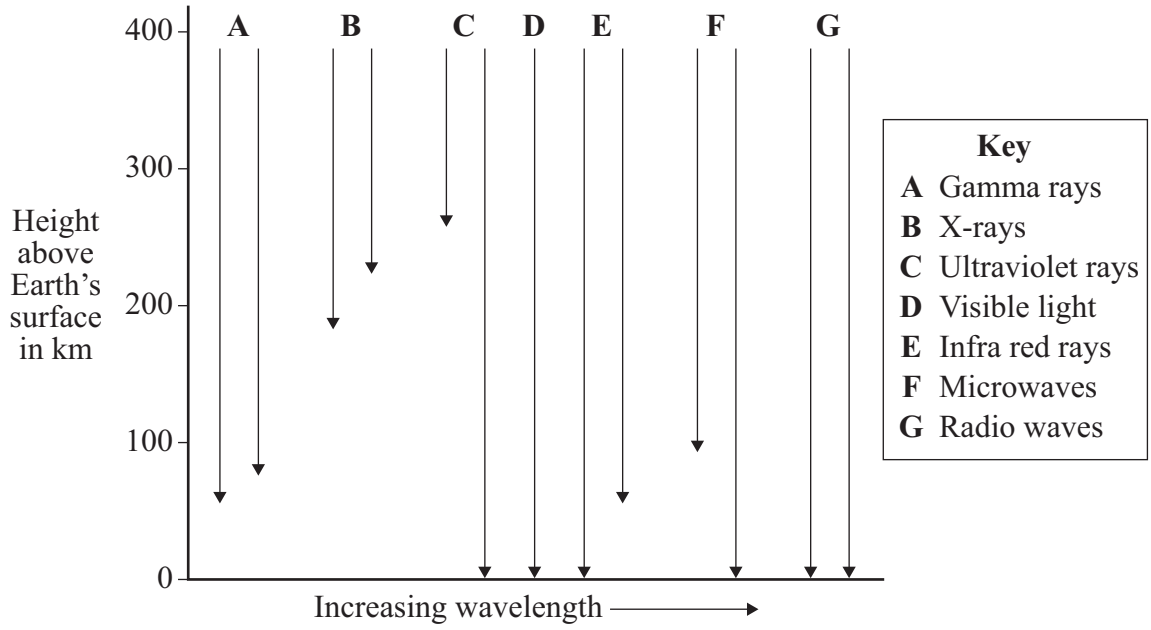
March 2008 | PHY1BP | Original Q9 | Legacy

QUESTION NINE

All forms of electromagnetic radiation from space are used by scientists to explore the Universe.

The diagram shows how far electromagnetic waves can penetrate the Earth's atmosphere.

Where two arrows are shown for a type of electromagnetic radiation, longer and shorter waves penetrate the atmosphere to different depths.



9A Which one of the following statements is true?

1 Gamma radiation penetrates the atmosphere further than all other types of electromagnetic radiation.

2 All frequencies of microwaves reach Earth's surface.

3 No frequencies of radio waves reach Earth's surface.

4 Higher frequencies of ultraviolet radiation are completely absorbed by the atmosphere.

9B What would be the minimum height above the Earth for a satellite carrying a telescope designed to detect gamma rays and X-rays of all wavelengths?

1 50 km

2 70 km

3 180 km

4 230 km

4.7.2.1 Electromagnetism

9C Which one of the following correctly describes the data on the diagram?

1 The absorption of electromagnetic radiation by the atmosphere is directly proportional to wavelength.

2 The absorption of electromagnetic radiation by the atmosphere is inversely proportional to wavelength.

3 The shorter the wavelength of electromagnetic radiation, the greater the absorption by the atmosphere.

4 Absorption of electromagnetic radiation does **not** depend only on wavelength.

9D Electromagnetic radiation from distant galaxies is very weak and is therefore very difficult to detect.

The Spitzer space telescope uses liquid helium to keep its scientific instruments at a very low temperature.

Which type of weak electromagnetic radiation would best be detected by instruments kept at this very low temperature?

1 gamma rays

2 X-rays

3 infra red rays

4 ultraviolet rays

END OF TEST

4.7.2.1 Electromagnetism

Question 24

June 2008 | PHY1H | Original Q3 | Legacy

3 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

3 (a) Explain why the Hubble telescope produces clearer images than optical telescopes positioned on the Earth.

.....

.....

.....

.....

(2 marks)

3 (b) After the Hubble telescope was launched into space, scientists found that it was not able to focus properly. Astronauts sent into space were able to repair the fault.

The James Webb telescope is to be fully assembled and tested before it is launched into space. Suggest why.

.....

.....

.....

.....

(2 marks)

3 (c) To get the large mirror for the James Webb telescope into space, it will be folded in segments, launched into space and then opened out. This is a complicated process so a working scale model of the optical system has been built.

Suggest **one** reason why building a scale model is a good idea.

.....

.....

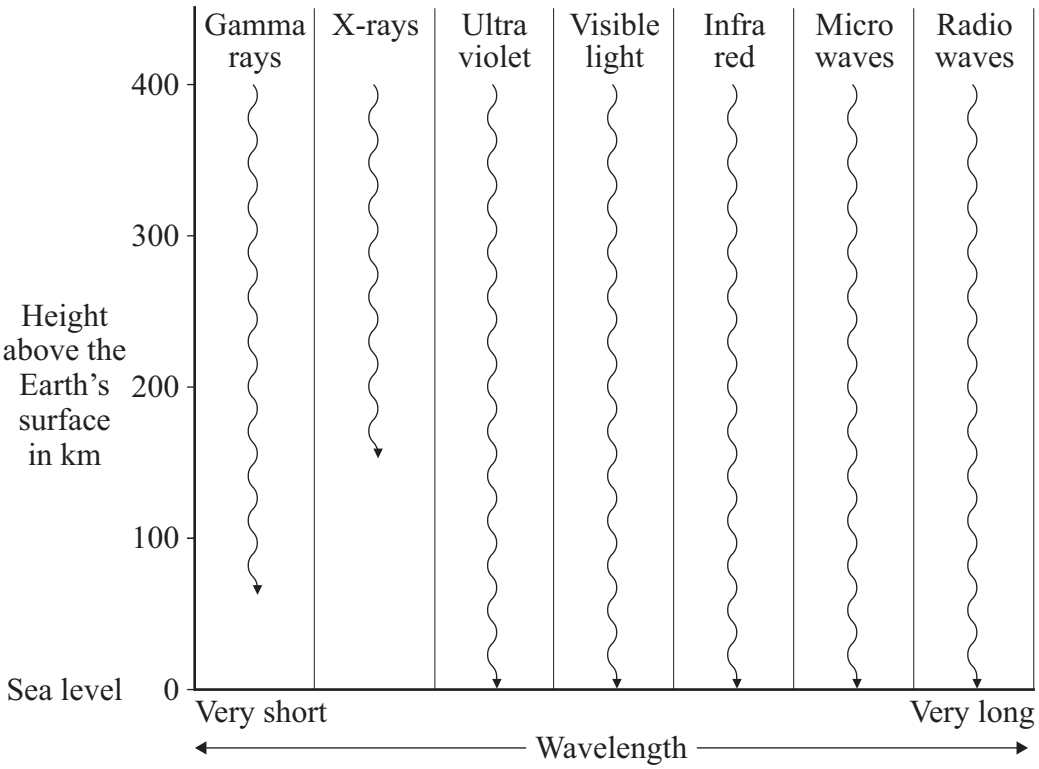
(1 mark)

4.7.2.1 Electromagnetism

Question 24 · continued

for mark

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



Explain why an optical telescope can be positioned on the Earth but an X-ray telescope must be in space.

.....

.....

.....

.....

(2 marks)

7

4.7.2.1 Electromagnetism

Question 25

November 2008 | PHY1BP | Original Q5 | Legacy

QUESTION FIVE

This question is about the electromagnetic spectrum and its use in communications.

5A Which one of the following types of electromagnetic wave would **not** be suitable for communications?

1 infra red

2 microwave

3 gamma

4 visible light

5B Which types of electromagnetic waves can be used to send signals along optical fibres?

1 infra red and ultraviolet

2 infra red and visible light

3 infra red, ultraviolet and visible light

4 ultraviolet and visible light

5C By 2012, all TV signals in the UK will be digital.

This will be an improvement over analogue signals because . . .

1 digital signals are less prone to interference.

2 digital signals pick up interference and amplify it.

3 in an analogue signal, interference is treated as part of the original signal.

4 when analogue signals are amplified, interference is amplified.

4.7.2.1 Electromagnetism

Question 25 · continued

5D Electromagnetic waves travel at a speed of 300 000 km/s.

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

A radio station transmits signals at a wavelength of 1.5 km.

The frequency of the waves is . . .

1 200 Hz

2 200 kHz

3 450 000 Hz

4 450 000 kHz

Turn over for the next question

4.7.2.1 Electromagnetism

Question 26

November 2008 | PHY1BP | Original Q9 | Legacy

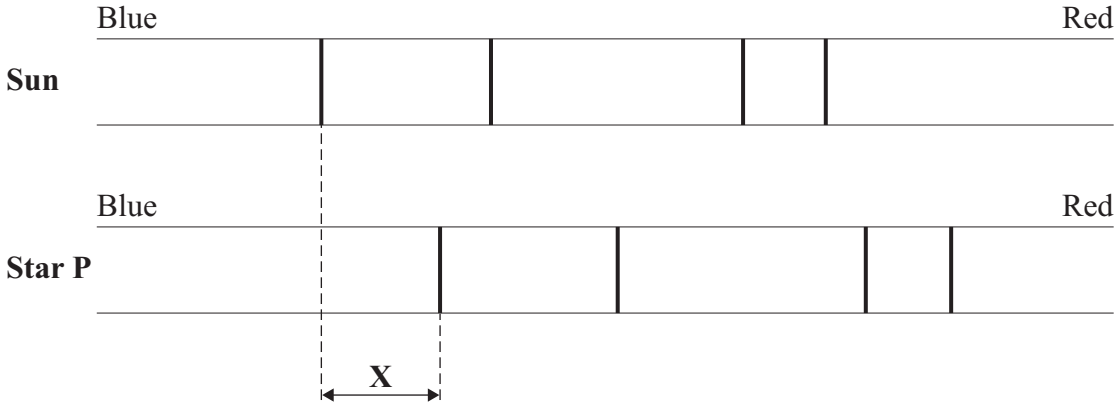
QUESTION NINE

The visible part of the electromagnetic spectrum from a star includes dark lines. These lines are at specific wavelengths.

The diagrams show the positions of the dark lines in the spectrum from the Sun and in the spectrum from a distant star, **P**.

Star **P** is moving away from the observer.

The dark lines in **P**'s spectrum are shown to be displaced.



9A The displacement marked **X** in the diagram is called the red-shift.

What change has occurred to the speed and frequency of the light to cause red-shift?

	Speed	Frequency
1	decreased	stayed the same
2	increased	stayed the same
3	stayed the same	decreased
4	stayed the same	increased

Question 26 · continued

9B Another star, **Q**, is further away from the observer than star **P** and is also moving away from the observer.

The displacement **X** in **Q**'s spectrum, compared with that in **P**'s is . . .

1 smaller and in the opposite direction.

2 bigger and in the opposite direction.

3 smaller and in the same direction.

4 bigger and in the same direction.

9C Edwin Hubble made measurements on the dark lines in the spectra from distant galaxies.

His observations led to the idea that the universe is expanding.

He observed that . . .

1 the further away the galaxy, the smaller the red-shift.

2 the further away the galaxy, the bigger the red-shift.

3 the most distant galaxies show a blue-shift.

4 the red-shift does not change with distance.

9D Scientists are interested in how the universe began.

Which one of the following statements is correct?

1 We now definitely know that the universe began with a 'big bang'.

2 There is no evidence about how the universe began.

3 The current evidence suggests that the universe began at a small point.

4 We now know that the galaxies will continue to get further apart.

END OF TEST

4.7.2.1 Electromagnetism

Question 27

January 2009 | PHY1H | Original Q5 | Legacy

5 (a) Microwaves are one type of electromagnetic wave.

5 (a) (i) Which type of electromagnetic wave has a lower frequency than microwaves?

.....

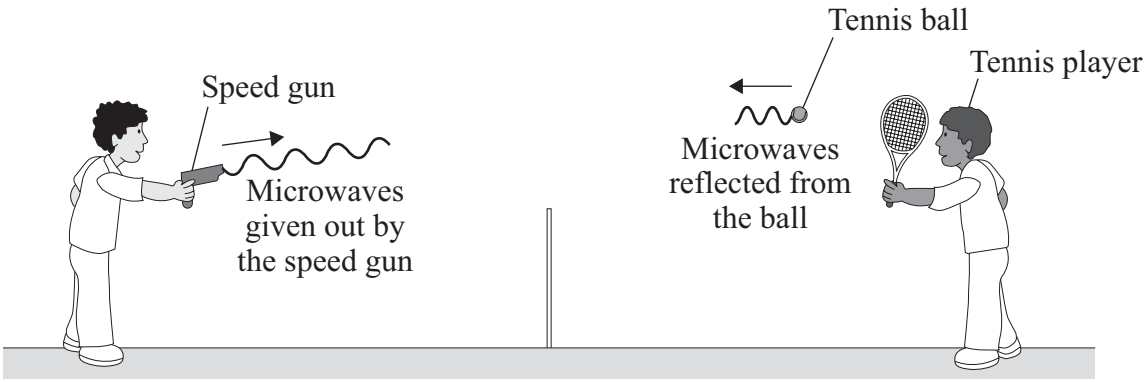
(1 mark)

5 (a) (ii) What do all types of electromagnetic wave transfer from one place to another?

.....

(1 mark)

5 (b) The picture shows a tennis coach using a speed gun to measure how fast the player serves the ball.



5 (b) (i) The microwaves transmitted by the speed gun have a frequency of 24 000 000 000 Hz and travel through the air at 300 000 000 m/s.

Use the equation in the box to calculate the wavelength of the microwaves emitted from the speed gun.

wave speed = frequency × wavelength

Show clearly how you work out your answer.

.....

.....

Wavelength = ... m

(2 marks)

4.7.2.1 Electromagnetism

Question 27 · continued

for mark

5 (b) (ii) Some of the microwaves transmitted by the speed gun are absorbed by the ball.

What effect will the absorbed microwaves have on the ball?

.....

.....

(1 mark)

5 (b) (iii) Some of the microwaves transmitted by the speed gun are reflected from the moving ball back towards the speed gun.

Describe how the wavelength and frequency of the microwaves change as they are reflected from the moving ball.

.....

.....

.....

.....

(2 marks)

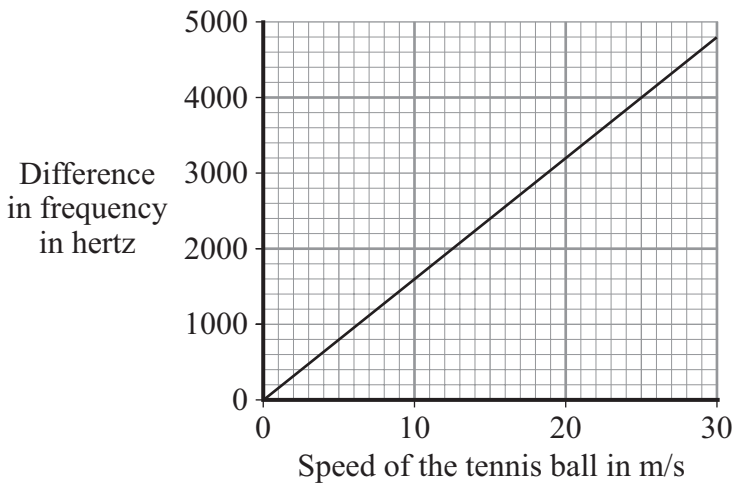
Question 5 continues on the next page

Question 27 · continued

for mark

5 (c) The difference in frequency between the transmitted and reflected waves is detected by the speed gun. This data is processed by a computer chip inside the speed gun, and then displayed as a speed.

5 (c) (i) The graph shows that the difference in frequency between the transmitted and reflected waves is directly proportional to the speed of the moving ball.



Why has a line graph been used to display the data?

.....

.....

(1 mark)

5 (c) (ii) Is it better to transfer the data to the computer as an analogue signal or as a digital signal?

.....

Give a reason for your answer.

.....

.....

(1 mark)

4.7.2.1 Electromagnetism

Question 27 · continued

for mark

5 (c) (iii) What is the difference between an analogue signal and a digital signal?

You may draw a labelled diagram to help you with your answer.

.....

.....

.....

.....

(2 marks)

11

4.7.2.1 Electromagnetism

Question 28

March 2009 | PHY1BP | Original Q4 | Legacy

QUESTION FOUR

This question is about electromagnetic waves.

4A Changes may occur in substances when they absorb the energy carried by electromagnetic waves.

Which row in the table is correct?

	An alternating current is created in the substance	The substance becomes hotter
1	always	never
2	sometimes	always
3	sometimes	sometimes
4	never	sometimes

4B Radio waves travel in straight lines. However, some types of radio waves can be received on the opposite side of the Earth from the transmitter.

This happens because the radio waves are . . .

1 absorbed by the atmosphere.

2 interfered with by the atmosphere.

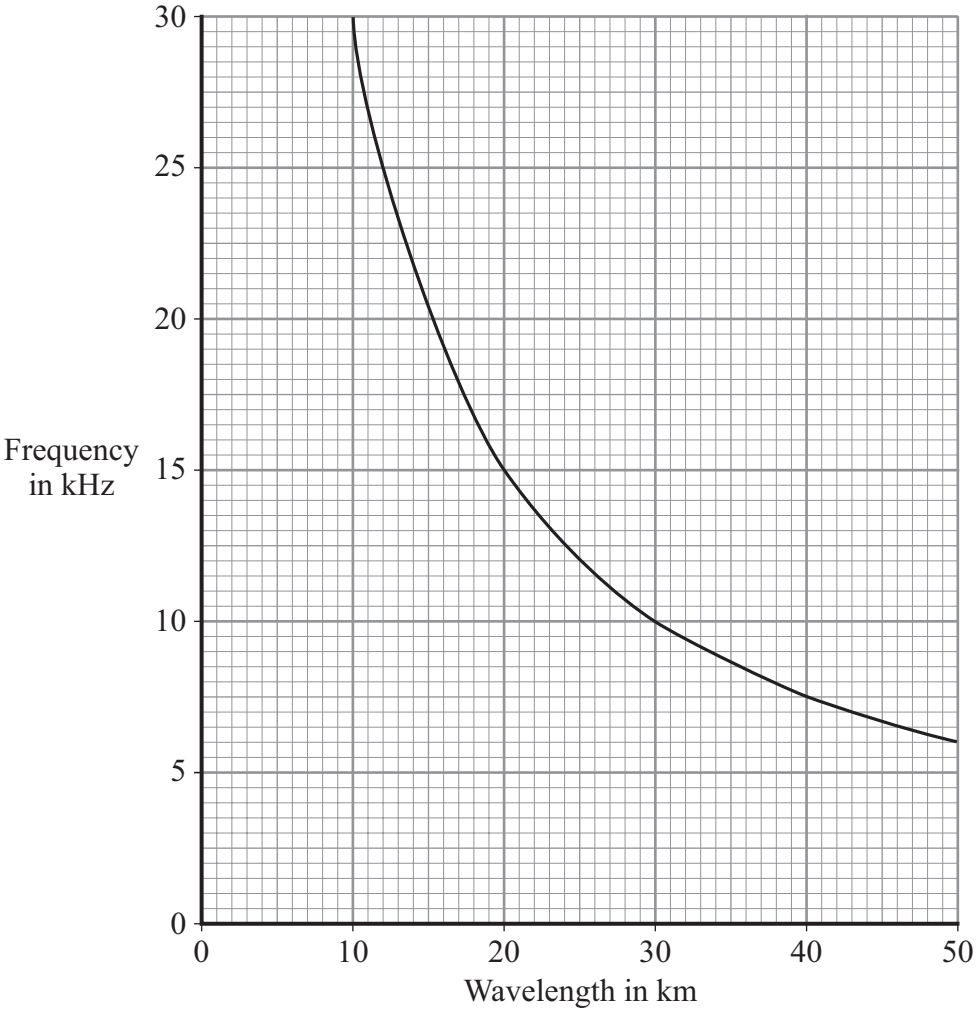
3 reflected by the atmosphere.

4 stopped by the atmosphere.

4.7.2.1 Electromagnetism

Question 28 · continued

The graph indicates how the frequency of electromagnetic waves changes with wavelength.



4C The graph shows that when the wavelength doubles, the frequency . . .

1 doubles.

2 halves.

3 quadruples.

4 stays the same.

4D What is the frequency of electromagnetic waves of wavelength 25 000 metres?

1 1.2 kHz

2 1.4 kHz

3 12 kHz

4 14 kHz

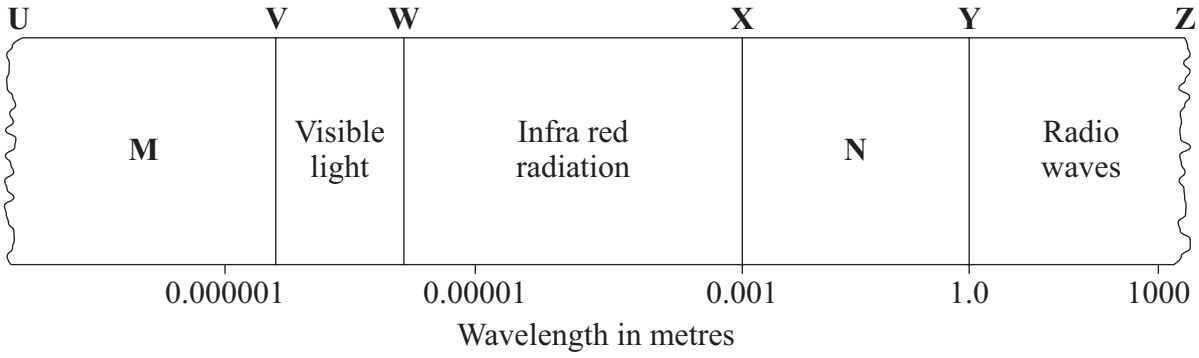
4.7.2.1 Electromagnetism

Question 29

March 2009 | PHY1BP | Original Q5 | Legacy

QUESTION FIVE

The diagram shows part of the electromagnetic spectrum.



5A Which row of the table gives the types of electromagnetic radiation that are present in **M** and **N**?

	M	N
1	gamma	microwaves
2	gamma	ultraviolet
3	ultraviolet	gamma
4	ultraviolet	microwaves

5B Which section of the electromagnetic spectrum can be used for communications?

1 **U** to **Z**

2 **V** to **Z**

3 **W** to **Z**

4 **X** to **Z**

4.7.2.1 Electromagnetism

Question 29 · continued

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

All electromagnetic waves travel at a speed of 300 000 000 m/s.

5C BBC Radio 4 is carried by radio waves with a wavelength of 1500 m.

What is the frequency of these waves?

1 0.000 005 Hz

2 0.005 Hz

3 200 kHz

4 450 000 000 kHz

5D Compact fluorescent lamps (CFLs) emit infra red radiation. This radiation can interfere with the infra red signal emitted by remote controls for televisions.

An article about CFLs says that the infra red rays are emitted at a frequency of about 300 kHz.

This is incorrect because this frequency would mean that the wavelength is in . . .

1 the gamma ray part of the electromagnetic spectrum.

2 the microwave part of the electromagnetic spectrum.

3 the radio wave part of the electromagnetic spectrum.

4 the ultraviolet part of the electromagnetic spectrum.

4.7.2.1 Electromagnetism

Question 30

March 2009 | PHY1BP | Original Q9 | Legacy

QUESTION NINE

Ultraviolet radiation is next to X-rays in the electromagnetic spectrum. Ultraviolet radiation consists of three regions: UVA, UVB, and UVC, as shown in the table.

	UVA	UVB	UVC	X-rays	

9A The UVA region of the spectrum has wavelengths between 315 and 400 nm. The visible light region of the spectrum extends to wavelengths of 700 nm.

In what wavelength region will violet light be found?

1 nanometre, 1 nm = 0.000 000 001 metre

1 360 – 400 nm

2 400 – 430 nm

3 620 – 700 nm

4 700 – 760 nm

9B Different types of electromagnetic radiation will penetrate materials to different depths. UVA will penetrate the top and middle layers of human skin. UVB will penetrate the top layer only.

This is surprising because gamma rays . . .

1 penetrate less than X-rays and have a lower frequency than X-rays.

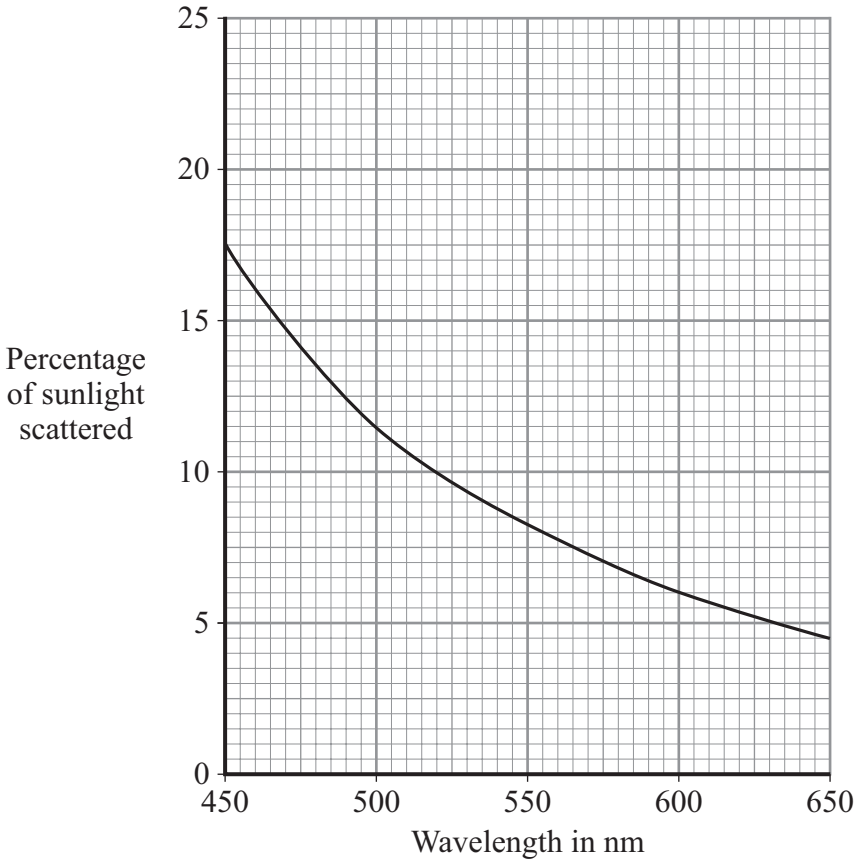
2 penetrate less than X-rays and have a higher frequency than X-rays.

3 penetrate more than X-rays and have a shorter wavelength than X-rays.

4 penetrate more than X-rays and have a longer wavelength than X-rays.

Question 30 · continued March 2009 | PHY1BP | Original Q9 | Legacy

9C The scattering of sunlight by the atmosphere causes the daylight colour of the sky to be blue. The graph shows how the scattering of sunlight changes with the wavelength.



What percentage of direct sunlight reaches the Earth **unscattered** at a wavelength of 500 nm?

1 11.5 %

2 37.5 %

3 62.5 %

4 88.5 %

9D How much scattering would you expect from ultraviolet rays?

1 less scattering than from visible light because ultraviolet rays have a lower frequency than visible light.

2 less scattering than from visible light because ultraviolet rays travel more slowly than visible light.

3 more scattering than from visible light because ultraviolet rays have a shorter wavelength than visible light.

4 the same scattering as from visible light because they both travel at the same speed.

END OF TEST

4.7.2.1 Electromagnetism

Question 31

June 2009 | PHY1BP | Original Q1 | Legacy

QUESTION ONE

Electromagnetic radiation can be grouped into types. Each type has a different range of wavelengths.

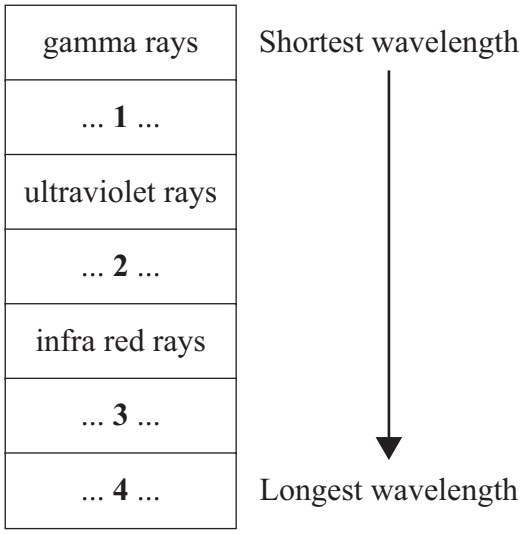
Match types of radiation, **A**, **B**, **C** and **D**, with the numbers **1–4** in the table.

A microwaves

B X-rays

C visible light

D radio waves



4.7.2.1 Electromagnetism

Question 32

June 2009 | PHY1BP | Original Q6 | Legacy

QUESTION SIX

Mobile phones make use of microwaves.

Microwave ovens use microwaves of a similar wavelength. These microwaves are absorbed by the water molecules in food.

Human and animal body tissues contain a lot of water molecules. Some people are worried that using mobile phones for long periods of time could lead to some form of brain damage.

Scientists have investigated this worry by exposing laboratory mice to mobile phone radiation and monitoring the mice for signs of brain abnormality.

6A Electromagnetic waves travel at a speed of 300 000 km/s. Some microwaves have a wavelength of 10 cm.

What is the frequency of these microwaves?

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

1 30 000 000 Hz

2 300 000 000 Hz

3 3 000 000 000 Hz

4 30 000 000 000 Hz

6B Electromagnetic waves that ionise may cause cancer. The higher the frequency of a wave, the more ionising the radiation.

Which type of radiation is most likely to cause cancer?

1 microwaves

2 infra red

3 ultraviolet

4 X-rays

4.7.2.1 Electromagnetism

Question 32 · continued

6C The power output of a microwave oven is at least 500 W.

The power output of mobile phones is limited to 2 W.

What is the most likely reason why this power limit was introduced?

1 to reduce interference between phones

2 to reduce heating effects on the brain

3 to allow phones to use the GPS (Global Positioning System)

4 to allow phones to use a digital signal

6D The tests on mice showed no evidence of brain abnormalities in the mice.

From this, the public can conclude that . . .

1 the results are not accurate because the tests were not carried out on humans.

2 as there is no evidence of danger to mice, there is probably no danger to humans.

3 as there is no evidence of danger to mice, there is no danger to humans.

4 the tests were not sensitive enough to record any evidence.

4.7.2.1 Electromagnetism

Question 33

June 2009 | PHY1BP | Original Q7 | Legacy

QUESTION SEVEN

Some types of electromagnetic radiation from space are absorbed by the Earth's atmosphere.

	Short wavelength radio	Short wavelength microwaves	Infra red	Visible light	Ultraviolet	X-rays	Gamma rays
Percentage absorbed by atmosphere	0	95	96	5	98	100	100

Different objects or events in the universe emit different types of electromagnetic radiation.

	Gamma ray bursts	Nebulae	Pulsars	Stars	Universe background radiation
Radiation emitted	gamma rays	infra red	radio	all types	short wavelength microwaves

The planets and moons of the solar system reflect light from the Sun.

7A Early civilisations observed the sky with the naked eye.

Which objects did they see?

1 moons, nebulae and pulsars

2 gamma ray bursts, moons and planets

3 nebulae and pulsars

4 moons, planets and stars

7B Telescopes that could detect electromagnetic waves of the lowest frequency were built in the 20th century. These telescopes are on the surface of the Earth.

From the information in the tables, which of the following, which could not have been observed before, could then be easily observed from the Earth's surface?

1 pulsars

2 gamma ray bursts

3 nebulae

4 stars

4.7.2.1 Electromagnetism

Question 33 · continued

7C In 1989, the background radiation from the universe was mapped from a telescope in space.

Why was this **not** done with telescopes based on Earth?

1 Because only 2% of ultraviolet radiation penetrates Earth's atmosphere.

2 Because only 4% of infra red radiation penetrates Earth's atmosphere.

3 Because only 5% of short wavelength microwave radiation penetrates Earth's atmosphere.

4 Because only 95% of visible radiation penetrates Earth's atmosphere.

7D The first table suggests that, with the exception of . . .

1 radio, the percentage of radiation absorbed by the atmosphere, increases with increasing wavelength.

2 radio, the percentage of radiation absorbed by the atmosphere, decreases with increasing wavelength.

3 visible light, the percentage of radiation absorbed by the atmosphere, increases with increasing wavelength.

4 visible light, the percentage of radiation absorbed by the atmosphere, decreases with increasing wavelength.

4.7.2.1 Electromagnetism

Question 34

June 2009 | PHY1H | Original Q1 | Legacy

1 (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

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

.....

(1 mark)

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

.....

(1 mark)

1 (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)

4.7.2.1 Electromagnetism

Question 34 · continued

for mark

1 (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.

.....

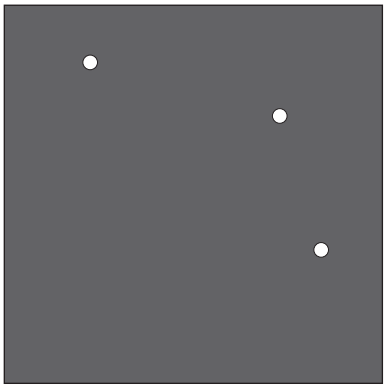
.....

.....

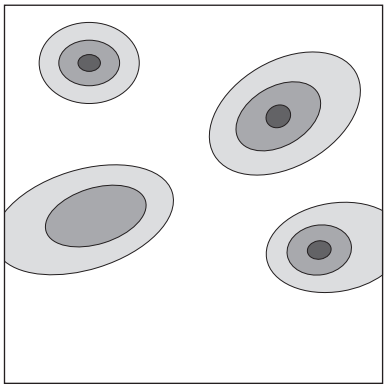
.....

(2 marks)

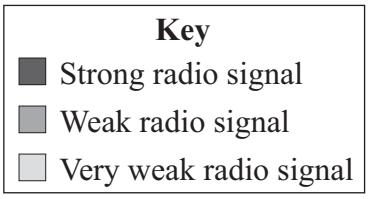
1 (d) The pictures represent the images produced using a visible light telescope and a radio telescope. Both images are of the same part of the sky. The shading on the radio telescope image represents the strength of the radio signals.



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)

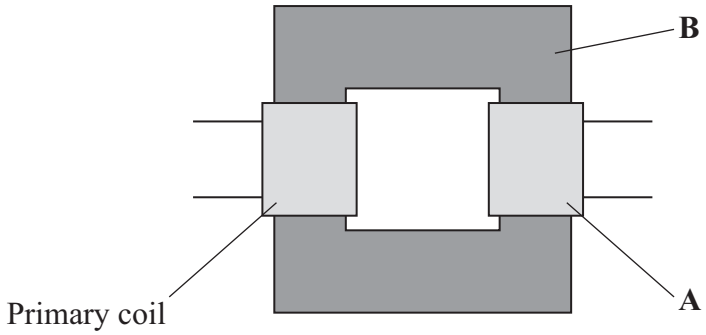
7

4.7.2.1 Electromagnetism

Question 35

June 2009 | PHY3H | Original Q1 | Legacy

1 (a) The diagram shows a transformer.



1 (a) (i) What is part **A**?

.....

(1 mark)

1 (a) (ii) What is part **B** and what is it made of?

.....

.....

(2 marks)

1 (a) (iii) When there is an alternating current in the primary coil, what is produced in part **B**?

.....

.....

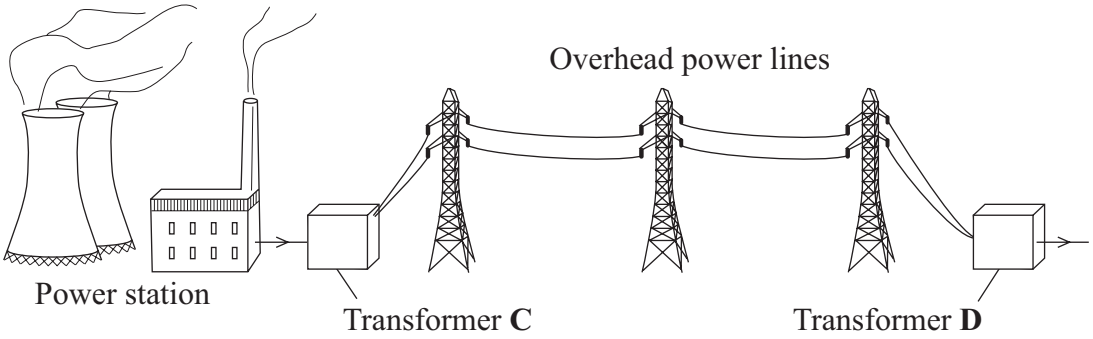
(2 marks)

4.7.2.1 Electromagnetism

Question 35 · continued

for mark

1 (b) Transformers are used in the National Grid. The diagram shows part of the National Grid.



Complete the **two** spaces in the sentence.

Transformer **C** is a ..... transformer and transformer **D** is a ..... transformer. *(1 mark)*

1 (c) This is an item from a newspaper.

Health at risk from power lines?

Are high voltage power lines a health risk to people who live near them?

Some scientists think that scientific evidence shows that they are.

Other scientists do not think that the scientific evidence supports this conclusion.

Which **two** suggestions would reduce the possible risk to people's health? Put a tick (✓) in the box next to your answers.

Do not build new houses near to existing power lines. ☐

Move the power lines so that they take the shortest routes. ☐

Move each power station to the centre of the nearest city. ☐

Build new power lines away from where people live. ☐

Use more transformers in the National Grid. ☐

(2 marks)

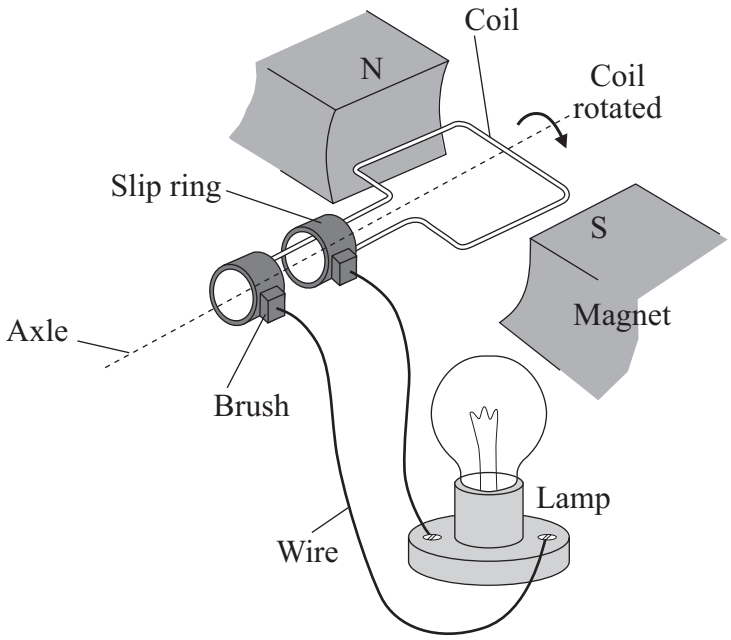
8

4.7.2.1 Electromagnetism

Question 36

June 2009 | PHY3H | Original Q7 | Legacy

7 The diagram shows a generator.
When the coil is rotated around the axle, a current is produced and the lamp lights up.



7 (a) Explain the purpose of the slip rings and brushes.

.....

.....

.....

(2 marks)

7 (b) Explain how this generator gives an a.c. rather than a d.c. output.

.....

.....

.....

(2 marks)

7 (c) In this design, the generator effect occurs because the coil rotates in a magnetic field.

How else can a generator effect occur?

.....

.....

(1 mark)

4.7.2.1 Electromagnetism

Question 37

November 2009 | PHY1BP | Original Q7 | Legacy

QUESTION SEVEN

There are two types of radio wave that carry television signals, VHF and UHF.

7A Some UHF waves have a frequency that is ten times bigger than some VHF waves.

The wavelength of these UHF waves, in comparison to the VHF ones, is . . .

1 ten times as big because they travel faster.

2 one tenth as big because they travel faster.

3 ten times as big because they travel at the same speed.

4 one tenth as big because they travel at the same speed.

7B One television channel transmits using waves of frequency 1000 MHz.

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

Speed of electromagnetic waves in a vacuum = 300 000 km/s

1 MHz = 1 million hertz

What is the wavelength of these waves?

1 0.3 m

2 3.0 m

3 0.3 km

4 3.0 km

4.7.2.1 Electromagnetism

Question 37 · continued

7C All television transmitters in the UK are going to be switched from analogue to digital signals.

Which row in the table is correct?

	Analogue signals	Digital signals
1	continuously varying	more prone to interference and cannot be processed by a computer
2	less prone to interference and can be easily processed by a computer	discrete values only, generally on and off
3	continuously varying	less prone to interference and can be easily processed by a computer
4	discrete values only, generally on and off	continuously varying

7D An aerial receives television signals.

The energy transferred by an electromagnetic wave carrying the television signal . . .

1 makes the aerial hotter so that it can detect the signal.

2 makes the aerial colder so that it can detect the signal.

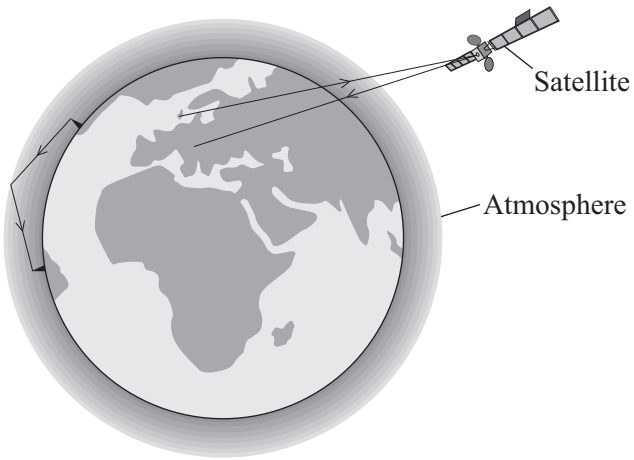
3 creates an alternating current in the aerial with the same frequency as the wave.

4 creates a direct current in the aerial with the same frequency as the wave.

4.7.2.1 Electromagnetism

Question 38

3 (a) Electromagnetic waves have many uses. The diagram shows two ways of sending information using electromagnetic waves.



3 (a) (i) What type of wave is used to send information to and from satellites?

.....

(1 mark)

3 (a) (ii) What property of this type of wave makes it suitable for satellite communications?

.....

(1 mark)

3 (b) The diagram shows two types of signal that can be used to send information. One of the signals is an analogue signal. The other is a digital signal.



Describe the differences between an analogue signal and a digital signal.

.....

.....

.....

.....

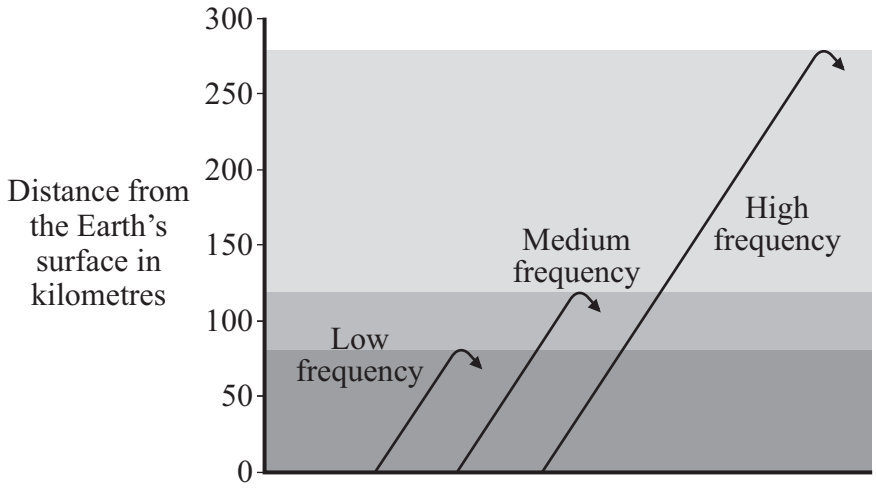
(2 marks)

4.7.2.1 Electromagnetism

Question 38 · continued

for mark

3 (c) Different frequency radio waves travel different distances through the atmosphere before being reflected.



Use the information in the diagram to describe the connection between the frequency of a radio wave and the distance the radio wave travels through the atmosphere before it is reflected.

.....

.....

(1 mark)

3 (d) Electromagnetic waves travel at a speed of 300 000 000 m/s.

A radio station transmits waves with a wavelength of 20 metres.

Use the equation in the box to calculate the frequency, in kilohertz (kHz), of these waves.

wave speed = frequency × wavelength

Show clearly how you work out your answer.

.....

.....

.....

Frequency = ... kHz

(2 marks)

7

4.7.2.1 Electromagnetism

Question 39

March 2010 | PHY1BP | Original Q9 | Legacy

QUESTION NINE

This question is about electromagnetic radiation.

9A Electromagnetic radiations are . . .

1 disturbances in an electric field.

2 disturbances of the air between source and receiver.

3 waves caused by pressure changes in a vacuum.

4 waves of very high frequency.

9B When electromagnetic radiation reaches a substance, . . .

1 all wavelengths will be absorbed by the substance.

2 all wavelengths will be reflected by the substance.

3 all wavelengths will be transmitted through the substance.

4 some wavelengths may be absorbed, some reflected and some transmitted.

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

All electromagnetic waves travel at 300 000 km/s.

9C Most schools have microwave generators that produce microwaves with a wavelength of 3 cm.

What is the frequency of these microwaves?

1 900 kHz

2 10 000 kHz

3 900 000 kHz

4 10 000 000 kHz

9D BBC Radio 4 transmits radio waves at a frequency of 200 kHz.

What is the wavelength of Radio 4?

1 1.5 m

2 600 m

3 1500 m

4 60 km

END OF TEST

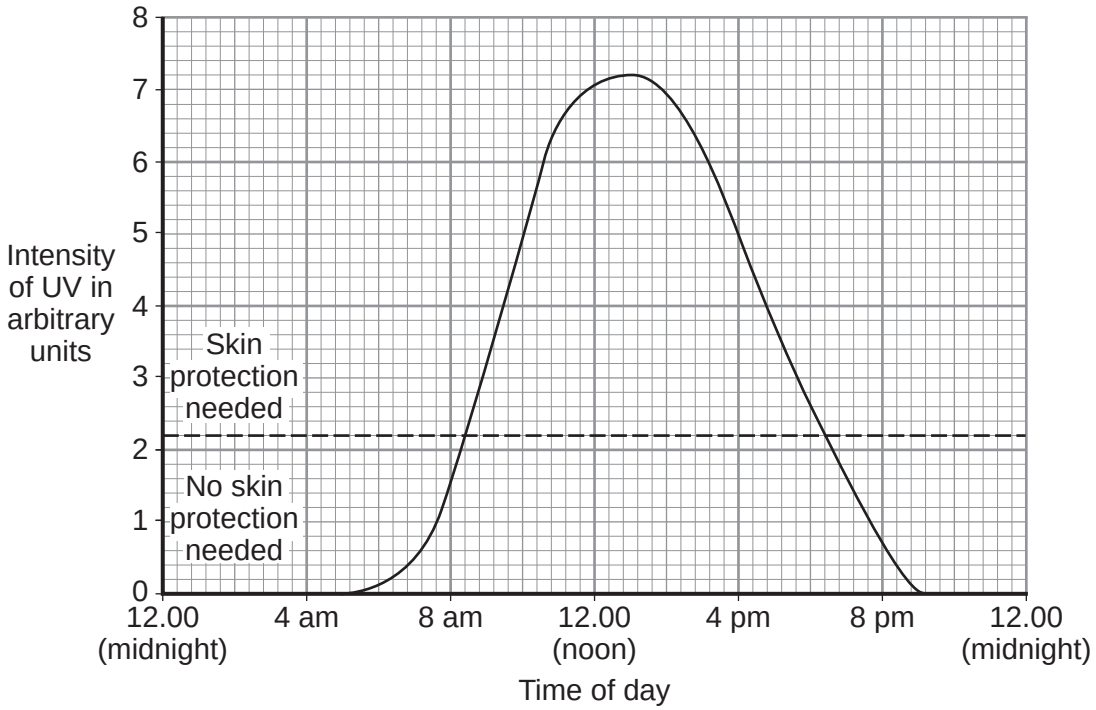
4.7.2.1 Electromagnetism

Question 40

June 2010 | PHY1BP | Original Q3 | Legacy

QUESTION THREE

The graph shows how the intensity of ultraviolet (UV) radiation changes during a typical day in June in the UK.



3A The intensity of UV radiation reaches a maximum at . . .

1 9.30 am

2 12.00 noon

3 1.00 pm

4 5.00 pm

4.7.2.1 Electromagnetism

Question 40 · continued

3B The dashed line (– – – –) on the graph shows the intensity above which you should protect your skin from UV radiation by using sunscreen cream.

For approximately how long is the intensity of UV radiation high enough to suggest that protection is needed?

1 0 hours

2 7 hours

3 10 hours

4 16 hours

3C For a typical day in December in the UK, how would you expect the graph to be different?

	Peak	Area under the graph
1	higher	the same
2	lower	the same
3	higher	bigger
4	lower	smaller

3D UV radiation travels as an electromagnetic wave.

Which row in the table below correctly shows the speed and frequency of UV compared with the speed and frequency of visible light?

	Speed of UV compared with visible light	Frequency of UV compared with visible light
1	slower	lower
2	same	higher
3	faster	higher
4	same	lower

4.7.2.1 Electromagnetism

Question 41

June 2010 | PHY1BP | Original Q6 | Legacy

QUESTION SIX

Radio and television programmes are transmitted through the air over long distances.

The information is carried by electromagnetic waves.

6A Compared with light waves, radio waves . . .

1 have a shorter wavelength and a higher speed.

2 have a lower frequency and the same speed.

3 have a longer wavelength and a lower speed.

4 have a higher frequency and the same speed.

6B A radio programme is broadcast on a wavelength of 1500 metres. The speed of the wave is 300 000 000 m/s.

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

The frequency of these waves is . . .

1 200 Hz

2 200 kHz

3 450 000 Hz

4 450 000 kHz

6C Over the next few years, all television signals will be changed from analogue to digital.

One advantage to television broadcasters of using digital signals instead of analogue signals is that . . .

1 they are easier to generate.

2 they are less prone to interference.

3 they can travel faster.

4 they can travel further.

4.7.2.1 Electromagnetism

6D Some people are worried about the effects of living close to a powerful radio transmitter.

Close to one transmitter, it was found that the number of children with leukaemia was slightly higher than normal. Leukaemia is a type of cancer of the blood.

What conclusion could you make from this observation?

1 Radio waves cause leukaemia.

2 There may be a connection between radio waves and leukaemia.

3 Adults are less likely than children to develop leukaemia.

4 Children should not be allowed to live near a radio transmitter.

Turn over for the next question

4.7.2.1 Electromagnetism

Question 42

June 2010 | PHY1H | Original Q4 | Legacy

4 (a) Microwaves and visible light are two types of electromagnetic wave. Both can be used for communications.

4 (a) (i) Give **two** properties that are common to both visible light and microwaves.

1 .....

.....

2 .....

.....

(2 marks)

4 (a) (ii) Name **two** more types of electromagnetic wave that can be used for communications.

..... and .....

(1 mark)

4 (b) Wi-Fi is a system that joins computers to the internet without using wires. Microwaves, with a wavelength of 12.5 cm, are used to link a computer to a device called a router. Microwaves travel through the air at 300 000 000 m/s.

Use the equation in the box to calculate the frequency of the microwaves used to link the computer to the router.

wave speed = frequency × wavelength

Show clearly how you work out your answer and give the unit.

.....

.....

.....

Frequency = ...

(3 marks)

4.7.2.1 Electromagnetism

Question 42 · continued

4 (c) Wi-Fi is used widely in schools. However, not everyone thinks that this is a good idea.

A politician commented on the increasing use of Wi-Fi. He said: 'I believe that these systems may be harmful to children.'

However, one group of scientists said that there is no reason why Wi-Fi should not be used in schools. These scientists also suggested that there is a need for further research.

4 (c) (i) Suggest what the politician could have done to persuade people that what he said was not just an opinion.

.....

.....

(1 mark)

4 (c) (ii) Why did the group of scientists suggest that there is a need for further research?

.....

.....

(1 mark)

8

4.7.2.1 Electromagnetism

Question 43

November 2010 | PHY1BP | Original Q5 | Legacy

QUESTION FIVE

Fluorescers are substances that are used to make objects look brighter. Fluorescers absorb ultraviolet radiation and re-emit it as visible light. This makes the object glow when exposed to ultraviolet radiation.

- Laundry detergents contain fluorescers to make 'white look even whiter'.
- Dental compounds contain fluorescers to make teeth look brighter.
- Since 1950, fluorescers have been added to white paper to brighten it.

5A A white shirt has been washed in detergent containing a fluorescer.

The white shirt will . . .

1 be much cleaner.

2 glow in the dark.

3 look cleaner.

4 stay cleaner for longer.

5B A dentist paints someone's teeth with enamel containing a fluorescer.

The enamel absorbs ultraviolet radiation from sunlight and then emits light with . . .

1 a higher frequency and a longer wavelength.

2 a higher frequency and a shorter wavelength.

3 a lower frequency and a longer wavelength.

4 a lower frequency and a shorter wavelength.

5C A document is dated 1805. The document glows when it is viewed in ultraviolet light.

The document is likely to . . .

1 be a forgery.

2 have been printed before 1805.

3 have a dull surface.

4 have a shiny surface.

4.7.2.1 Electromagnetism

Question 43 · continued

5D The ultraviolet radiation used to view the document has a wavelength of 0.000 000 1 metres.

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

Speed of electromagnetic waves = 300 000 000 m/s

What is the frequency of ultraviolet radiation of wavelength 0.000 000 1 metres?

1 30 Hz

2 3 000 000 Hz

3 3 000 000 000 Hz

4 3 000 000 000 000 000 Hz

Turn over for the next question

4.7.2.1 Electromagnetism

Question 44

November 2010 | PHY1BP | Original Q6 | Legacy

QUESTION SIX

Waves from different parts of the electromagnetic spectrum are used for communications.

6A Optical fibres can bend light around corners.

This is because the light . . .

1 is absorbed in the optical fibre.

2 is transmitted through the walls of the optical fibre.

3 is reflected inside the optical fibre.

4 travels faster in the optical fibre.

6B A metal aerial absorbs the energy carried by radio waves. This creates an alternating current (a.c.) in the metal and may produce a temperature change.

Which row in the table is correct?

	Frequency of a.c. produced	Temperature of metal
1	higher than the frequency of the radio waves	increases
2	the same as the frequency of the radio waves	increases
3	lower than the frequency of the radio waves	decreases
4	the same as the frequency of the radio waves	decreases

6C Television and telephone signals sent via satellites use microwaves rather than long wavelength radio waves.

This is because microwaves . . .

1 can pass easily through the Earth's atmosphere.

2 can travel through a vacuum.

3 have longer wavelengths than radio waves.

4 travel faster than radio waves.

4.7.2.1 Electromagnetism

6D Digital signals are replacing analogue signals in television and telephone transmissions.

Which one of the following statements is correct?

1 Digital signals have discrete values only and are more prone to interference than analogue signals.

2 Digital signals have discrete values only and are less prone to interference than analogue signals.

3 Digital signals vary continuously and are more prone to interference than analogue signals.

4 Digital signals vary continuously and are less prone to interference than analogue signals.

Turn over for the next question

4.7.2.1 Electromagnetism

Question 45

January 2011 | PHY1H | Original Q1 | Legacy

1 Small sailing boats can be fitted with a passive radar device. The device increases the chance that the small boat will be seen on the radar screen of a large ship.
The radar transmitter on the large ship emits microwaves.

1 (a) Microwaves and radio waves are both part of the electromagnetic spectrum.

How are microwaves different from radio waves?

.....

.....

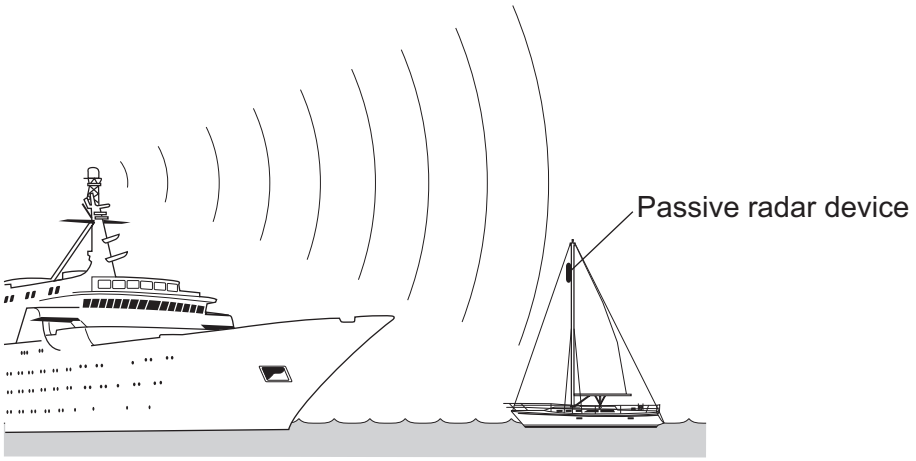
(1 mark)

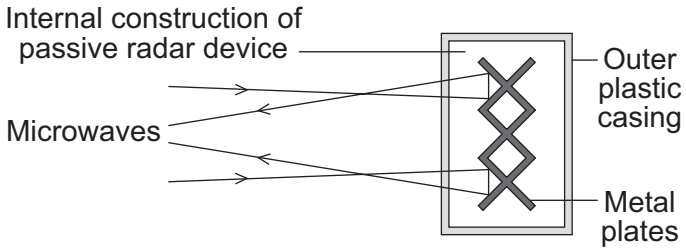
1 (b) How fast do microwaves travel through the air or a vacuum compared to radio waves?

.....

(1 mark)

1 (c) The diagrams show the position of a passive radar device on a small boat and the internal construction of one type of passive radar device.





4.7.2.1 Electromagnetism

Question 45 · continued

Microwaves can be absorbed, reflected or transmitted by different materials and types of surface.

Explain what happens to the microwaves from the ship's transmitter when they reach the passive radar device.

.....

.....

.....

.....

(2 marks)

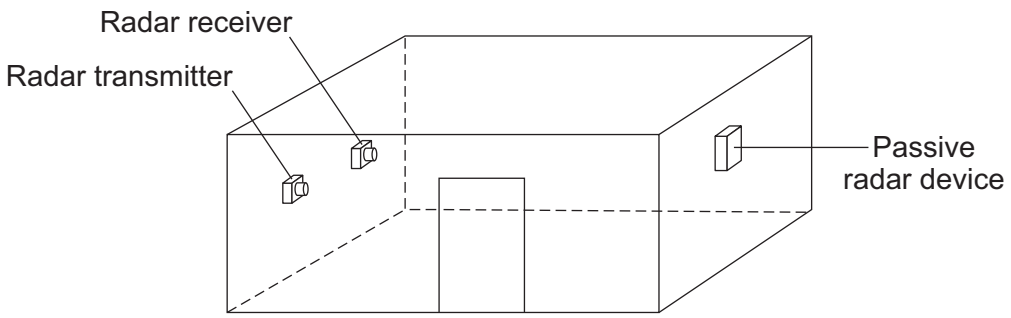
Question 1 continues on the next page

4.7.2.1 Electromagnetism

Question 45 · continued

1 (d) Each type of passive radar device has an RCS value. The larger the RCS value, the easier it is for a small boat fitted with the device to be detected.

An independent group of scientists measured the RCS values of 4 different types of device. The RCS value for each device was measured in the same room using the same equipment.



1 (d) (i) Why are the walls of the room covered in a material that absorbs the waves emitted by the radar transmitter?

.....

.....

(1 mark)

1 (d) (ii) Why is it important to use the same room and the same equipment?

.....

.....

(1 mark)

1 (d) (iii) Why is it important that the measurements are made by an independent group of scientists?

.....

.....

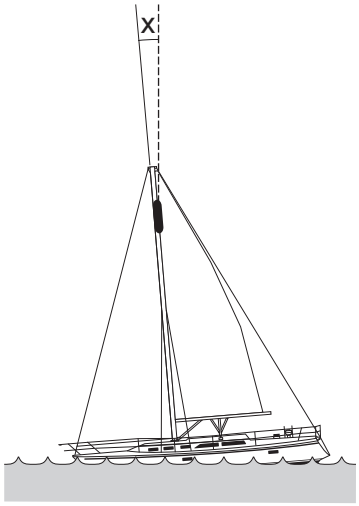
(1 mark)

4.7.2.1 Electromagnetism

Question 45 · continued

1 (e) The movement of a small boat causes the mast and device to lean over, therefore the RCS values were measured at different angles.

The table gives the RCS values obtained by the scientists.



Device	Angle X			
	0°	5°	10°	15°
A	1.4	1.6	1.7	1.8
B	4.7	2.6	2.3	1.9
C	9.3	3.3	1.9	1.1
D	4.5	4.8	5.0	4.6

1 (e) (i) Describe how the RCS values for **device A** are different to the RCS values for **device B**.

.....

.....

.....

.....

(2 marks)

1 (e) (ii) The scientists recommended that a passive radar device fitted to a small boat should have:

- the largest possible RCS value
- an RCS value consistently above 2.0

Which **one** of the devices, **A**, **B**, **C** or **D**, would you recommend that someone fits to their boat?

.....

Give a reason for your answer.

.....

.....

(1 mark)

10

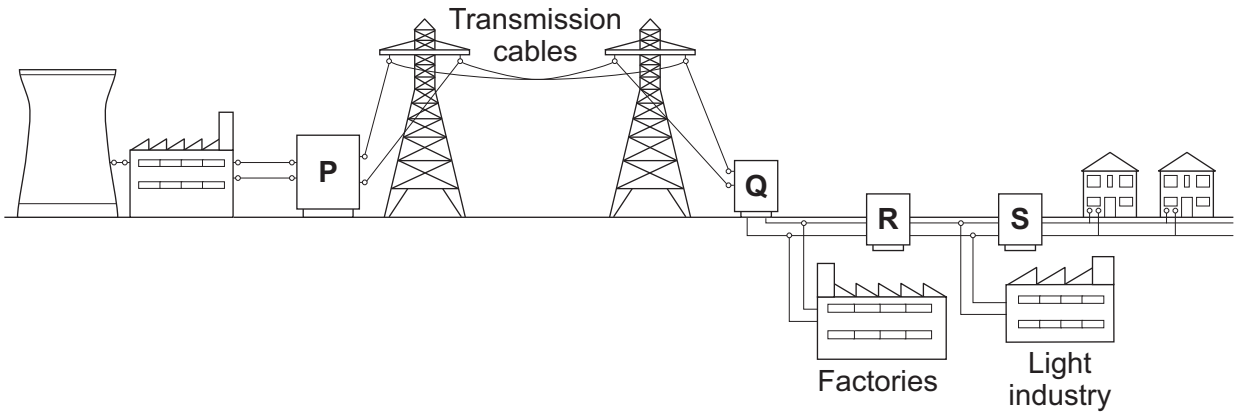
4.7.2.1 Electromagnetism

Question 46

March 2011 | PHY1AP | Original Q8 | Legacy

QUESTION EIGHT

The diagram shows a power station supplying electricity to the National Grid. There are four transformers in the system, labelled **P**, **Q**, **R** and **S**.



8A Which row in the table correctly describes each transformer?

	P	Q	R	S
1	step up	step down	step down	step down
2	step down	step up	step up	step up
3	step up	step down	step up	step down
4	step up	step up	step down	step down

8B The voltage across the overhead transmission cables is very high.

The best explanation for this is that . . .

1 it allows thinner cables to be used and the energy loss from the cables is reduced.

2 the energy loss from the cables is reduced and it allows the distance between pylons to be reduced.

3 the distance between the pylons can be reduced and thicker cables can be used.

4 it allows the current to travel more slowly and thicker cables can be used.

Question 46 · continued

8C Changing the voltage between the power station and the transmission cables using transformer **P** also changes the current flowing and the efficiency of distribution.

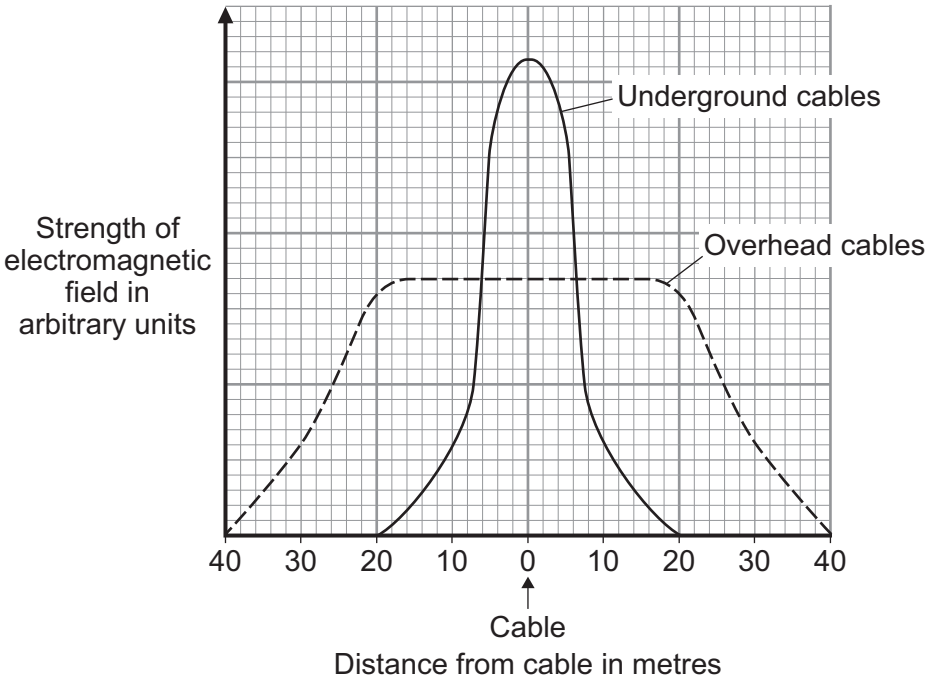
Which row of the table correctly shows these changes?

	Voltage	Current	Efficiency
1	increases	increases	increases
2	decreases	decreases	increases
3	decreases	decreases	decreases
4	increases	decreases	increases

8D Transmission cables can either be suspended from pylons above ground or they can be buried underground.

An electromagnetic field is produced when an electric current flows through a cable. Some people think that these fields can cause a health risk.

The graph shows how the strength of the electromagnetic field varies with distance from the cable for both overhead cables and underground cables.



Which of the following conclusions could be made from the graph?

1 When you are within 5 metres of the cable, the possible risk to health is bigger with an underground cable.

2 The possible health risk from overhead cables falls to zero when you are 20 metres away.

3 The biggest possible health risk from overhead cables occurs when you are 40 metres away.

4 Between 10 and 40 metres away, the biggest possible health risk is from underground cables.

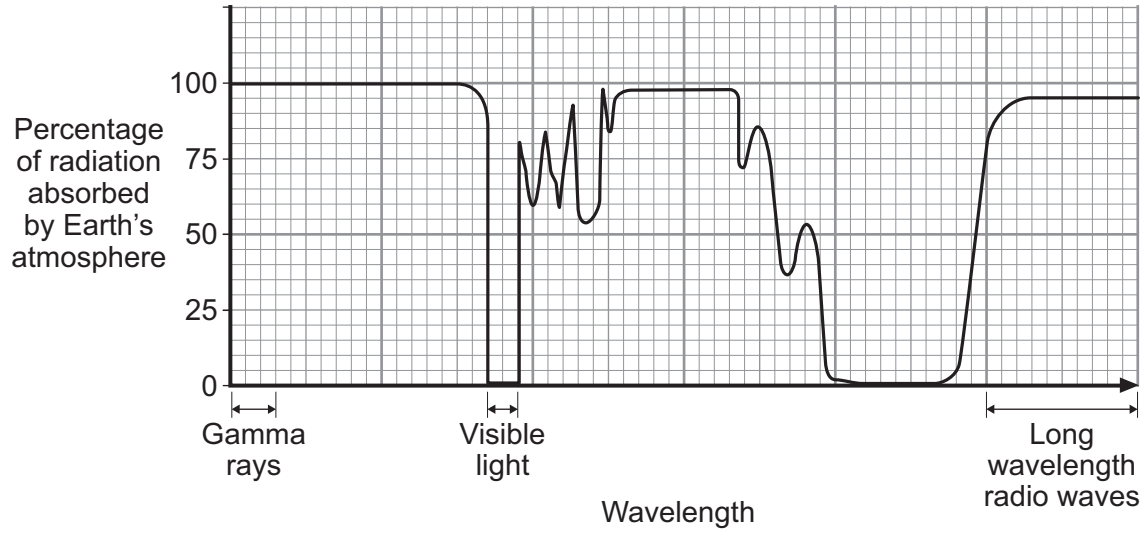
4.7.2.1 Electromagnetism

Question 47

March 2011 | PHY1BP | Original Q4 | Legacy

QUESTION FOUR

The diagram shows the absorption of electromagnetic radiation by the Earth's atmosphere.



4A The diagram shows that . . .

1 all wavelengths of gamma radiation reach the Earth's surface.

2 all wavelengths of radio waves reach the Earth's surface.

3 all wavelengths of ultraviolet radiation reach the Earth's surface.

4 all wavelengths of visible light reach the Earth's surface.

4B Some objects in space emit X-rays.

Where would you put a telescope to detect these X-rays?

1 above the Earth's atmosphere

2 at the top of a hill

3 at ground level in a hot desert

4 at ground level in the Antarctic

4.7.2.1 Electromagnetism

Question 47 · continued

The table gives information about some space telescopes.

Name	Hubble	Compton	Chandra	Spitzer
Launched in	1990	1991	1999	2003
Detects	infra red rays ultraviolet rays visible light	gamma rays	X-rays	infra red rays

4C Which statement about these space telescopes can be deduced from the information in the table?

1 They all collect data using mirrors.

2 They all detect electromagnetic radiation.

3 They are all in space at present.

4 They were all used to study the Earth.

4D From the information in the table, which one of the following emissions could be detected by one of these space telescopes?

1 alpha particles

2 nuclear radiation

3 radio waves

4 sound waves

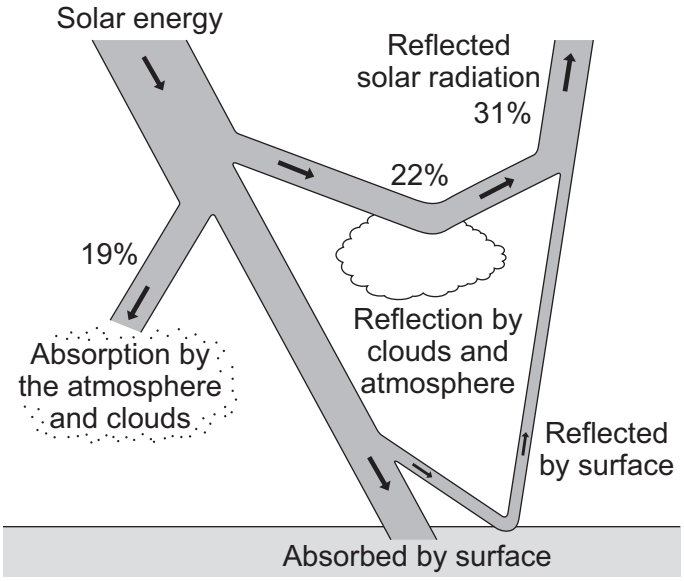
4.7.2.1 Electromagnetism

Question 48

March 2011 | PHY1BP | Original Q9 | Legacy

QUESTION NINE

The diagram shows what happens to solar energy as it enters the Earth's atmosphere on one day.



9A What percentage of the energy is absorbed by the Earth's surface?

1 28 %

2 50%

3 72 %

4 78 %

9B Solar radiation consists of different groups from the electromagnetic spectrum. In the ultraviolet region there are three main types, as shown in the diagram below.

Gamma	X-ray	Ultraviolet **UVC UVB UVA**	Visible	Infra red	Microwave	Radio

Which of the following statements is correct?

1 UVA rays have the same frequency, longer wavelength and travel at a faster speed than UVB rays.

2 UVB rays have a lower frequency, the same wavelength and travel at the same speed as UVC rays.

3 UVB rays have a lower frequency, a longer wavelength and travel at the same speed as UVC rays.

4 UVB rays have a higher frequency, a shorter wavelength and travel at a slower speed than UVC rays.

4.7.2.1 Electromagnetism

Question 48 · continued

March 2011 | PHY1BP | Original Q9 | Legacy

A measure of the ability of a surface to reflect sunlight is called the 'albedo' of the surface.

The *albedo* has a range of values from 0 (no reflection) to 1 (total reflection).

The table below gives the *albedo* values for some surfaces on the Earth.

Surface	Albedo
forest	0.06 – 0.14
crops	0.15 – 0.25
dry soil	0.24 – 0.35
ice	0.33 – 0.38
dry sand	0.36 – 0.44
old snow	0.42 – 0.60
new concrete	0.50 – 0.60
fresh snow	0.80 – 0.90

9C From the table, which of the following surfaces has the biggest range of *albedo* values?

1 crops

2 dry sand

3 dry soil

4 old snow

9D The average *albedo* of the Earth – atmosphere system is currently about 0.30. Scientists think that this value may rise over the next 50 years.

Which one of the following statements supports their idea?

1 More crops are being produced.

2 The Earth is getting further away from the Sun.

3 There is a decrease in forest area and an increase in urban areas.

4 Less fresh snow is being deposited because of climate change.

END OF TEST

4.7.2.1 Electromagnetism

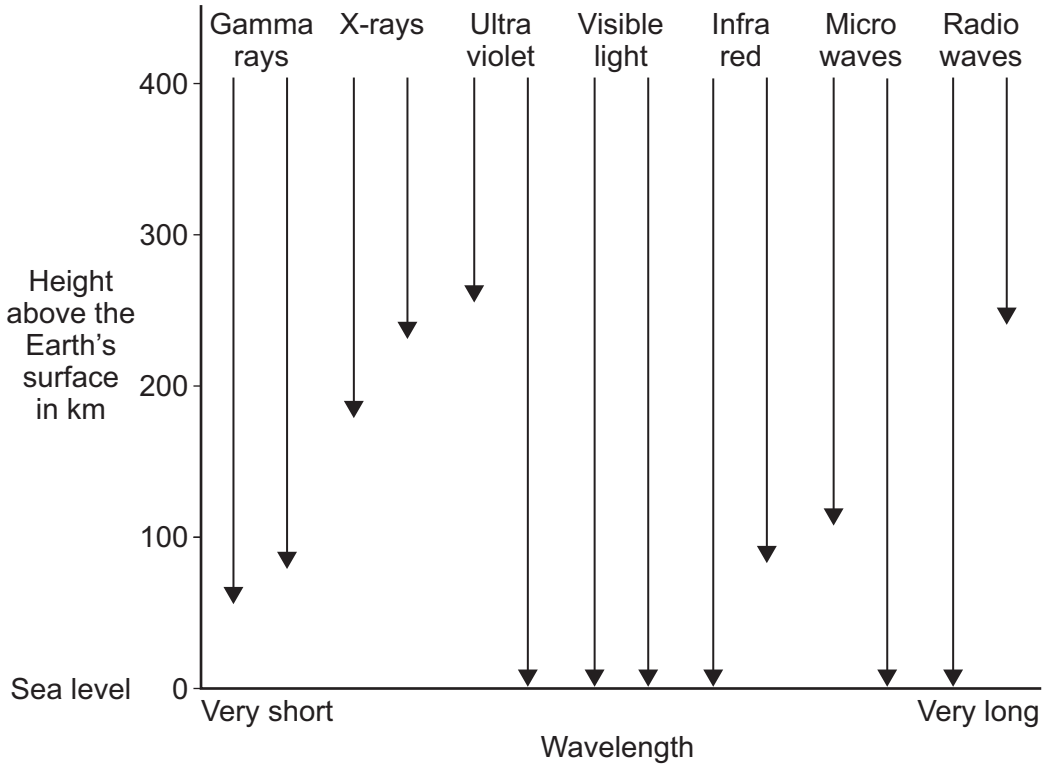
Question 49

June 2011 | PHY1BP | Original Q4 | Legacy

QUESTION FOUR

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.



4A 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.

4B 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.

4.7.2.1 Electromagnetism

Question 49 · 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

4C The Hubble telescope detects visible light.

Which telescope detects infra red radiation?

1 Chandra

2 FUSE

3 INTEGRAL

4 Spitzer

4D Which telescope detects X-rays?

1 Chandra

2 FUSE

3 INTEGRAL

4 Spitzer

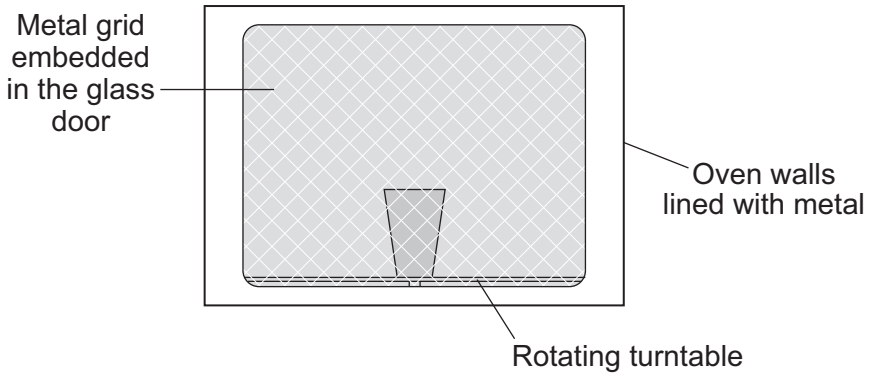
4.7.2.1 Electromagnetism

Question 50

June 2011 | PHY1BP | Original Q5 | Legacy

QUESTION FIVE

The diagram shows a microwave oven.



The microwaves have a frequency of 2500 MHz.

1 MHz = 1 000 000 Hz

5A The wave speed of the microwaves is 300 000 000 m/s.

What is the wavelength of the microwaves?

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

1 0.12 m

2 1.2 m

3 7.5 m

4 8.3 m

5B Which one of the following statements about electromagnetic radiations best explains why food can be heated by microwaves?

1 All electromagnetic radiations are disturbances in an electric field.

2 All electromagnetic radiations travel through a vacuum at the same speed.

3 All electromagnetic radiations travel as waves.

4 All electromagnetic radiations move energy from one place to another.

4.7.2.1 Electromagnetism

Question 50 · continued

5C The inside walls of the microwave oven are lined with metal. The door has a metal grid embedded in the glass.

The reason for using metal is that . . .

1 microwaves create an alternating current in the metal.

2 microwaves reflect off metal surfaces.

3 microwaves are absorbed by metals.

4 microwaves are transmitted by metals.

5D Microwaves are dangerous to living creatures. Microwaves can also affect radio and television reception.

Which feature of the oven shown in the diagram makes sure that microwaves do not escape through the door?

1 the rotating turntable

2 the metal lining

3 the embedded metal grid

4 the glass

4.7.2.1 Electromagnetism

Question 51

June 2011 | PHY1BP | Original Q8 | Legacy

QUESTION EIGHT

The transmission of television programmes in all areas of the UK is changing from using analogue signals to using digital signals.

8A Which row in the table correctly describes digital signals?

1	continuously variable	can be easily processed by computers
2	continuously variable	cannot be easily processed by computers
3	discrete values only	can be easily processed by computers
4	discrete values only	cannot be easily processed by computers

8B Cable television transmission sends signals along optical fibres made from glass.

One of the reasons for using these fibres is that . . .

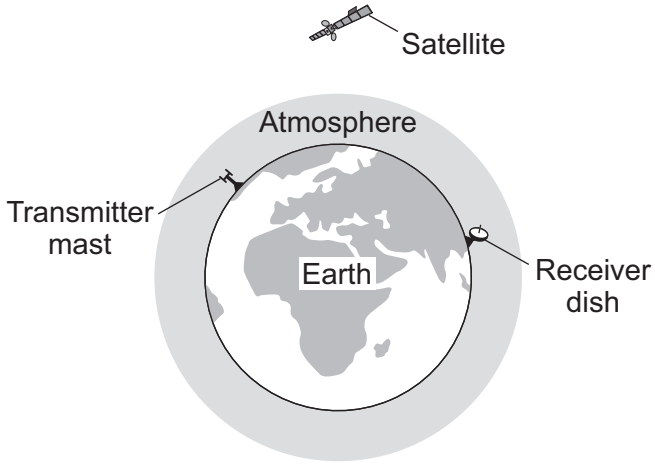
1 radio waves travel faster in glass than they do in air.

2 radio waves can be reflected inside the fibre so that the signal can go round corners.

3 visible light can travel through the walls of the fibre, just as it does through a window.

4 visible light can be reflected inside the fibre so that the signal can go round corners.

8C Satellite television programmes are transmitted from one side of the Earth to the other side.



4.7.2.1 Electromagnetism

Question 51 · continued June 2011 | PHY1BP | Original Q8 | Legacy

Which row in the table correctly describes the type of electromagnetic wave used and the reason for using this type of wave?

	Type of electromagnetic wave	Reason for use
1	microwaves	can travel in a curved path
2	microwaves	can pass through the Earth's atmosphere
3	radio waves	can travel in a curved path
4	radio waves	can pass through the Earth's atmosphere

8D Digital signals are better than analogue signals for transmitting satellite television programmes because . . .

1 they travel at a higher speed in a vacuum.

2 they spread out in all directions from the transmitter.

3 they are less prone to distortion by interference.

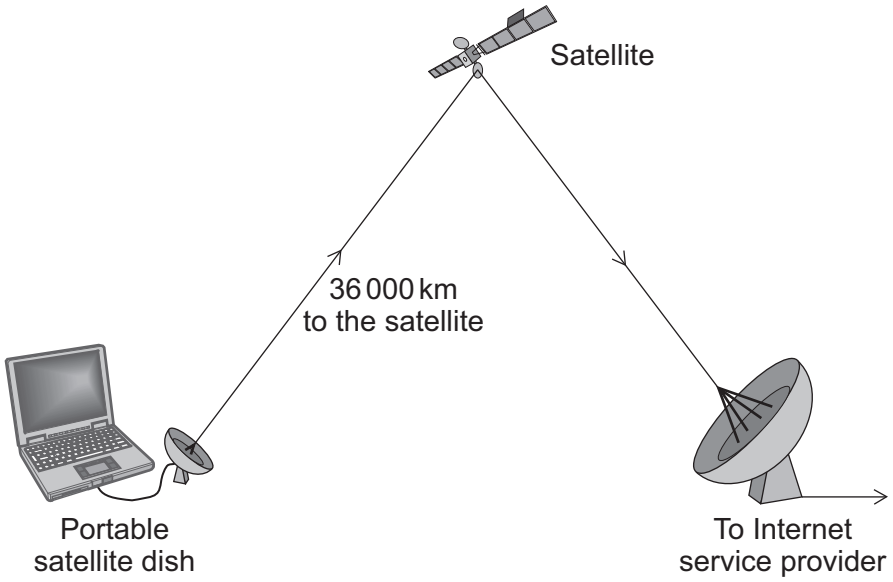
4 when amplified, any interference they have picked up is not amplified.

4.7.2.1 Electromagnetism

Question 52

June 2011 | PHY1H | Original Q3 | Legacy

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



3 (a) (i) Name the type of electromagnetic wave used to send information to and from the satellite.

.....

(1 mark)

3 (a) (ii) The information is sent to and from the satellite using a *digital signal*.

Describe a *digital signal*.

You may draw a diagram to help you answer.

.....

.....

(1 mark)

4.7.2.1 Electromagnetism

Question 52 · continued

3 (a) (iii) Give **one** advantage of sending information as a digital signal rather than as an analogue signal.

.....

.....

(1 mark)

3 (b) Electromagnetic waves travel at a speed of 300 000 000 m/s.
The waves travelling to and from the satellite have a wavelength of 15 cm.

Use the equation in the box to calculate the frequency of these waves.

wave speed = frequency × wavelength

Show clearly how you work out your answer and give the unit.

.....

.....

Frequency = ...

(3 marks)

3 (c) In 2009, parts of the African country Kenya, were linked to the Internet by a super-fast optical fibre. Before that, all Internet connections had to be made via a satellite link.

3 (c) (i) Complete the following sentence.

Signals can be sent along an optical fibre using either visible light or

..... .

(1 mark)

3 (c) (ii) Suggest a reason why signals sent through the optical fibre arrive faster than signals sent via a satellite link.

.....

.....

(1 mark)

8

4.7.2.1 Electromagnetism

Question 53

November 2011 | PHY1BP | Original Q1 | Legacy

QUESTION ONE

The frequencies of the waves in the electromagnetic spectrum can be grouped into types.

Match types, **A**, **B**, **C** and **D**, with the descriptions **1**–**4** in the table.

A gamma rays

B infra red rays

C radio waves

D ultraviolet rays

1	They have a higher frequency than X-rays.
2	They have a lower frequency than microwaves.
3	They have a lower frequency than visible light but a higher frequency than microwaves.
4	They have a lower frequency than X-rays but a higher frequency than visible light.

4.7.2.1 Electromagnetism

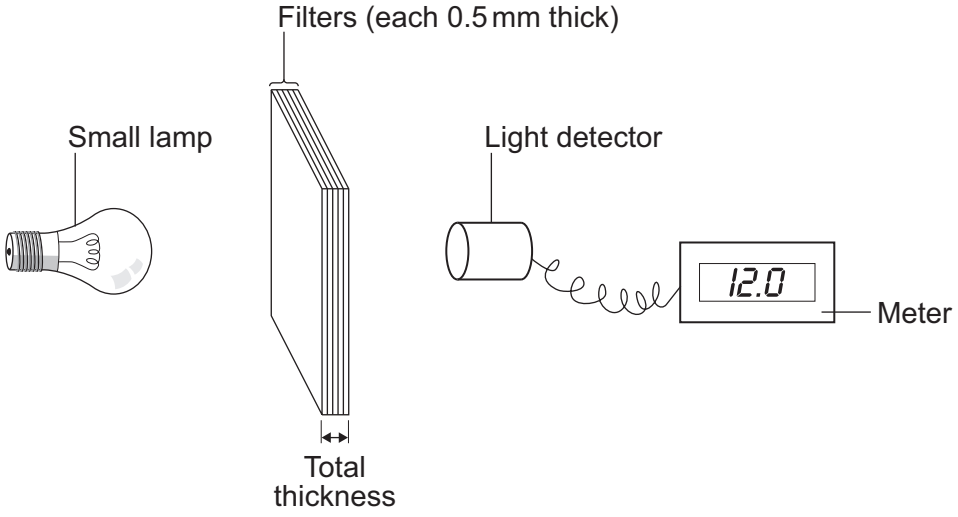
Question 54

November 2011 | PHY1BP | Original Q6 | Legacy

QUESTION SIX

Different numbers of coloured filters were placed between a small lamp and a light detector. Each filter was 0.5 mm thick.

The meter showed the intensity of the light reaching the detector.



The graph shows how the light intensity changes as the thickness of the filters changes.



4.7.2.1 Electromagnetism

Question 54 · continued

6A Which is the best description of the pattern shown by the graph considering all the coloured filters?

1 The light intensity transmitted is directly proportional to the total thickness of the filters.

2 The light intensity transmitted is inversely proportional to the total thickness of the filters.

3 As the total thickness of the filters increases, the light intensity transmitted increases.

4 As the total thickness of the filters increases, the light intensity transmitted decreases.

6B What is the light intensity reading when 14 blue filters are used?

1 4.5 units

2 6.2 units

3 6.5 units

4 6.6 units

6C How many green filters would be needed to reduce the initial light intensity by 50 %?

1 three

2 five

3 six

4 seven

6D Which types of electromagnetic radiation are used to send signals along optical fibres?

1 infra red rays and ultraviolet rays

2 infra red rays and visible light

3 infra red rays, ultraviolet rays and visible light

4 visible light and ultraviolet rays

4.7.2.1 Electromagnetism

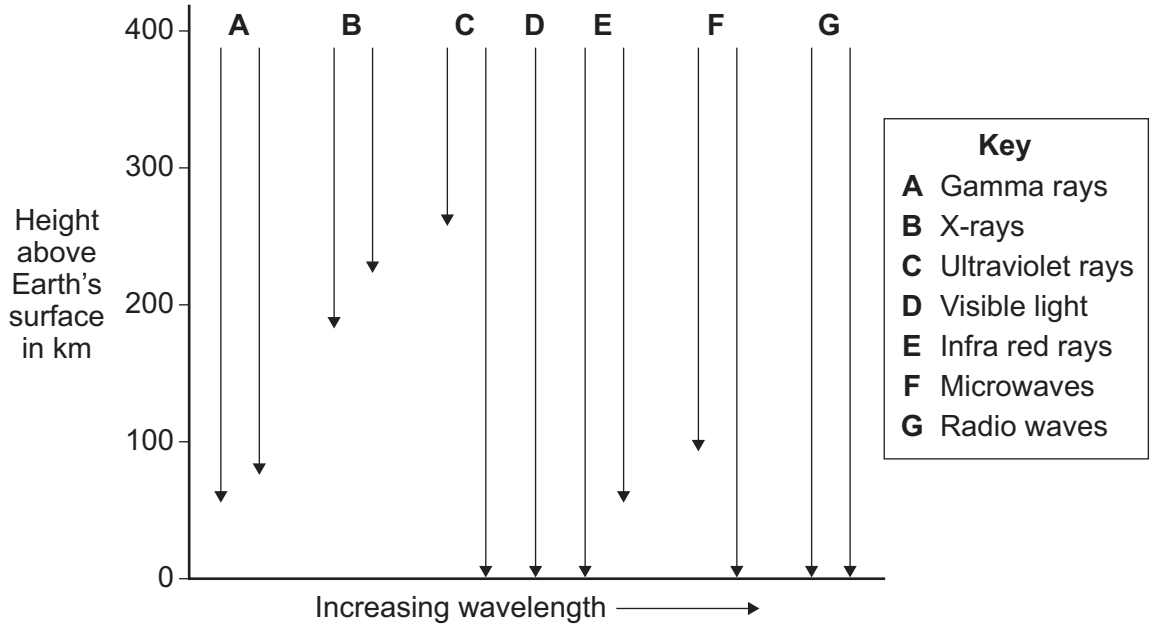
Question 55

November 2011 | PHY1BP | Original Q9 | Legacy

QUESTION NINE

The diagram shows how far electromagnetic waves can penetrate the Earth's atmosphere.

Where two arrows are shown for a particular type of electromagnetic radiation, longer and shorter waves penetrate the atmosphere to different depths.



9A Which one of the following statements is true?

1 Gamma rays penetrate the atmosphere further than all other types of electromagnetic radiation.

2 All frequencies of ultraviolet radiation reach the Earth's surface.

3 No frequencies of radio waves reach the Earth's surface.

4 Higher frequencies of microwaves are completely absorbed by the atmosphere.

9B What would be the minimum height above the Earth for a satellite carrying telescopes designed to detect gamma rays, X-rays and ultraviolet radiation of all wavelengths?

1 50 km

2 70 km

3 180 km

4 260 km

4.7.2.1 Electromagnetism

Question 55 · continued

9C Optical telescopes used to observe objects in space are limited because they can be used only . . .

1 as ground-based telescopes.

2 at night.

3 to observe a small region of the electromagnetic spectrum.

4 to observe one region of the sky.

9D Electromagnetic radiation from distant galaxies is very weak and is therefore very difficult to detect.

Some space telescopes use liquid helium to keep scientific instruments at a very low temperature.

Which type of weak electromagnetic radiation would best be detected by instruments kept at a very low temperature?

1 gamma rays

2 X-rays

3 infra red rays

4 ultraviolet rays

END OF TEST

4.7.2.1 Electromagnetism

Question 56

June 2012 | PH1HP | Original Q5 | Legacy

5 Radio waves and microwaves are two types of electromagnetic wave.

Both waves:

- can be used for communications
- travel at the same speed through air.

5 (a) Give **two** more properties that are the same for both radio waves and microwaves.

1 .....

.....

2 .....

.....

(2 marks)

5 (b) Some satellites are used to transmit television programmes. Signals are sent to, and transmitted from, the satellites using microwaves.

What is the property of microwaves that allows them to be used for satellite communications?

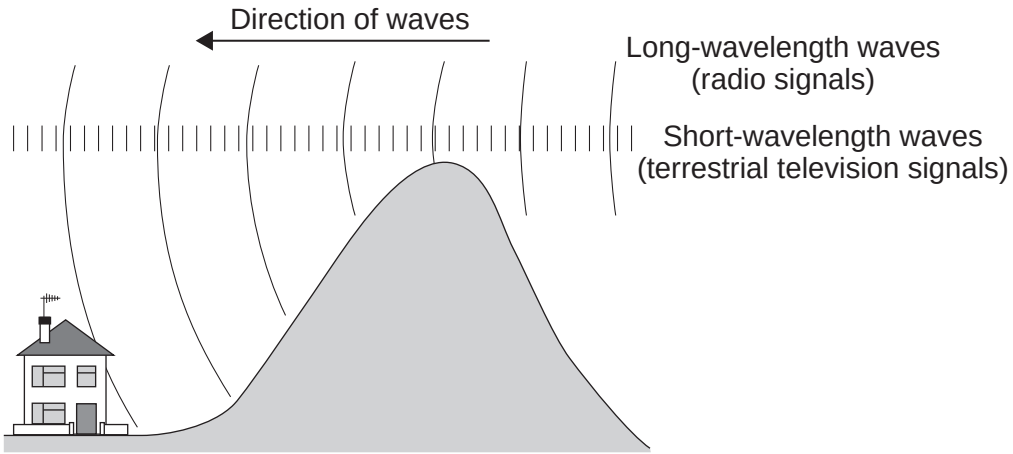
.....

.....

(1 mark)

5 (c) Terrestrial television does not use satellites.

Terrestrial television signals and radio signals both use radio waves.
Radio signals are transmitted at a longer wavelength than terrestrial television signals.



4.7.2.1 Electromagnetism

Question 56 · continued

In hilly areas it may be possible to receive radio signals but not receive terrestrial television signals.

Explain why.

.....

.....

.....

.....

.....

.....

(3 marks)

5 (d) Electromagnetic waves travel at a speed of 3.0×10^8 m/s.
A radio station transmits waves with a wavelength of 2.5×10^2 m.

Calculate the frequency of the radio waves.

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer and give the unit.

.....

.....

.....

Frequency = ...

(3 marks)

9

4.7.2.1 Electromagnetism

Question 57

June 2012 | PH1HP | Original Q8 | Legacy

8 (a) The 'Big Bang' theory uses red-shift as evidence to explain the beginning of the Universe.

How does the red-shift from distant galaxies provide evidence for the beginning of the Universe?

.....

.....

.....

.....

.....

.....

(3 marks)

8 (b) Cosmic microwave background radiation (CMBR) is a type of electromagnetic radiation. CMBR fills the Universe. It was first discovered in 1965 by two astronomers called Penzias and Wilson.

8 (b) (i) What do scientists believe is the origin of CMBR?

.....

.....

(1 mark)

8 (b) (ii) Why was the discovery of CMBR so important to the scientists believing the 'Big Bang' theory to be correct?

.....

.....

(1 mark)

8 (b) (iii) How is the wavelength of CMBR likely to change, if at all, over the next billion years?

.....

Give a reason for your answer.

.....

.....

(2 marks)

7

4.7.2.1 Electromagnetism

Question 58

January 2013 | PH1HP | Original Q5 | Legacy

5 Galaxies emit all types of electromagnetic wave.

5 (a) (i) Which type of electromagnetic wave has the shortest wavelength?

.....

(1 mark)

5 (a) (ii) State **one** difference between an ultraviolet wave and a visible light wave.

.....

.....

(1 mark)

5 (b) Electromagnetic waves travel through space at a speed of 3.0×10^8 m/s.

The radio waves emitted from a distant galaxy have a wavelength of 25 metres.

Calculate the frequency of the radio waves emitted from the galaxy and give the unit.

Use the correct equation from the Physics Equations Sheet.

.....

.....

.....

Frequency = ...

(3 marks)

5 (c) Scientists use a radio telescope to measure the wavelength of the radio waves emitted from the galaxy in part **(b)** as the waves reach the Earth. The scientists measure the wavelength as 25.2 metres. The effect causing this observed increase in wavelength is called red-shift.

5 (c) (i) The waves emitted from most galaxies show red-shift.

What does red-shift tell scientists about the direction most galaxies are moving?

.....

.....

(1 mark)

4.7.2.1 Electromagnetism

Question 58 · continued

5 (c) (ii) The size of the red-shift is **not** the same for all galaxies.

What information can scientists find out about a galaxy when they measure the size of the red-shift the galaxy produces?

.....

.....

.....

.....

(2 marks)

5 (c) (iii) What does the observation of red-shift suggest is happening to the Universe?

.....

.....

(1 mark)

9

4.7.2.1 Electromagnetism

Question 59

June 2013 | PH1HP | Original Q7 | Legacy

7 (a) Electromagnetic waves form a continuous spectrum with a range of wavelengths.

What is the approximate range of wavelengths of electromagnetic waves?

Tick (✓) **one** box.

10^{-15} metres to 10^{4} metres ☐

10^{-4} metres to 10^{15} metres ☐

10^{-6} metres to 10^{6} metres ☐

(1 mark)

7 (b) Infrared waves and microwaves are used for communications.

7 (b) (i) Give **one** example of infrared waves being used for communication.

.....

.....

(1 mark)

7 (b) (ii) A mobile phone network uses microwaves to transmit signals through the air. The microwaves have a frequency of 1.8×10^{9} Hz and travel at a speed of 3.0×10^{8} m/s.

Calculate the wavelength of the microwaves.

Use the correct equation from the Physics Equations Sheet.

Give your answer to **two** significant figures.

.....

.....

.....

Wavelength = ... m

(3 marks)

4.7.2.1 Electromagnetism

Question 59 · continued

7 (c) Some scientists suggest there is a possible link between using a mobile phone and male fertility.

The results of their study are given in the table.

Mobile phone use in hours per day	Sperm count in millions of sperm cells per cm^3 of semen
0	86
less than 2	69
2 – 4	59
more than 4	50

The results show a negative correlation: the more hours a mobile phone is used each day, the lower the sperm count. However, the results do **not** necessarily mean using a mobile phone causes the reduced sperm count.

Suggest **one** reason why.

.....

.....

(1 mark)

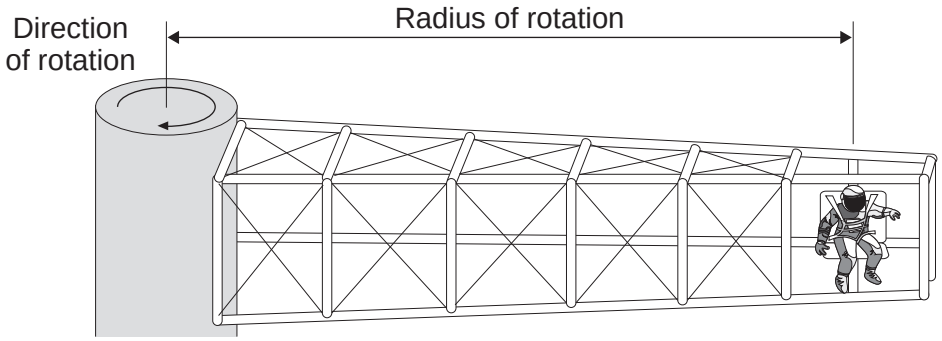
6

4.7.2.1 Electromagnetism

Question 60

June 2013 | PH3HP | Original Q5 | Legacy

5 The diagram shows a 'G-machine'. The G-machine is used in astronaut training.



The G-machine moves the astronaut in a horizontal circle.

5 (a) When the G-machine is rotating at constant speed, the astronaut is accelerating.

State the name and direction of the force causing the astronaut to accelerate.

Name of force .....

Direction of force .....

.....

(2 marks)

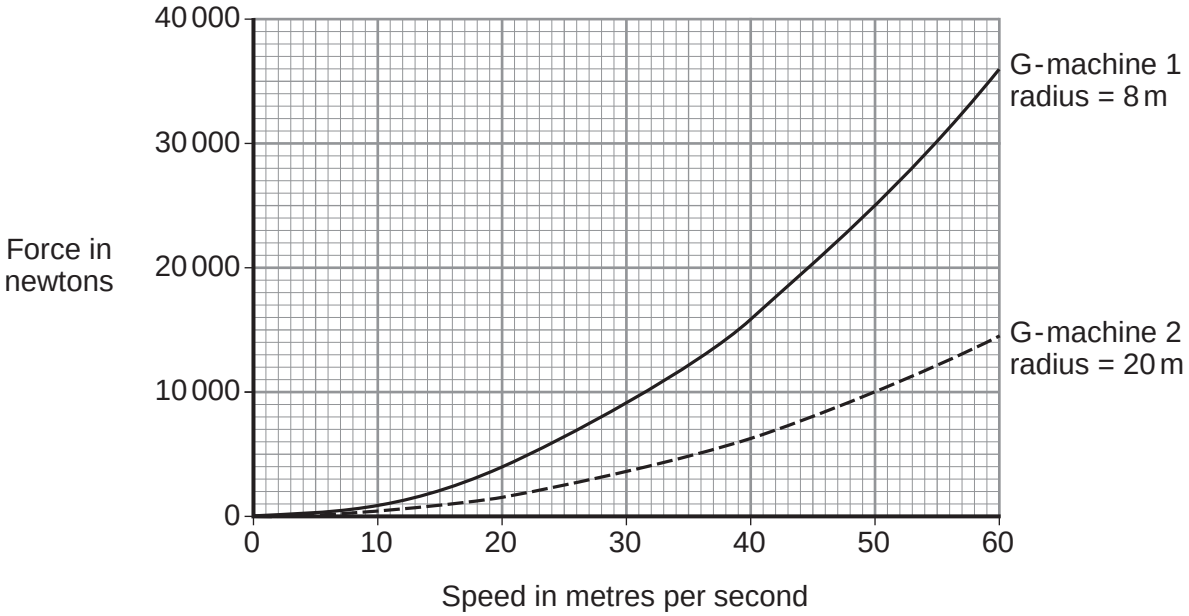
4.7.2.1 Electromagnetism

Question 60 · continued

5 (b) The force causing the astronaut to move in a circle is measured.

The graph shows how the speed of the astronaut affects the force causing the astronaut to move in a circle for two different G-machines.

The radius of rotation of the astronaut is different for each G-machine.



5 (b) (i) State **three** conclusions that can be made from the graph.

1 .....

.....

2 .....

.....

3 .....

.....

(3 marks)

5 (b) (ii) The speed of rotation of G-machine 1 is increased from 20 m/s to 40 m/s.

Determine the change in force on the astronaut.

.....

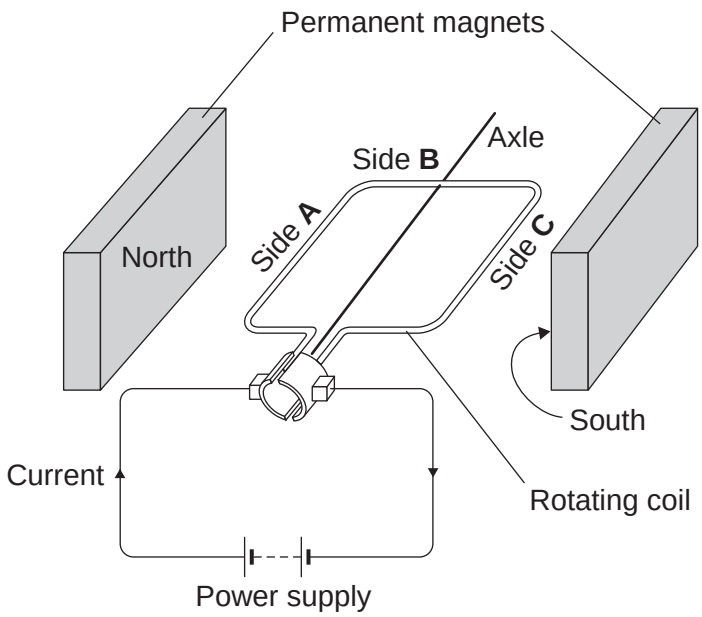
Change in force = ... N

(1 mark)

4.7.2.1 Electromagnetism

Question 60 · continued

5 (c) Each G-machine is rotated by an electric motor. The diagram shows a simple electric motor.



5 (c) (i) A current flows through the coil of the motor.

Explain why side **A** of the coil experiences a force.

.....

.....

.....

.....

(2 marks)

5 (c) (ii) Draw arrows on the diagram to show the direction of the forces acting on side **A** of the coil and side **C** of the coil.

(1 mark)

5 (c) (iii) When horizontal, side **B** experiences no force.

Give the reason why.

.....

.....

(1 mark)

4.7.2.1 Electromagnetism

Question 60 · continued

5 (d) While a G-machine is rotating, the operators want to increase its speed.

What can the operators do to make the G-machine rotate faster?

.....

.....

(1 mark)

5 (e) The exploration of space has cost a lot of money.

Do you think spending lots of money on space exploration has been a good thing?

Draw a ring around your answer.

Yes **No**

Give a reason for your answer.

.....

.....

(1 mark)

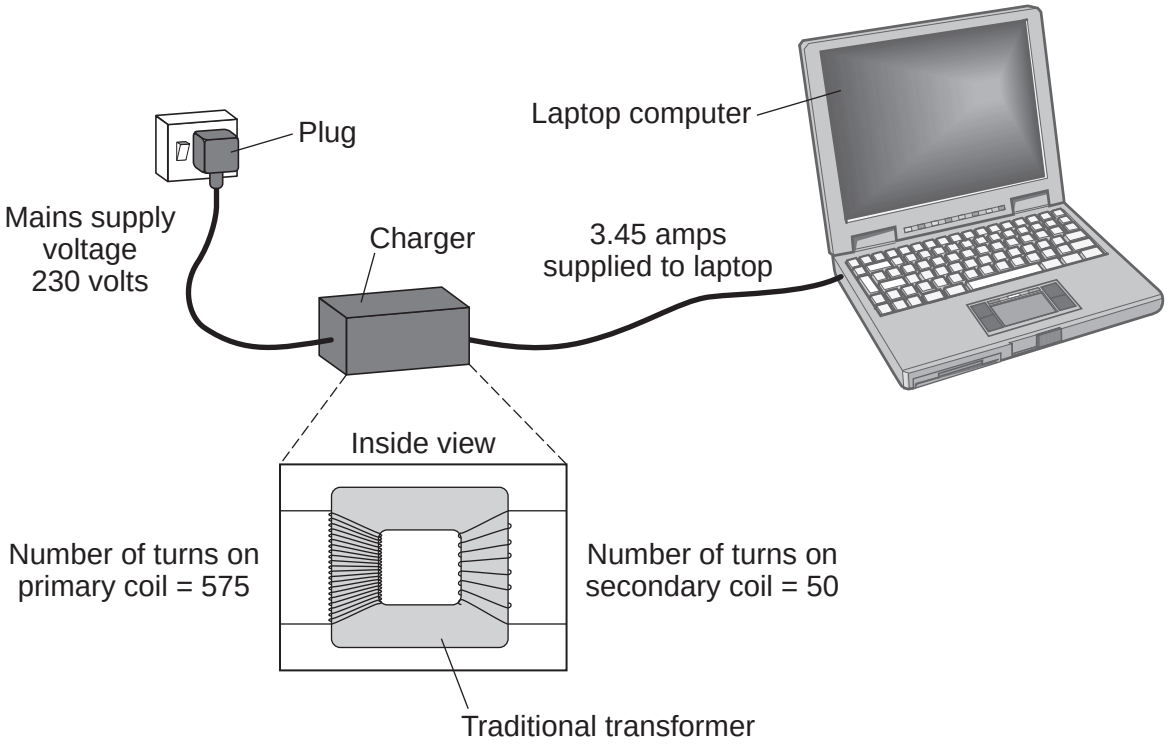
12

4.7.2.1 Electromagnetism

Question 61

June 2013 | PH3HP | Original Q7 | Legacy

7 Batteries inside laptop computers are charged using laptop chargers. The laptop charger contains a traditional transformer.



7 (a) The alternating current flowing through the primary coil of the transformer creates an alternating current in the secondary coil.

Explain how.

.....

.....

.....

.....

.....

.....

.....

.....

(3 marks)

4.7.2.1 Electromagnetism

Question 61 · continued

7 (b) (i) Use information from the diagram to calculate the potential difference the charger supplies to the laptop.

Use the correct equation from the Physics Equations Sheet.

.....

.....

.....

.....

Potential difference = ... V

(2 marks)

7 (b) (ii) Calculate the current in the primary coil of the transformer when the laptop is being charged.

Assume the transformer is 100% efficient.

Use the correct equation from the Physics Equations Sheet.

.....

.....

.....

.....

Current = ... A

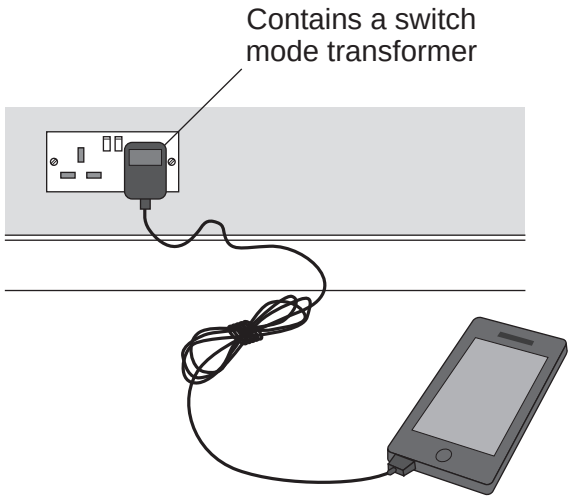
(2 marks)

Question 7 continues on the next page

4.7.2.1 Electromagnetism

Question 61 · continued

7 (c) Switch mode transformers can be used in mobile phone chargers.



Switch mode transformers and traditional transformers can both use the UK mains supply.

The switch mode transformer is smaller and lighter than the traditional transformer used in the laptop charger.

Give **one** other advantage of the switch mode transformer.

.....

.....

(1 mark)

7 (d) Laptop batteries and mobile phone batteries can only be recharged a limited number of times. After this, the batteries cannot store enough charge to be useful. Scientists are developing new batteries that can be recharged many more times than existing batteries.

Suggest **one** other advantage of developing these new batteries.

.....

.....

.....

(1 mark)

9

4.7.2.1 Electromagnetism

Question 62

June 2014 | PH1HP | Original Q3 | Legacy

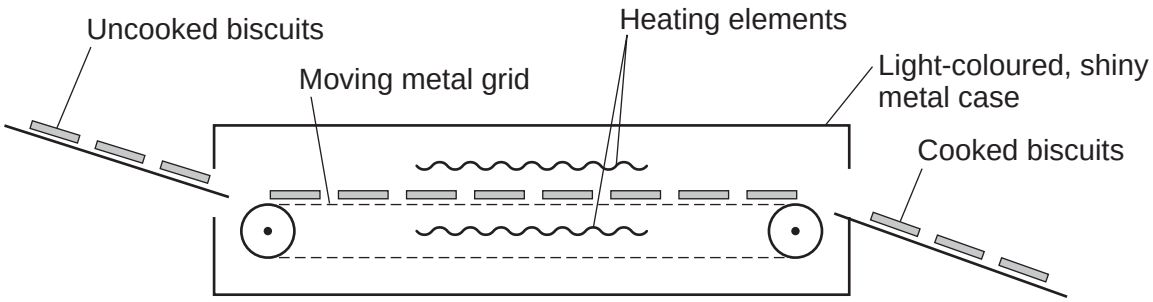
3 **Figure 1** shows one way that biscuit manufacturers cook large quantities of biscuits.

The uncooked biscuits are placed on a moving metal grid.

The biscuits pass between two hot electrical heating elements inside an oven.

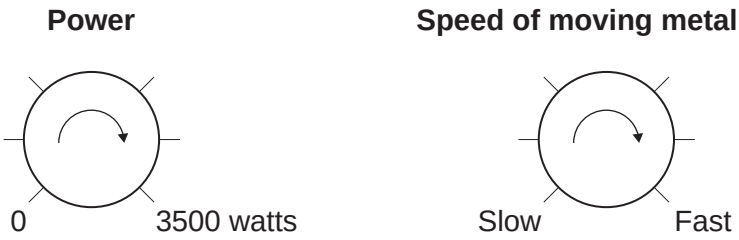
The biscuits turn brown as they cook.

Figure 1



The oven has two control knobs, as shown in **Figure 2**.

Figure 2



3 (a) Which type of electromagnetic radiation makes the biscuits turn brown?

[1 mark]

.....

3 (b) Suggest **two** ways of cooking the biscuits in this oven, to make them turn browner.

[2 marks]

1 .....

.....

2 .....

.....

4.7.2.1 Electromagnetism

Question 62 · continued

3 (c) The inside and outside surfaces of the oven are light-coloured and shiny.

Explain why.

[3 marks]

.....

.....

.....

.....

.....

.....

6

Turn over for the next question

4.7.2.1 Electromagnetism

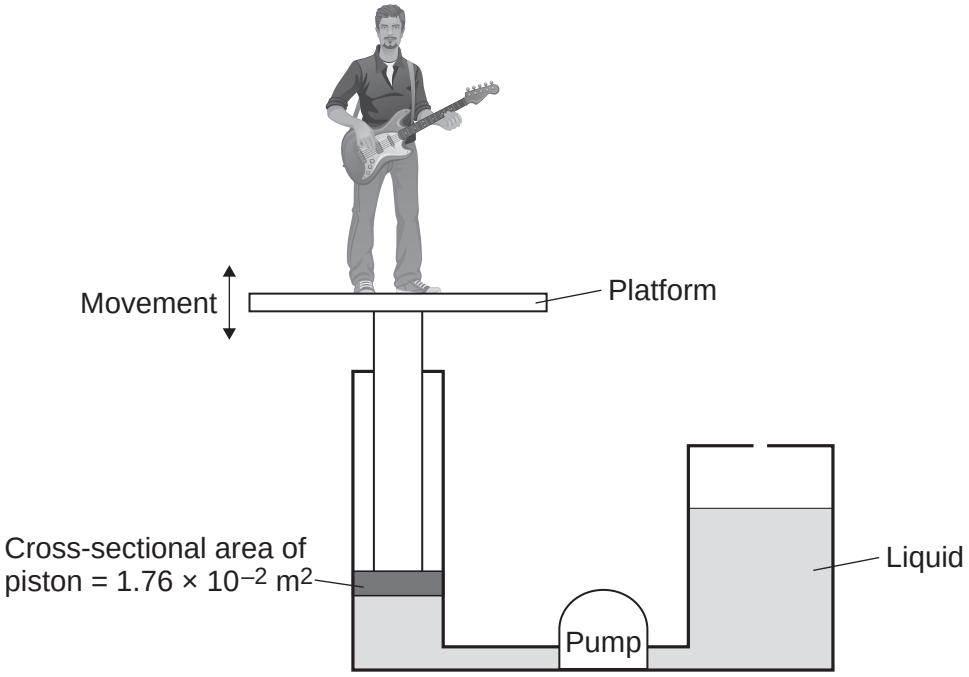
Question 63

June 2014 | PH3HP | Original Q8 | Legacy

8 Musicians sometimes perform on a moving platform.

Figure 13 shows the parts of the lifting machine used to move the platform up and down.

Figure 13



8 (a) What type of system uses a liquid to transmit a force?

[1 mark]

.....

8 (b) The pump creates a pressure in the liquid of 8.75 x 10^4 Pa to move the platform upwards.

Calculate the force that the liquid applies to the piston.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

.....

.....

.....

Force = ... N

4.7.2.1 Electromagnetism

Question 63 · continued

8 (c) The liquid usually used in the machine is made by processing oil from underground wells. A new development is to use plant oil as the liquid.

Extracting plant oil requires less energy than extracting oil from underground wells.

Suggest an environmental advantage of using plant oil.

[1 mark]

.....

.....

.....

Question 8 continues on the next page

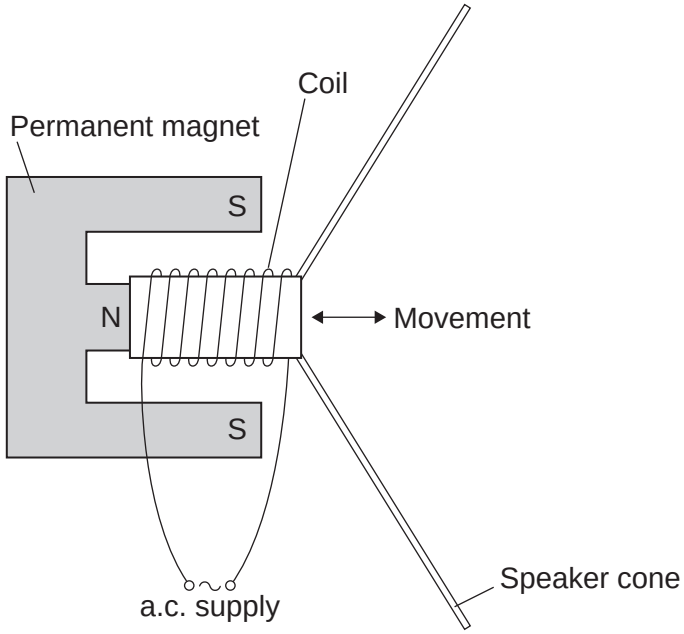
4.7.2.1 Electromagnetism

Question 63 · continued

8 (d) Musicians often use loudspeakers.

Figure 14 shows how a loudspeaker is constructed.

Figure 14



The loudspeaker cone vibrates when an alternating current flows through the coil.

Explain why.

[4 marks]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

8

4.7.2.1 Electromagnetism

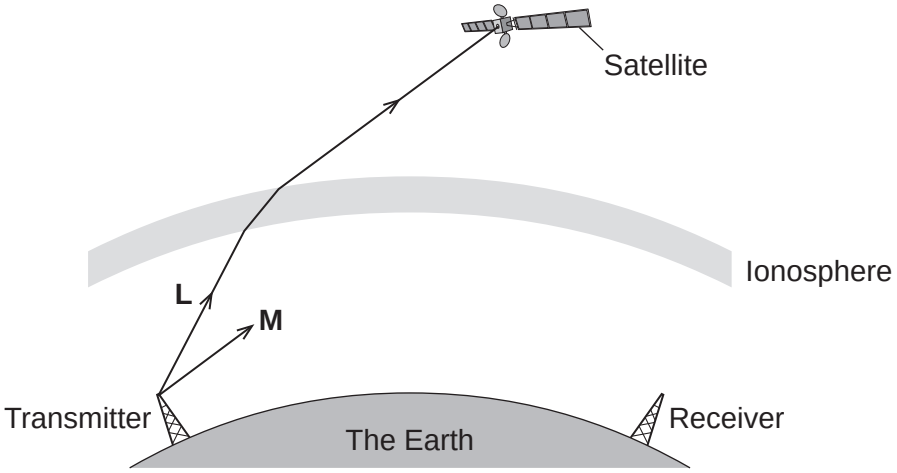
Question 64

June 2015 | PH1HP | Original Q4 | Legacy

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

Figure 4 shows a transmitter emitting two electromagnetic waves, **L** and **M**.

Figure 4



4 (a) (i) Wave **L** is used to send a signal to a satellite.
Which part of the electromagnetic spectrum does wave **L** belong to?

[1 mark]

.....

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

[1 mark]

.....

4 (b) Wave **M** is **reflected** by the ionosphere.

4 (b) (i) On **Figure 4**, draw the path of wave **M** until it reaches the receiver.

[2 marks]

4 (b) (ii) On **Figure 4**, draw a line to show the normal where wave **M** meets the ionosphere.
Label the line **N**.

[1 mark]

4.7.2.1 Electromagnetism

Question 64 · continued

4 (c) Give **two** properties of all electromagnetic waves.

[2 marks]

1 .....

.....

2 .....

.....

7

Turn over for the next question

4.7.2.1 Electromagnetism

Question 65

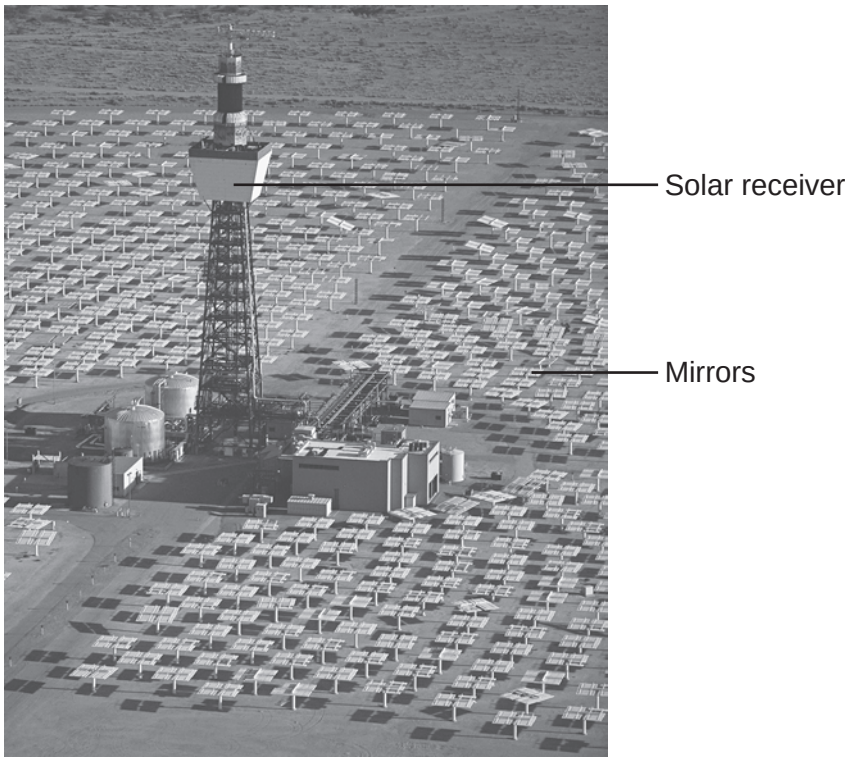
June 2015 | PH1HP | Original Q5 | Legacy

5 **Figure 5** shows a solar thermal power station that has been built in a hot desert.

The power station uses energy from the Sun to heat water to generate electricity.

Energy from the Sun is reflected towards a solar receiver using many mirrors.

Figure 5



5 (a) (i) Which part of the electromagnetic spectrum provides most of the energy to heat the water in a solar thermal power station?

[1 mark]

.....

4.7.2.1 Electromagnetism

Question 65 · continued

5 (a) (ii) Describe how heated water is used to generate electricity by this solar thermal power station.
The process is the same as in a fossil fuel power station.

[3 marks]

.....

.....

.....

.....

.....

.....

5 (b) A new type of solar power station, called a solar storage power station, is able to store energy from the Sun by heating molten chemical salts.
The stored energy can be used to generate electricity at night.

5 (b) (i) It is important that the molten chemical salts have a high specific heat capacity.
Suggest **one** reason why.

[1 mark]

.....

.....

5 (b) (ii) The solar storage power station can store a maximum of 2 200 000 kWh of energy.
The solar storage power station can supply a town with a maximum electrical power of 140 000 kW.

Calculate for how many hours the energy stored by the solar storage power station can supply the town with electrical power.

Give your answer to 2 significant figures.

Use the correct equation from the Physics Equations Sheet.

[3 marks]

.....

.....

.....

Time = ... hours

Question 5 continues on the next page

4.7.2.1 Electromagnetism

Question 65 · continued

5 (b) (iii) **Table 3** gives information about the place where the solar storage power station has been built.

Table 3

Season	Mean number of daylight hours	Mean power received from the Sun per square metre in kW
Spring	11.5	0.90
Summer	13.5	1.10
Autumn	12.0	0.95
Winter	10.5	0.71

The solar storage power station does not operate at the maximum possible electrical output every day of the year.

Suggest why.

[2 marks]

.....

.....

.....

.....

5 (c) Power stations do not work at maximum possible electrical output all the time.
The 'capacity factor' of a power station is calculated using the equation:

$$\text{Capacity factor} = \frac{\text{actual electrical output per year}}{\text{maximum possible electrical output per year}}$$

4.7.2.1 Electromagnetism

Question 65 · continued

Table 4 shows capacity factors for different types of power station.

Table 4

Type of power station	Renewable energy source	Capacity factor
Coal	No	0.41
Natural gas	No	0.48
Nuclear	No	0.66
Solar thermal	Yes	0.33
Tidal	Yes	0.26
Wind turbine	Yes	0.30

5 (c) (i) Compare the capacity factors of the renewable power stations with those of the non-renewable power stations in **Table 4**.
Explain the reason for the difference between the capacity factors.

[3 marks]

……

……

……

……

……

……

5 (c) (ii) The capacity factor of a solar storage power station is higher than for all other renewable power stations.
Suggest **one** reason why.

[1 mark]

……

……

14

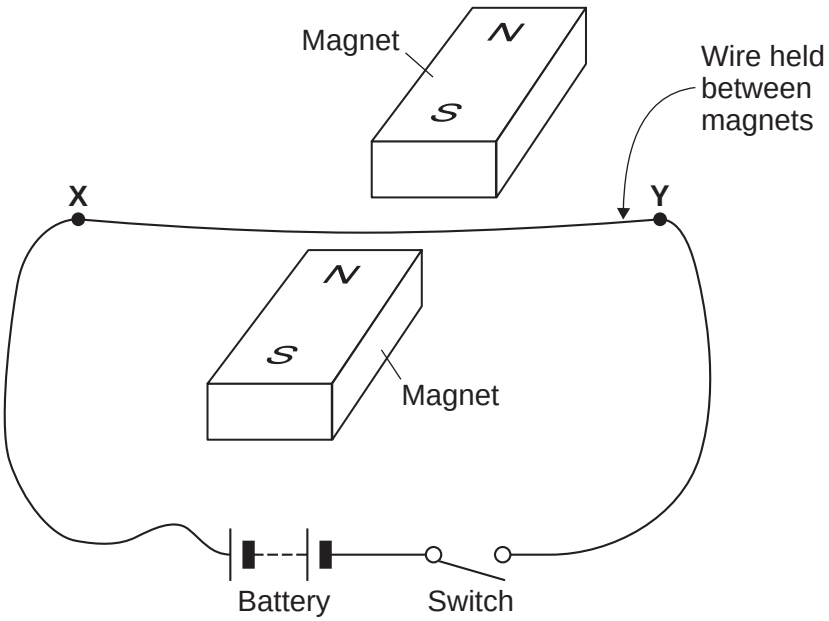
4.7.2.1 Electromagnetism

Question 66

June 2015 | PH3HP | Original Q5 | Legacy

5 **Figure 10** shows apparatus set up by a student.

Figure 10



Closing the switch creates a force that acts on the wire **XY**.

5 (a) (i) Explain why a force acts on the wire **XY** when the switch is closed.

[3 marks]

.....

.....

.....

.....

.....

.....

5 (a) (ii) The force causes the wire **XY** to move.
Draw an arrow on **Figure 10** to show the direction in which the wire **XY** will move.

[1 mark]

5 (a) (iii) State the effect that this experiment demonstrates.

[1 mark]

.....

4.7.2.1 Electromagnetism

Question 66 · continued

5 (b) The student replaced the battery with a low frequency alternating current (a.c.) power supply.

The student closed the switch.

5 (b) (i) Describe the movement of the wire.

[1 mark]

.....

5 (b) (ii) Give a reason for your answer to part **(b)(i)**.

[1 mark]

.....

.....

.....

7

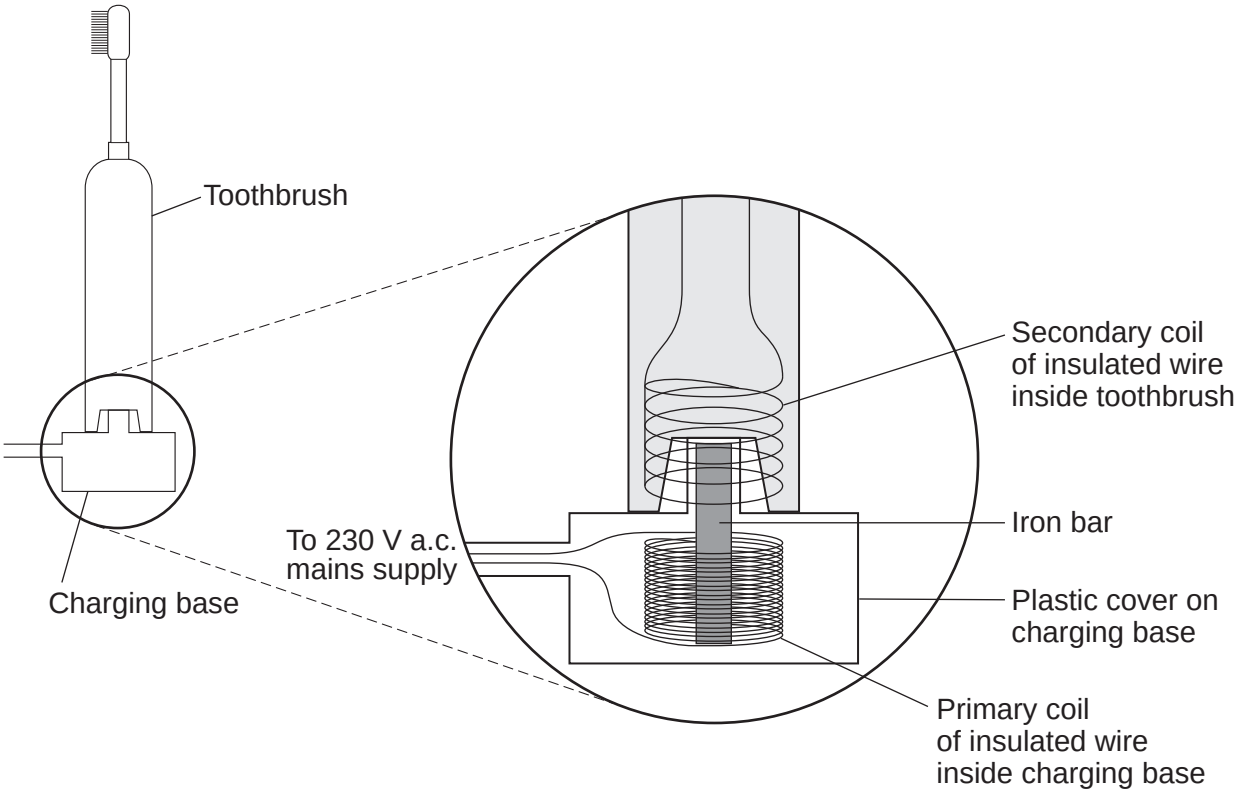
4.7.2.1 Electromagnetism

Question 67

June 2015 | PH3HP | Original Q8 | Legacy

8 An electric toothbrush is charged by standing it on a separate charging base. **Figure 15** shows the inside of the electric toothbrush and the charging base.

Figure 15



8 (a) An alternating potential difference (p.d.) across the coil in the charging base creates an alternating current in the coil inside the toothbrush.

Explain how.

[3 marks]

.....

.....

.....

.....

.....

.....

.....

.....

4.7.2.1 Electromagnetism

Question 67 · continued

8 (b) When the toothbrush is being charged, the p.d. across the primary coil in the charging base is 230 V.

The charging p.d. across the secondary coil in the toothbrush is 7.2 V.

The primary coil in the charging base has 575 turns of wire on its coil.

Calculate the number of turns on the secondary coil inside the toothbrush.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

.....

.....

.....

.....

Number of turns on the secondary coil = ...

5

4.7.2.1 Electromagnetism

Question 68

June 2016 | PH1HP | Original Q4 | Legacy

4 Infrared and microwaves are two types of electromagnetic radiation.

4 (a) (i) State **one** example of the use of each type of radiation for communication.

[2 marks]

Infrared: _____

Microwaves: _____

4 (a) (ii) Some of the properties of infrared and microwaves are the same.

State **two** of these properties.

[2 marks]

1 _____

_____

2 _____

_____

4 (b) In 1964, physicists discovered microwave radiation that filled the universe.

4 (b) (i) Name this type of radiation.

[1 mark]

_____

4 (b) (ii) State the importance of this discovery made by the physicists.

[1 mark]

_____

_____

6

4.7.2.1 Electromagnetism

Question 69

June 2016 | PH3HP | Original Q1 | Legacy

1 (a) Electromagnets are often used at recycling centres to separate some types of metals from other materials.

Give **one** reason why an electromagnet would be used rather than a permanent magnet.

[1 mark]

_____

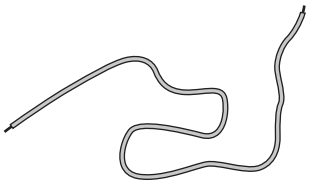
_____

1 (b) **In this question you will gain marks for using good English, organising information clearly and using scientific words correctly.**

Some students want to build an electromagnet.

The students have the equipment shown in **Figure 1**.

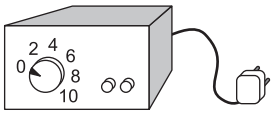
Figure 1



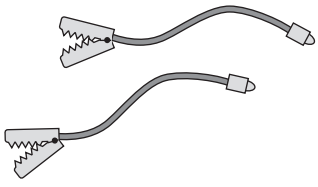
Insulated wire



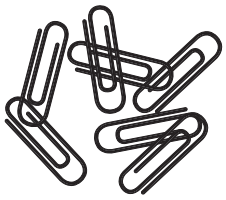
Iron nail



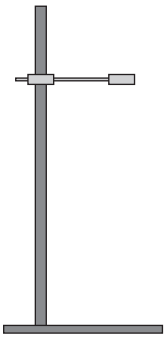
Power supply



Connecting leads



Steel paperclips



Wooden clamp and stand

4.7.2.1 Electromagnetism

Question 69 · continued

Describe how the students could build an electromagnet. Include in your answer how the students should vary and test the strength of their electromagnet.

[6 marks]

Extra space

7

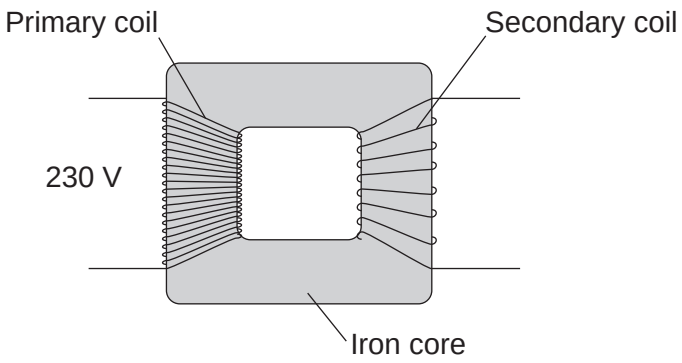
4.7.2.1 Electromagnetism

Question 70

June 2016 | PH3HP | Original Q2 | Legacy

2 **Figure 2** shows the structure of a traditional transformer.

Figure 2



2 (a) There is an alternating current in the primary coil of the transformer.

State what is produced in the iron core.

[2 marks]

2 (b) A transformer has only **one** turn of wire on the secondary coil.
The potential difference across the secondary coil is 11.5 V
The potential difference across the primary coil is 230 V

Calculate the number of turns on the primary coil.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

Number of turns on the primary coil = _____

Question 2 continues on the next page

Question 70 · continued

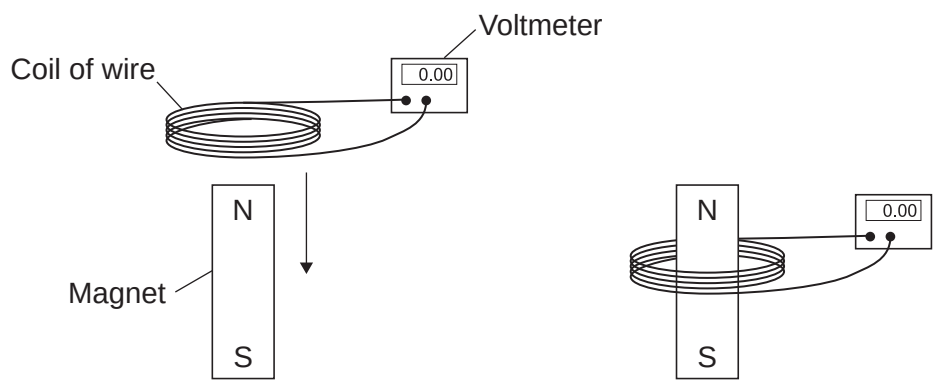
2 (c) In most transformers, the power output is less than the power input.

State why.

[1 mark]

2 (d) Two students investigated how magnets can be used to produce a potential difference. The students held a coil of wire above a magnet. The students quickly lowered the coil so that the magnet was inside the coil, as shown in **Figure 3**.

Figure 3



The students recorded the maximum potential difference for coils with different numbers of turns of wire. The results are shown in **Table 1**.

Table 1

Number of turns of wire in the coil	Maximum potential difference in volts	
	Results from student 1	Results from student 2
5	0.09	0.08
10	0.20	0.15
15	0.31	0.25
20	0.39	0.33
25	0.51	0.39

4.7.2.1 Electromagnetism

Question 70 · continued

2 (d) (i) State the resolution of the voltmeter.

Give **one** reason why the resolution of the voltmeter is suitable for this investigation.

[2 marks]

Resolution _____

Reason _____

_____

2 (d) (ii) The two students used exactly the same equipment to carry out their investigations. Both students recorded their results correctly.

Give the reason why student 2 got different results from student 1.

[1 mark]

_____

_____

2 (d) (iii) The students decided that even though the results were different, there was no need to repeat the investigation.

How do the results show that the investigation is reproducible?

[1 mark]

_____

_____

2 (d) (iv) State the name of the process which causes the potential difference to be produced in this investigation.

[1 mark]

_____

2 (e) A transformer has been developed that can be used with many different devices.

Suggest **one** advantage of having a transformer that can be used with many different devices.

[1 mark]

_____

_____

11

4.7.2.1 Electromagnetism

Question 71

June 2017 | PH1HP | Original Q1 | Legacy

1 A laser emits light waves in the visible region of the electromagnetic spectrum.

1 (a) What type of wave are all electromagnetic waves?

[1 mark]

_____

1 (b) The light from a laser has a wavelength of 6.5×10^{-7} m

The speed of light is 3.0×10^{8} m/s

Calculate the frequency of the light from the laser.

Give your answer to 2 significant figures.

Use the correct equation from the Physics Equations Sheet.

[3 marks]

_____

_____

_____

Frequency = _____ Hz

1 (c) What is the approximate range of wavelengths of the electromagnetic spectrum?

Tick (✓) **one** box.

[1 mark]

Range of wavelengths in metres	**Tick (✓)**
10^{-10} to 10^{8}	
10^{-8} to 10^{6}	
10^{-15} to 10^{4}	

5

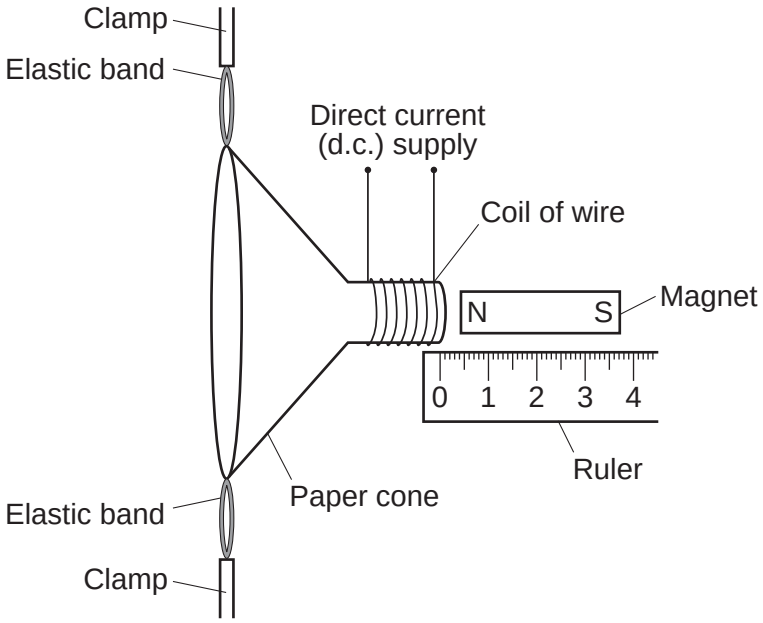
4.7.2.1 Electromagnetism

Question 72

June 2017 | PH3HP | Original Q1 | Legacy

1 **Figure 1** shows a loudspeaker made by a student. When there is a current in the coil the paper cone moves.

Figure 1



The student investigates how changing the size of the current in the coil of wire affects the distance moved by the paper cone.

1 (a) State **two** variables the student should control.

[2 marks]

1 _____

_____

2 _____

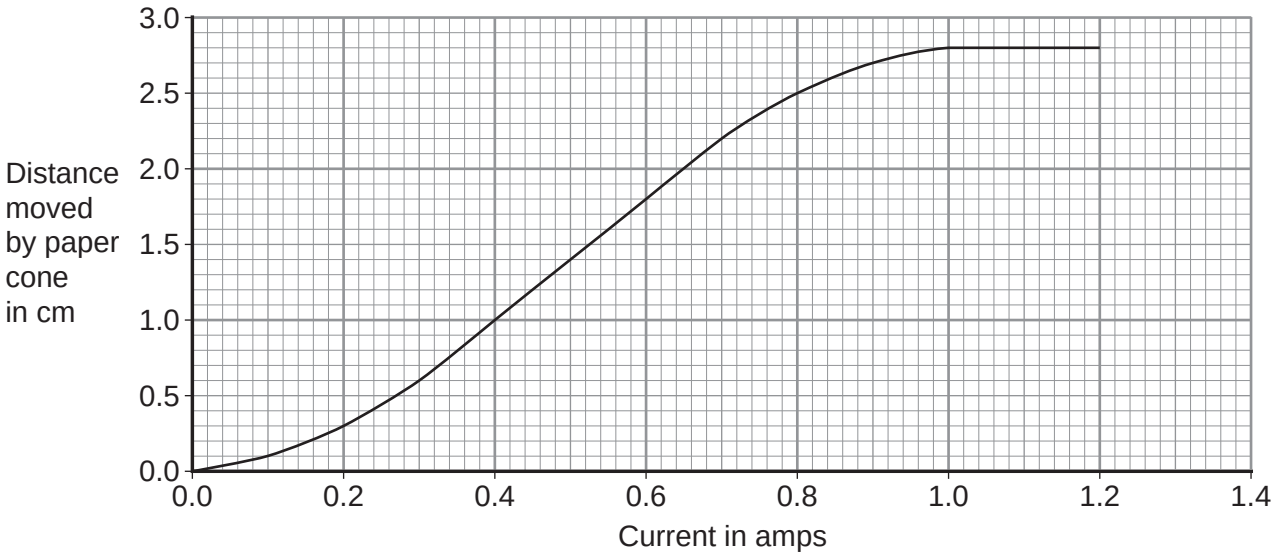
_____

4.7.2.1 Electromagnetism

Question 72 · continued

1 (b) The results of the student's investigation are shown in **Figure 2**.

Figure 2



1 (b) (i) When the current increases from 0.5 A to 0.9 A, how much does the distance moved increase?

[2 marks]

Increase in distance moved = _____ cm

1 (b) (ii) State **two** conclusions that can be made from the graph.

[2 marks]

1 _____

_____

2 _____

_____

6

4.7.2.1 Electromagnetism

Question 73

June 2018 | 8463/2H | Original Q3

0 3 P-waves and S-waves are two types of seismic wave caused by earthquakes.

0 3 . 1 Which **one** of the statements about P-waves and S-waves is correct?

Tick **one** box.

[1 mark]

P-waves and S-waves are transverse. ☐

P-waves and S-waves are longitudinal. ☐

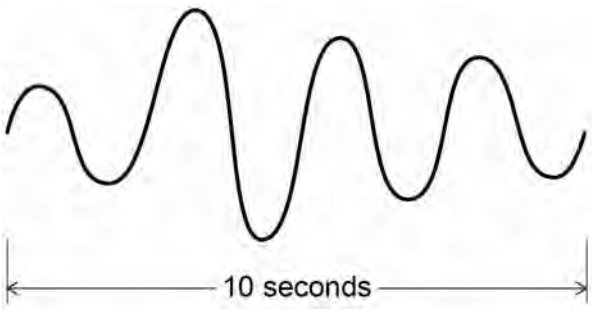
P-waves are transverse and S-waves are longitudinal. ☐

P-waves are longitudinal and S-waves are transverse. ☐

Seismometers on the Earth's surface record the vibrations caused by seismic waves.

Figure 3 shows the vibration recorded by a seismometer for one P-wave.

Figure 3



0 3 . 2 Calculate the frequency of the P-wave shown in **Figure 3**.

[1 mark]

Frequency = _____ Hz

4.7.2.1 Electromagnetism

Question 73 · continued

0 3 . 3 Write down the equation which links frequency, wavelength and wave speed.

[1 mark]

0 3 . 4 The P-wave shown in **Figure 3** is travelling at 7200 m/s.

Calculate the wavelength of the P-wave.

[3 marks]

Wavelength = _____ m

0 3 . 5 Explain why the study of seismic waves provides evidence for the structure of the Earth's core.

[2 marks]

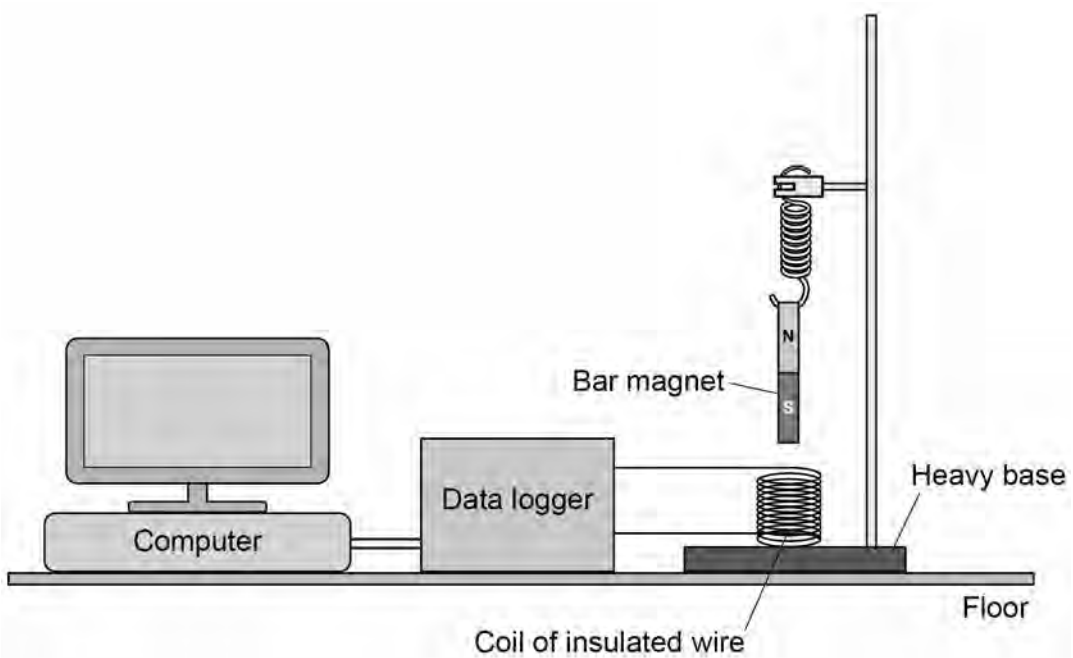
Question 3 continues on the next page

4.7.2.1 Electromagnetism

Question 73 · continued

Figure 4 shows a simple seismometer made by a student.

Figure 4



To test that the seismometer works, the student pushes the bar magnet into the coil and then releases the bar magnet.

0 3 . 6 Why does the movement of the bar magnet induce a potential difference across the coil?

[1 mark]

0 3 . 7 Why is the induced potential difference across the coil alternating?

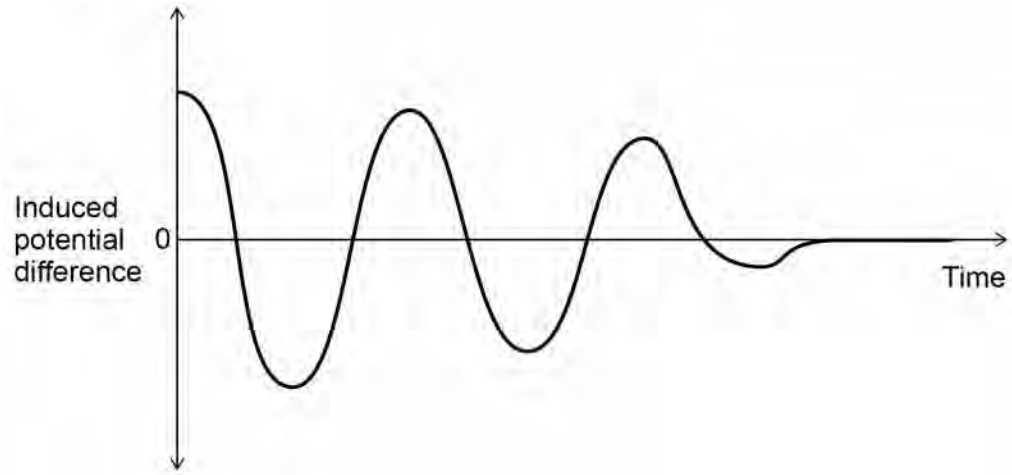
[1 mark]

4.7.2.1 Electromagnetism

Question 73 · continued

0 3 . 8 **Figure 5** shows how the potential difference induced across the coil varies after the bar magnet has been released.

Figure 5



Which statement describes the movement of the magnet when the induced potential difference is zero?

Tick **one** box.

[1 mark]

Accelerating upwards. ☐

Constant speed upwards. ☐

Decelerating downwards. ☐

Stationary. ☐

0 3 . 9 The seismometer cannot detect small vibrations.

Suggest **two** changes to the design of the seismometer that would make it more sensitive to small vibrations.

[2 marks]

1 _____

_____

2 _____

_____

13

4.7.2.1 Electromagnetism

Question 74

June 2018 | 8463/2H | Original Q10

1 0 The circle in **Figure 18** represents a straight wire carrying a current. The cross shows that the current is into the plane of the paper.

Figure 18



1 0 . 1 Complete **Figure 18** to show the magnetic field pattern around the wire.

[2 marks]

1 0 . 2 The magnetic flux density 10 cm from the wire is 4 microtesla.

Which of the following is the same as 4 microtesla?

Tick **one** box.

[1 mark]

4×10^{-2} T ☐

4×10^{-3} T ☐

4×10^{-6} T ☐

4×10^{-9} T ☐

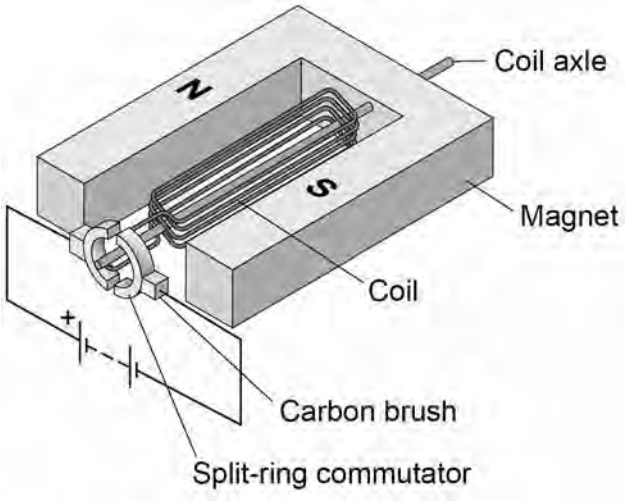
Question 10 continues on the next page

4.7.2.1 Electromagnetism

Question 74 · continued

1 0 . 3 **Figure 19** shows a simple electric motor.

Figure 19



When there is a current in the coil, the coil rotates continuously.

Explain why.

[4 marks]

7

4.7.2.1 Electromagnetism

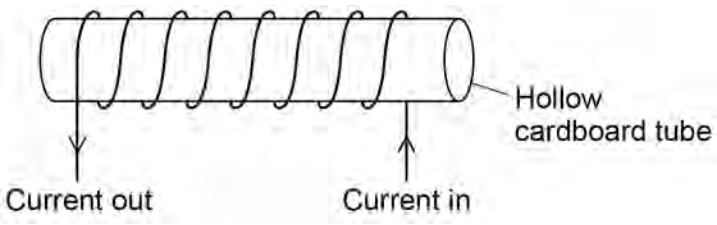
Question 75

0 4 . 1 **Figure 5** shows a solenoid.

Draw the magnetic field of the solenoid on **Figure 5**.

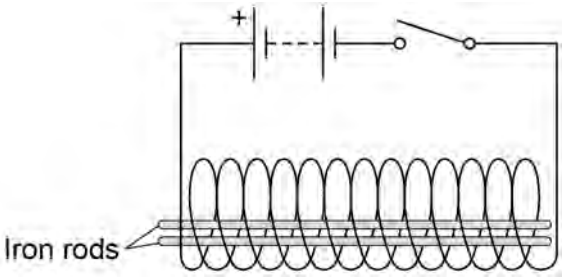
[2 marks]

Figure 5



0 4 . 2 **Figure 6** shows two iron rods placed inside a solenoid.

Figure 6



Explain why the iron rods move apart when the switch is closed.

[2 marks]

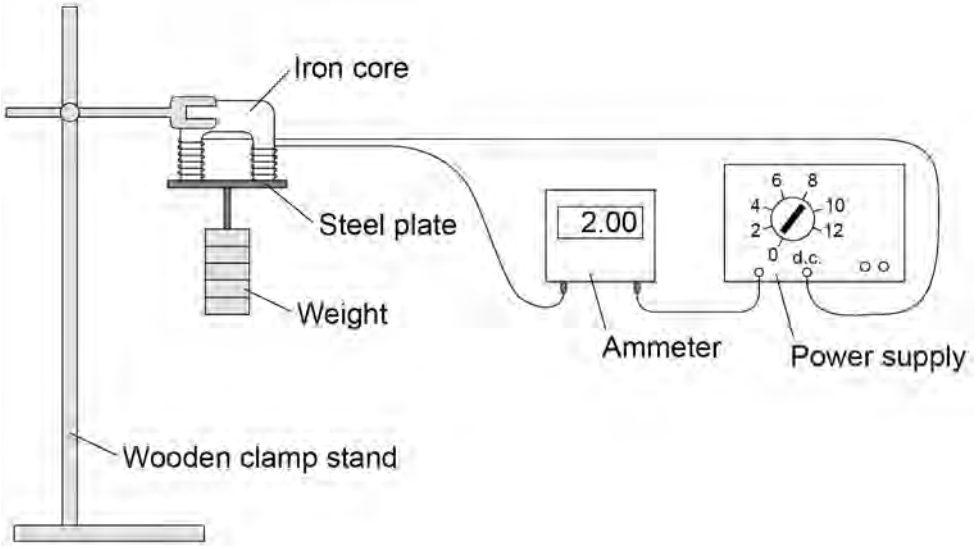
Question 75 · continued

A student investigated the strength of an electromagnet.

The student investigated how the strength depended on:
- the current in the wire
- the number of turns of wire around the iron core.

Figure 7 shows the equipment used.

Figure 7



The student measured the strength of the electromagnet as the maximum weight the electromagnet could hold.

0 4 . 3 **Table 1** shows the results.

Table 1

Current in amps	Number of turns of wire	Maximum weight in newtons
1.0	30	6.5
1.5	20	6.4
2.0	10	3.7

Explain why the method used by the student is **not** valid for this investigation.

[2 marks]

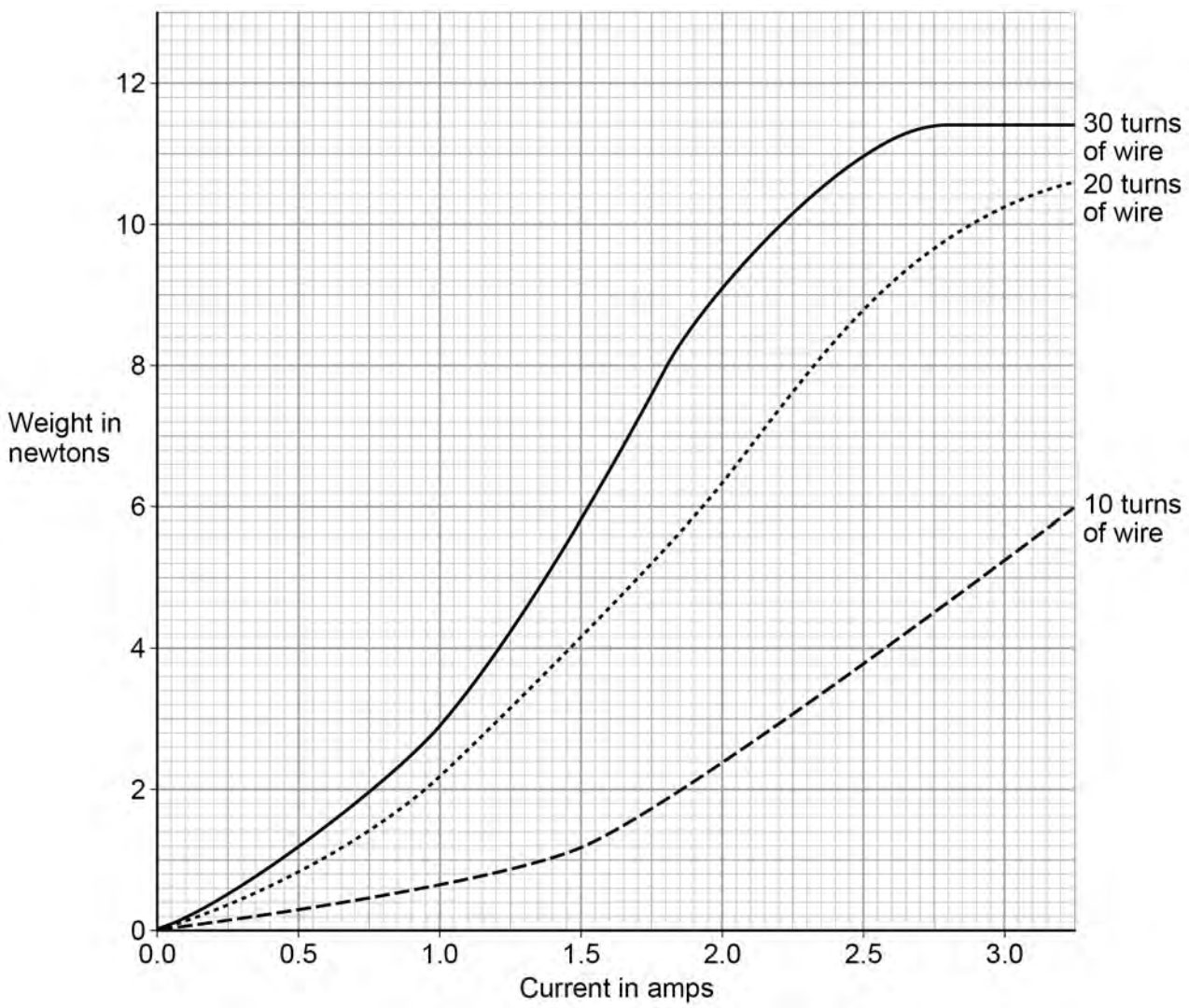
4.7.2.1 Electromagnetism

Question 75 · continued

A second student repeated the investigation using the same equipment.

Figure 8 shows the second student's results.

Figure 8



0 4 . 4 How does increasing the current in the wire affect the strength of the electromagnet, when the electromagnet has 30 turns of wire?

[1 mark]

4.7.2.1 Electromagnetism

Question 75 · continued

0 4 . 5 How does increasing the number of turns of wire from 10 to 20 affect the strength of the electromagnet, compared to increasing the number of turns of wire from 20 to 30?

[1 mark]

8

Turn over for the next question

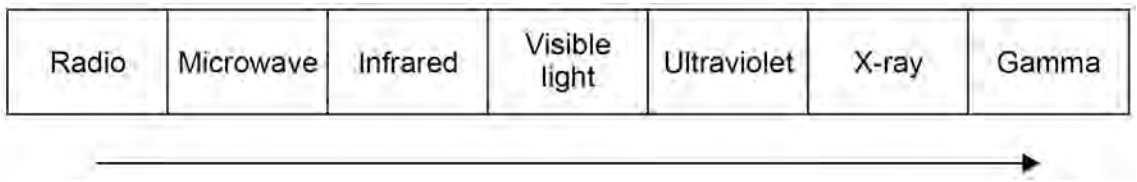
4.7.2.1 Electromagnetism

Question 76

June 2019 | 8463/2H | Original Q7

0 7 . 1 **Figure 12** shows the electromagnetic spectrum.

Figure 12



Which statement is correct for the direction of the arrow in **Figure 12**?

[1 mark]

Tick (✓) **one** box.

- The wavelength decreases and the wave speed in air increases. ☐
- The frequency increases and the wavelength increases. ☐
- The frequency increases and the wave speed in air stays the same. ☐
- The wavelength increases and the wave speed in air increases. ☐

0 7 . 2 Explain how the properties of X-rays make them suitable for the medical imaging of bones.

[2 marks]

Question 7 continues on the next page

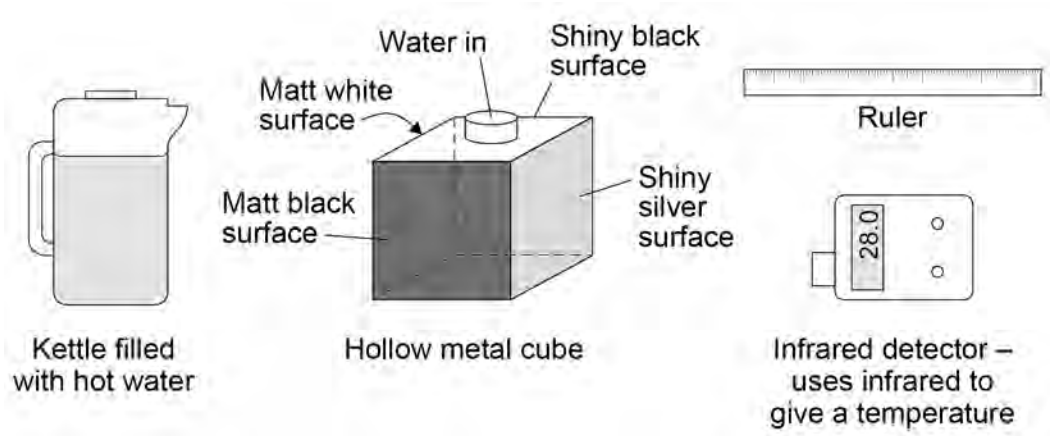
Question 76 · continued

A student investigated the infrared radiation emitted from the sides of a hollow metal cube.

The sides of the cube are different colours or textures.

Figure 13 shows the equipment used.

Figure 13



Boiling water was poured into the cube. The amount of infrared radiation emitted from each vertical surface was then measured.

0 7 . 3 Boiling water is a hazard in this investigation.

Suggest how the risk of harm could be reduced in this investigation.

[1 mark]

0 7 . 4 What is the control variable in this investigation?

[1 mark]

Question 76 · continued

Table 2 shows the results.

Table 2

Type of surface	Temperature in °C
Matt black	68.0
Matt white	65.5
Shiny black	66.3
Shiny silver	28.0

0 7 . 5 The four temperature values in **Table 2** cannot be used to show that the infrared detector gives precise readings.

Give the reason why.

[1 mark]

0 7 . 6 The student looked at the data in **Table 2** and concluded:

'A black surface always emits more infrared radiation than a white surface.'

Explain how using an infrared detector with a resolution of 1 °C would have affected the student's conclusion.

[2 marks]

4.7.2.1 Electromagnetism

Question 76 · continued

Albedo is a measure of the amount of solar radiation reflected by an object compared to the total solar radiation incident on the object.

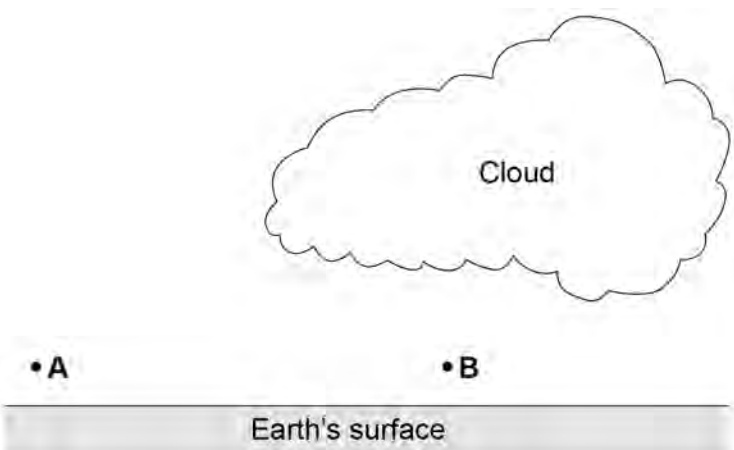
A perfect reflector has an Albedo value of 1.0
A perfect absorber has an Albedo value of 0.0

0 7 . 7 What is the Albedo value of a perfect black body?

[1 mark]

0 7 . 8 **Figure 14** shows two points, **A** and **B**, just above the Earth's surface.

Figure 14



The average Albedo value of the Earth's surface is 0.3
The Albedo value of thick cloud varies between 0.6 and 0.9

At night the air at point **A** cools faster than the air at point **B**.

Explain why.

[3 marks]

12

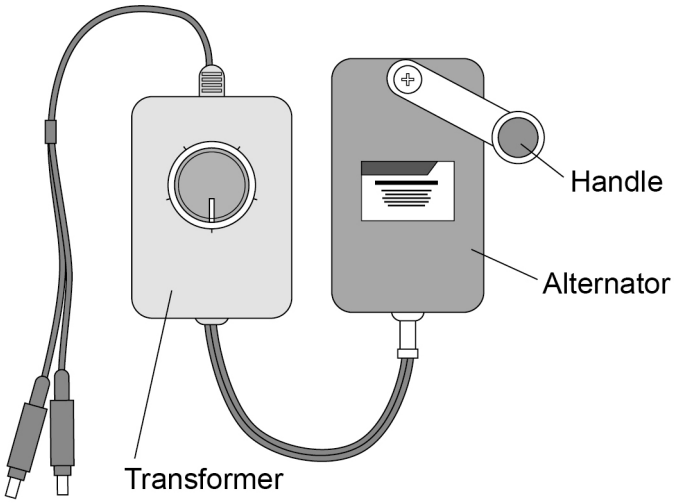
4.7.2.1 Electromagnetism

Question 77

November 2020 | 8463/2H | Original Q7

0 7 **Figure 10** shows a portable power supply.

Figure 10



0 7 . 1 The portable power supply has an alternator connected to a transformer.

The transformer can be adjusted to have different numbers of turns on the secondary coil.

Suggest why.

[2 marks]

4.7.2.1 Electromagnetism

Question 77 · continued

0 7 . 2 A lamp is connected to the power supply.

The lamp requires an input potential difference of 5.0 V.

The alternator generates a potential difference of 1.5 V.

The primary coil of the transformer has 150 turns.

Calculate the number of turns needed on the secondary coil.

[3 marks]

Number of turns on the secondary coil = _____

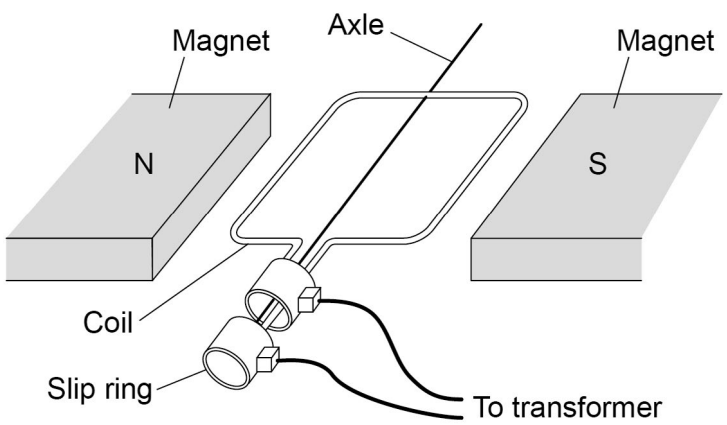
Question 7 continues on the next page

4.7.2.1 Electromagnetism

Question 77 · continued

Figure 11 shows the inside parts of the alternator.

Figure 11



0 7 . 3 The handle of the alternator is turned, causing the coil to rotate.

Explain why an alternating current is induced in the coil.

[5 marks]

4.7.2.1 Electromagnetism

Question 77 · continued

0 7 . 4 Suggest the purpose of the slip rings.

[1 mark]

0 7 . 5 The alternator from the portable power supply is disconnected from the transformer and lamp.

Explain why the handle of the alternator becomes much easier to turn.

[3 marks]

14

4.7.2.1 Electromagnetism

Question 78

November 2021 | 8463/2H | Original Q5

0 5 Ultraviolet is a type of electromagnetic wave.

0 5 . 1 Give **one** use of ultraviolet.

[1 mark]

_____

0 5 . 2 An ultraviolet wave has a wavelength of 300 nanometres.

Which of the following is equal to 300 nanometres?

[1 mark]

Tick (✓) **one** box.

3×10^{7} m ☐

3×10^{-7} m ☐

3×10^{9} m ☐

3×10^{-9} m ☐

0 5 . 3 The speed of ultraviolet waves is 3×10^{8} m/s.

Calculate the frequency of the ultraviolet wave.

Use your answer to Question **05.2**

[3 marks]

_____

_____

_____

_____

_____

Frequency = _____ Hz

4.7.2.1 Electromagnetism

Question 78 · continued

0 5 . 4 **Table 1** gives the wavelength of an ultraviolet wave and three other electromagnetic waves.

Table 1

	Ultraviolet	Wave E	Wave F	Wave G
Wavelength in nanometres	300	0.1	600	100 000

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

[1 mark]

Wave	Name
Wave E	Infrared
Wave F	Visible light
Wave G	X-rays

0 5 . 5 Electromagnetic waves are transverse.

Some other types of wave are longitudinal.

Describe the difference between transverse and longitudinal waves.

[2 marks]

8

4.7.2.1 Electromagnetism

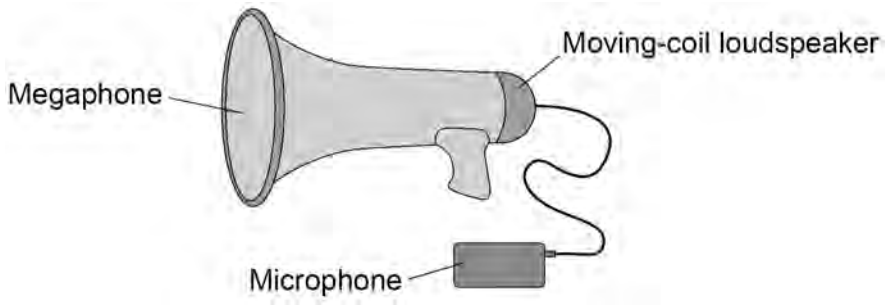
Question 79

June 2023 | 8463/2H | Original Q4

0 4 A megaphone uses a loudspeaker to amplify sounds that are detected by a microphone.

Figure 10 shows a megaphone and microphone.

Figure 10



0 4 . 1 Complete the sentence.

[1 mark]

The microphone is used to convert the pressure variations in sound waves into variations in _____ .

4.7.2.1 Electromagnetism

Question 79 · continued

0 4 . 2 The loudspeaker contains a permanent magnet.

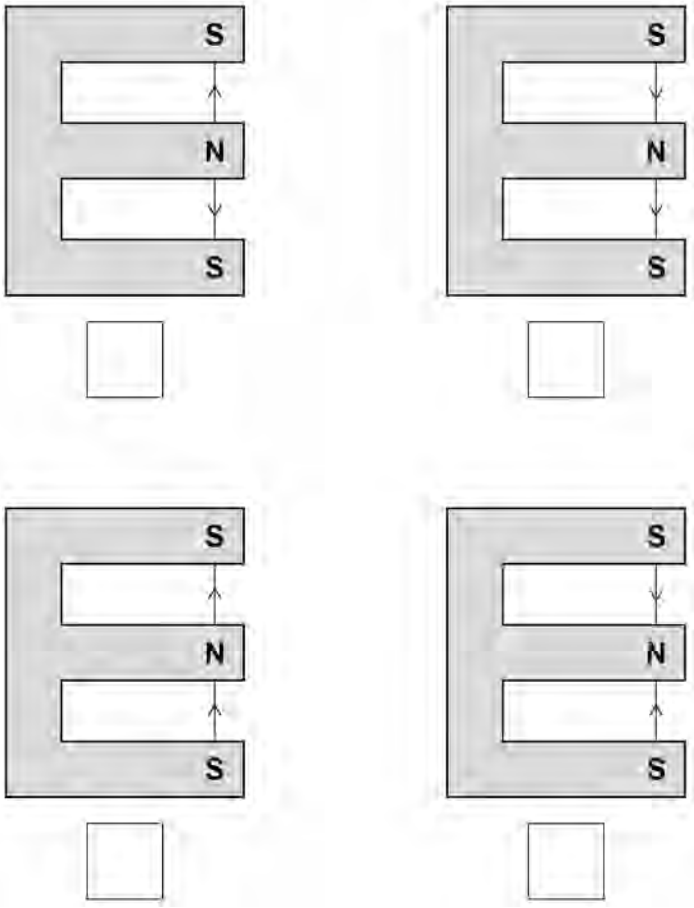
Which diagram in **Figure 11** shows the direction of the magnetic field between the north pole and the south pole of the magnet?

The magnets are shown in cross-section.

[1 mark]

Tick (✓) **one** box.

Figure 11



0 4 . 3 Some magnets are permanent magnets and some are induced magnets.

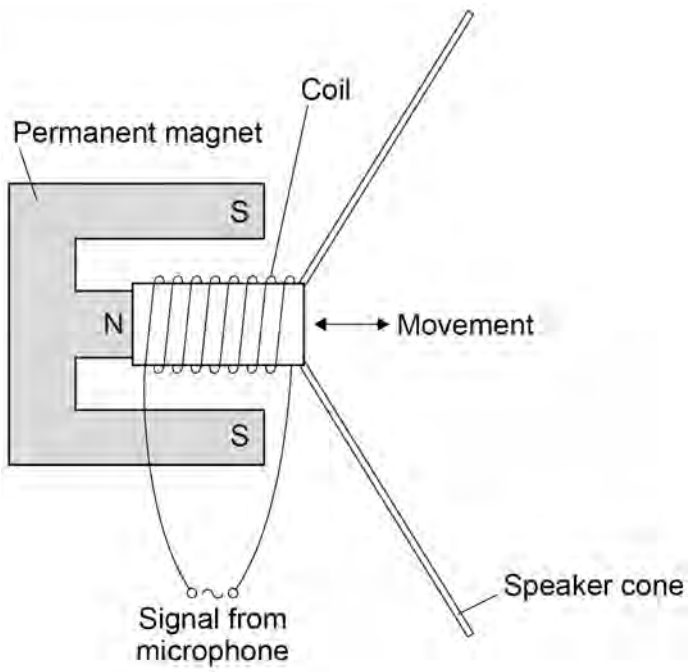
What is an induced magnet?

[1 mark]

Question 79 · continued

Figure 12 shows the parts of the loudspeaker in the megaphone.

Figure 12



A current in the coil of the loudspeaker causes the coil to move.

0 4 . 4 What is the name of the effect that causes the coil to move?

[1 mark]

Tick (✓) **one** box.

- Electromagnet effect ☐
- Induction effect ☐
- Motor effect ☐
- Speaker effect ☐

4.7.2.1 Electromagnetism

Question 79 · continued

0 4 . 5 When the current in the coil is 16 mA, the force on the coil is 0.013 N.

The length of the wire that makes up the coil is 6.5 m.

Calculate the magnetic flux density around the coil in the electromagnet.

Use the Physics Equations Sheet.

[4 marks]

Magnetic flux density = _____ T

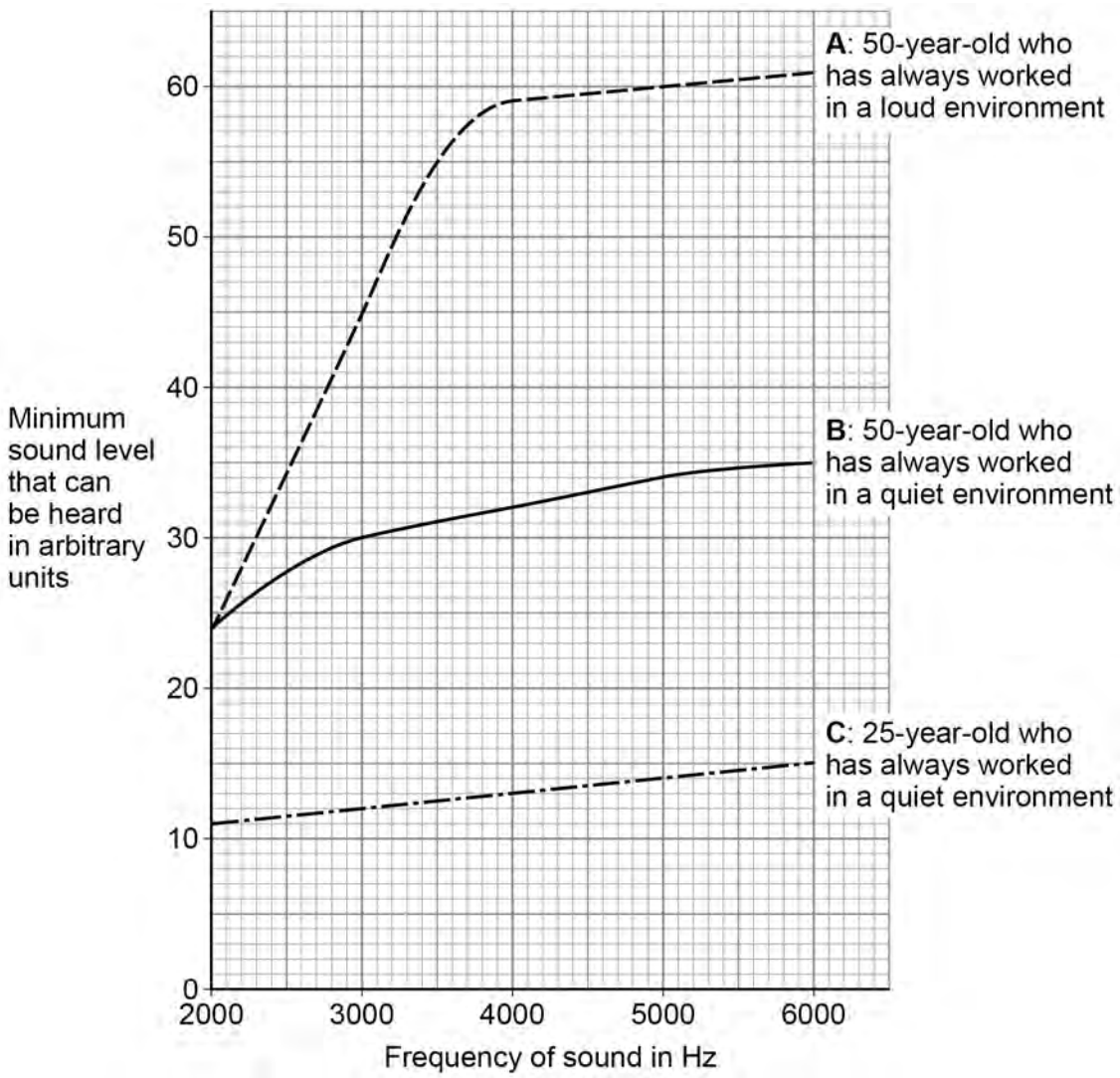
Question 4 continues on the next page

0 4 . 6 Megaphones can produce very loud sounds.

A person's hearing can be affected by age and by working in a loud environment.

Figure 13 shows how frequency affects the minimum sound level that can be heard by three different people, **A**, **B** and **C**.

Figure 13



4.7.2.1 Electromagnetism

Question 79 · continued

Compare how different factors affect the minimum sound level that these people can hear.

[4 marks]

12

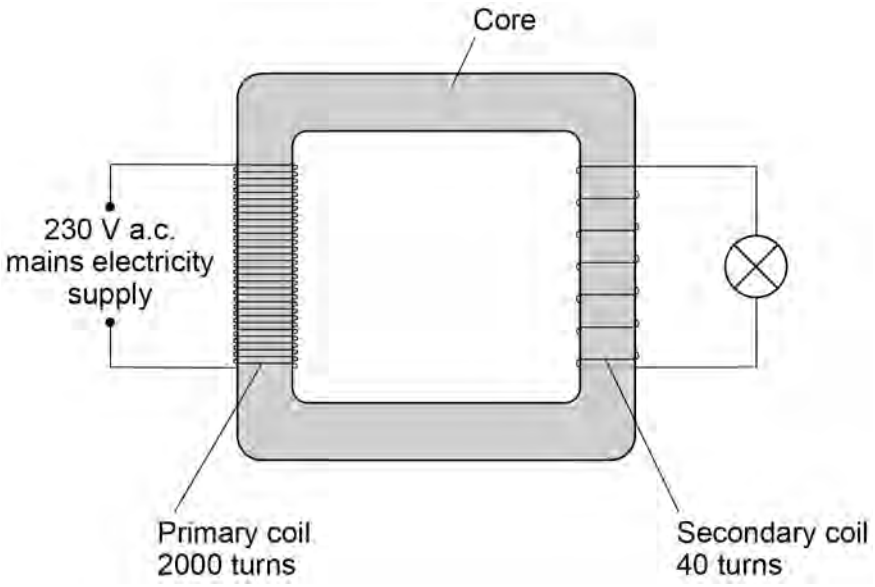
4.7.2.1 Electromagnetism

Question 80

June 2023 | 8463/2H | Original Q8

0 8 **Figure 21** shows a transformer used to power a lamp using the mains electricity supply.

Figure 21



0 8 . 1 What material is used to make the core of the transformer?

Give the reason for using this material.

[2 marks]

Material _____

Reason _____

_____

4.7.2.1 Electromagnetism

Question 80 · continued

0 8 . 2 Determine the current in the secondary coil when the power output of the transformer is 6.9 W.

The transformer is 100% efficient.

Use the Physics Equations Sheet.

[5 marks]

Current in the secondary coil = _____ A

7

4.7.2.1 Electromagnetism

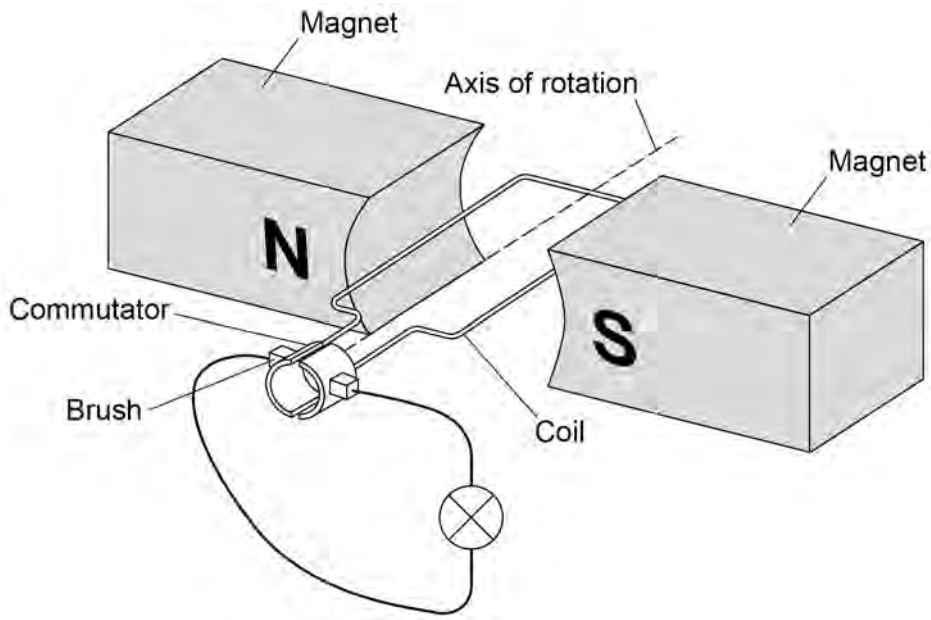
Question 81

June 2023 | 8463/2H | Original Q9

0 9 A dynamo is used to generate an electric current.

Figure 22 shows the inside parts of the dynamo connected to a lamp.

Figure 22



0 9 . 1 The coil is rotated.

Explain why a direct current is induced in the coil.

[5 marks]

4.7.2.1 Electromagnetism

Question 81 · continued

0 9 . 2 Sketch a graph on **Figure 23** to show how the potential difference generated across the lamp varies for **two** complete revolutions of the dynamo coil.

[1 mark]

Figure 23



0 9 . 3 The lamp is disconnected from the dynamo.

Explain why the dynamo becomes much easier to turn.

[3 marks]

9

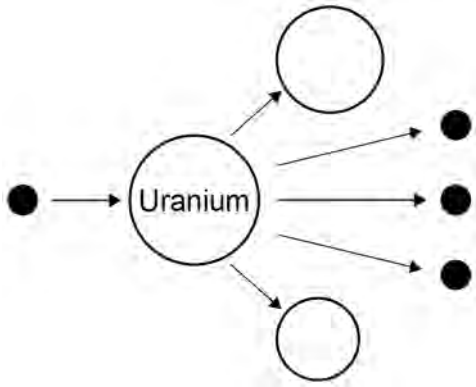
4.7.2.1 Electromagnetism

Question 82

0 2 The process of nuclear fission is used in nuclear power stations.

Figure 2 shows the process of nuclear fission.

Figure 2



0 2 . 1 Complete the sentences.

Choose answers from the box.

[3 marks]

electrons	**gamma rays**	**neutrons**	**nuclei**	**protons**

In nuclear power stations, energy is released from

uranium _____.

The uranium in **Figure 2** splits into two parts and

releases three _____.

The process of nuclear fission releases electromagnetic radiation in the

form of _____.

4.7.2.1 Electromagnetism

Question 82 · continued

Use the Physics Equations Sheet to answer questions **02.2** and **02.3**.

0 2 . 2 Write down the equation which links energy (*E*), power (*P*) and time (*t*).

[1 mark]

0 2 . 3 A nuclear power station has a power output of 500 MW.

Calculate the energy output in 3600 s.

Give your answer in J.

[3 marks]

Energy output = _____ J

0 2 . 4 Radioactive waste produced by nuclear power stations has a long half-life.

Suggest **one** precaution taken to reduce the hazard caused by radioactive waste from power stations.

[1 mark]

4.7.2.1 Electromagnetism

Question 82 · continued

0 2 . 5 Nuclear power stations do **not** generate electricity every day of the year.

One nuclear power station generated electricity for 92% of a year.

one year = 365 days

Calculate the number of days during the year that the nuclear power station generated electricity.

[2 marks]

Number of days = _____

10

Turn over for the next question

4.7.2.1 Electromagnetism

Question 83

June 2025 | 8463/2H | Original Q4

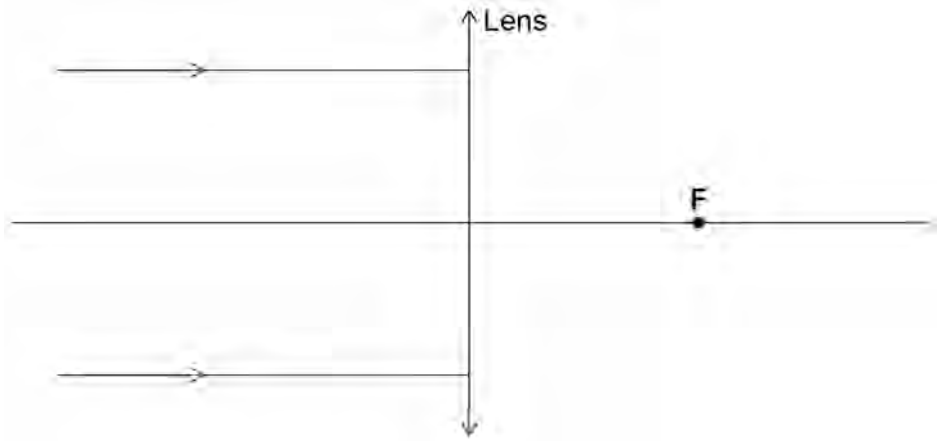
0 4 Telescopes are used to look at distant objects.

Some telescopes use lenses to form an image.

Figure 5 shows two parallel rays of light incident on a lens in a telescope.

The principal focus of the lens is labelled **F**.

Figure 5



0 4 . 1 What type of lens is shown in **Figure 5**?

[1 mark]

0 4 . 2 Complete the ray diagram in **Figure 5**.

[2 marks]

Question 4 continues on the next page

4.7.2.1 Electromagnetism

Question 83 · continued

The James Webb Space Telescope can detect electromagnetic radiation beyond the visible spectrum.

0 4 . 3 The shortest wavelength of electromagnetic radiation that can be detected by the James Webb Space Telescope is 0.60 μm.

speed of electromagnetic radiation = 3.0×10^8 m/s

Calculate the frequency of electromagnetic radiation that has a wavelength of 0.60 μm.

Use the Physics Equations Sheet.

[4 marks]

Frequency = _____ Hz

0 4 . 4 Complete the sentence.

[1 mark]

Electromagnetic radiation detected from distant galaxies is red-shifted.

This means that the electromagnetic radiation shows an increase in

_____.

4.7.2.1 Electromagnetism

Question 83 · continued

0 4 . 5 Why is the electromagnetic radiation from distant galaxies red-shifted?

[1 mark]

Tick (✓) **one** box.

All observed light from distant galaxies appears red. ☐

Distant galaxies are moving away from our galaxy. ☐

Distant galaxies are moving at the speed of light. ☐

0 4 . 6 The James Webb Space Telescope has detected electromagnetic radiation from many different galaxies.

Electromagnetic radiation from one of the galaxies detected shows the greatest red-shift ever observed.

What conclusion can be made about the distance to this galaxy?

[1 mark]

0 4 . 7 The James Webb Space Telescope is an artificial satellite that orbits the Sun at a constant speed.

Explain why the velocity of the satellite changes as it orbits the Sun.

[3 marks]

13

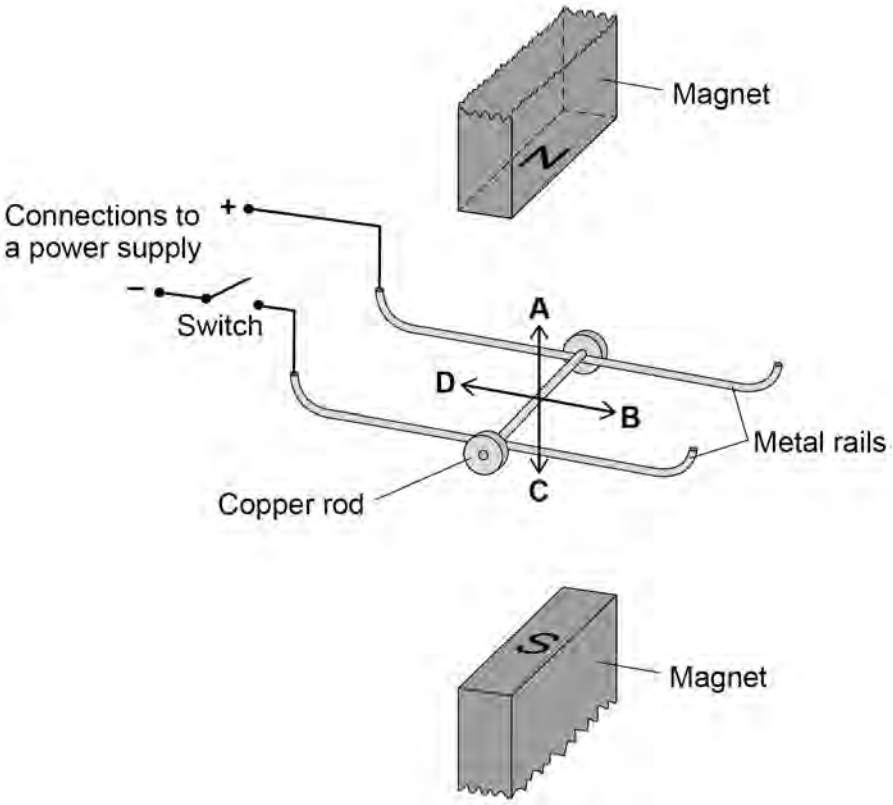
4.7.2.1 Electromagnetism

Question 84

June 2025 | 8463/2H | Original Q7

0 7 **Figure 7** shows some apparatus used to demonstrate the motor effect.

Figure 7



When the switch is closed the copper rod accelerates.

0 7 . 1 What direction is the acceleration of the copper rod?

[1 mark]

Tick (✓) **one** box.

A ☐

B ☐

C ☐

D ☐

4.7.2.1 Electromagnetism

Question 84 · continued

0 7 . 2 The copper rod has a mass of 5.0 g.

The length of the copper rod in the magnetic field is 0.070 m.

The magnetic flux density is 0.30 T.

Calculate the initial acceleration of the rod when the current in the rod is 2.0 A.

Use the Physics Equations Sheet.

[5 marks]

Initial acceleration = _____ m/s^2

Question 7 continues on the next page

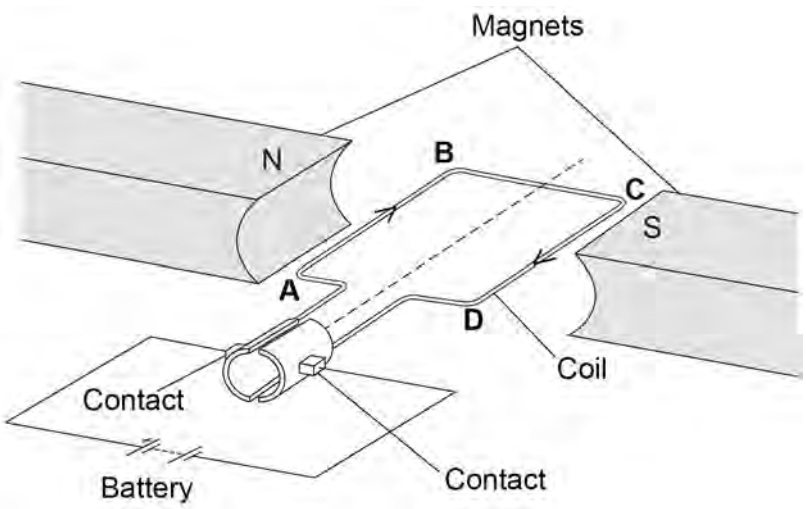
Question 84 · continued

Figure 8 shows a simple motor.

There is a magnetic field between the two permanent magnets.

When there is a current in the coil, a magnetic field is produced around the coil.

Figure 8



0 7 . 3 Explain how these magnetic fields cause the coil to continuously rotate.

[4 marks]

4.7.2.1 Electromagnetism

Question 84 · continued

0 7 . 4 In **Figure 8** the coil of the motor is in a horizontal position.

Explain why the resultant moment on the coil is zero when the coil is in a vertical position.

[2 marks]

12

Turn over for the next question

4.7.2.1 Electromagnetism

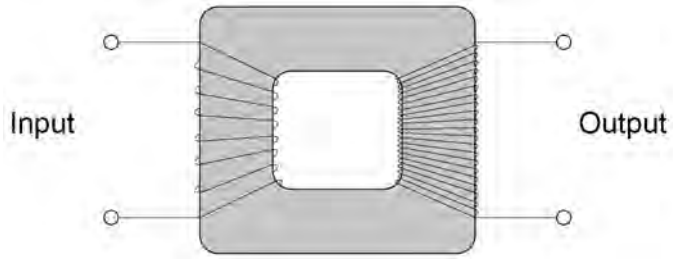
Question 85

June 2025 | 8463/2H | Original Q9

0 9 Transformers are used to change alternating potential differences.

0 9 . 1 **Figure 11** shows a transformer.

Figure 11



Why is the core of the transformer made from iron?

[1 mark]

Question 9 continues on the next page

4.7.2.1 Electromagnetism

Question 85 · continued

0 9 . 2 A transformer has 345 turns on the primary coil and 6000 turns on the secondary coil.

The potential difference across the secondary coil is 400 kV.

Calculate the potential difference across the primary coil.

Use the Physics Equations Sheet.

Give your answer in volts.

[4 marks]

Potential difference = _____ V

0 9 . 3 There is an alternating current in the primary coil of a transformer.

Explain why there is an alternating potential difference across the ends of the secondary coil of the transformer.

[3 marks]

8