AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 6.7.2.1

Electromagnetism

Past-paper questions

Tier	**Foundation**
Question groups	**13**
Available paper years	**2018–2025**

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.

6.7.2.1 Electromagnetism

Question 01

June 2018 | 8464/P/2F | Original Q4

0 4 **Figure 5** shows types of waves within the electromagnetic spectrum.

Some of the types of waves are represented by letters.

Figure 5

P	**microwaves**	**Q**	**visible light**	**R**		**S**	**gamma rays**

0 4 . 1 Which letter shows the position of ultraviolet (UV) radiation within the electromagnetic spectrum?

[1 mark]

Tick **one** box.

P ☐ **Q** ☐ **R** ☐ **S** ☐

0 4 . 2 A special lamp can produce UV radiation.

Which **two** statements describe the electromagnetic waves emitted by a UV lamp?

[2 marks]

Tick **two** boxes.

They have a higher frequency than X-rays. ☐

They have the same wave speed as visible light. ☐

They have a longer wavelength than microwaves. ☐

They have a lower frequency than gamma rays. ☐

They have a greater wave speed than radio waves. ☐

6.7.2.1 Electromagnetism

Question 01 · continued

0 4 . 3 UV radiation is used to treat a vitamin D deficiency.

People should **not** use a UV lamp for long periods of time.

State **two** risks of exposure to high levels of UV radiation.

[2 marks]

1 _____

_____

2 _____

_____

0 4 . 4 Ionising radiation is used for some medical imaging.

Name **two** types of electromagnetic waves that are used.

[2 marks]

1 _____

2 _____

7

6.7.2.1 Electromagnetism

Question 02

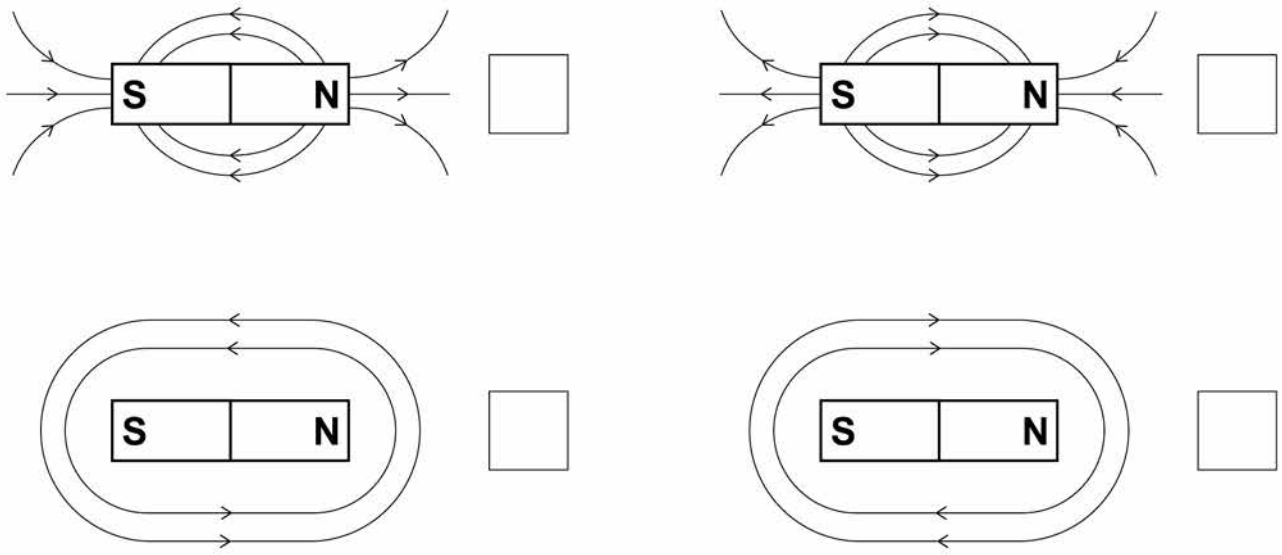
June 2018 | 8464/P/2F | Original Q8

0 8 A magnet produces a magnetic field.

0 8 . 1 Which diagram shows the magnetic field pattern around a bar magnet?

[1 mark]

Tick **one** box.



0 8 . 2 **Figure 13** shows three metal blocks.

The blocks are not labelled.

One block is a permanent magnet, one is iron and one is aluminium.

Figure 13



Describe how another permanent magnet can be used to identify the blocks.

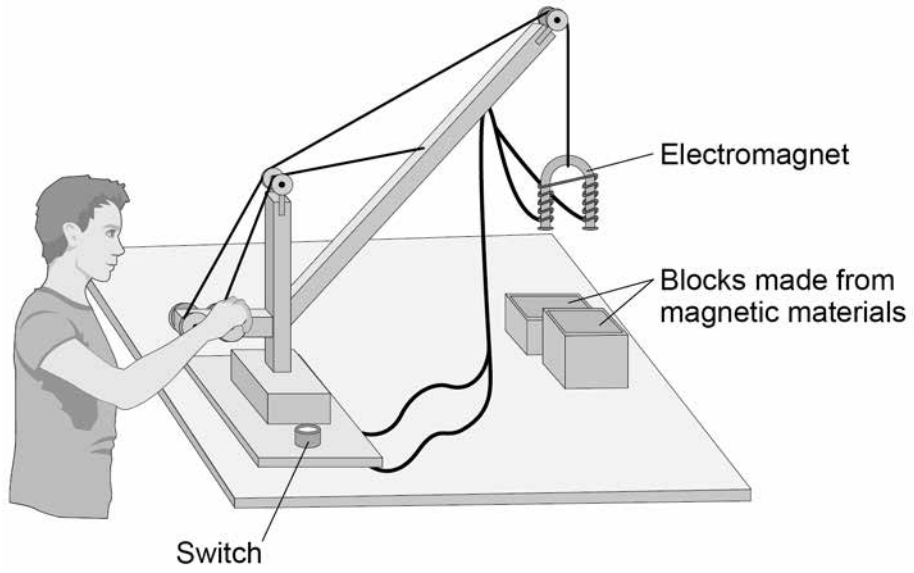
[3 marks]

6.7.2.1 Electromagnetism

Question 02 · continued

0 8 . 3 **Figure 14** shows a toy crane.

Figure 14



The toy crane uses an electromagnet to pick up and move the blocks.

Explain how this electromagnet is able to pick up and move the blocks.

[6 marks]

6.7.2.1 Electromagnetism

Question 03

June 2019 | 8464/P/1F | Original Q3

0 3 In an experiment, a beam of alpha particles was directed at a thin sheet of gold foil.

0 3 . 1 Most of the alpha particles passed straight through the gold foil.

Alpha particles which passed close to the nucleus of a gold atom did **not** pass straight through.

What happened to the alpha particles which passed close to the nucleus of a gold atom?

[1 mark]

0 3 . 2 The results suggested that the diameter of the nucleus of a gold atom is $\frac{1}{6000}$ of the diameter of the atom.

The diameter of a gold atom is 0.18 nm

Calculate the diameter of a gold nucleus in nm

[2 marks]

Diameter = _____ nm

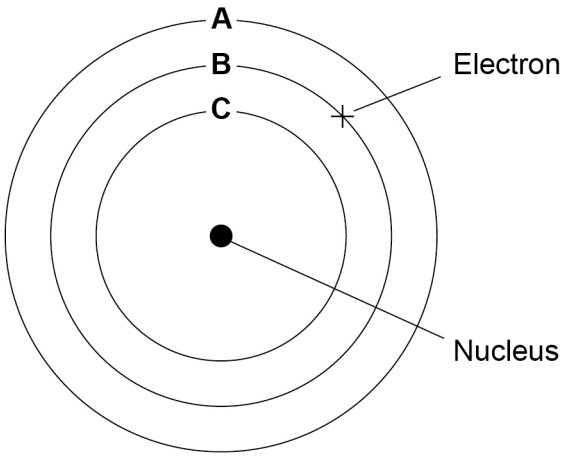
6.7.2.1 Electromagnetism

Question 03 · continued

0 3 . 3 Further experiments showed that gold nuclei are surrounded by electrons in different energy levels.

Figure 4 shows three of the energy levels around the nucleus of a gold atom.

Figure 4



The electron in energy level **B** absorbs electromagnetic radiation.

Which energy level will the electron be in after it has absorbed the electromagnetic radiation?

[1 mark]

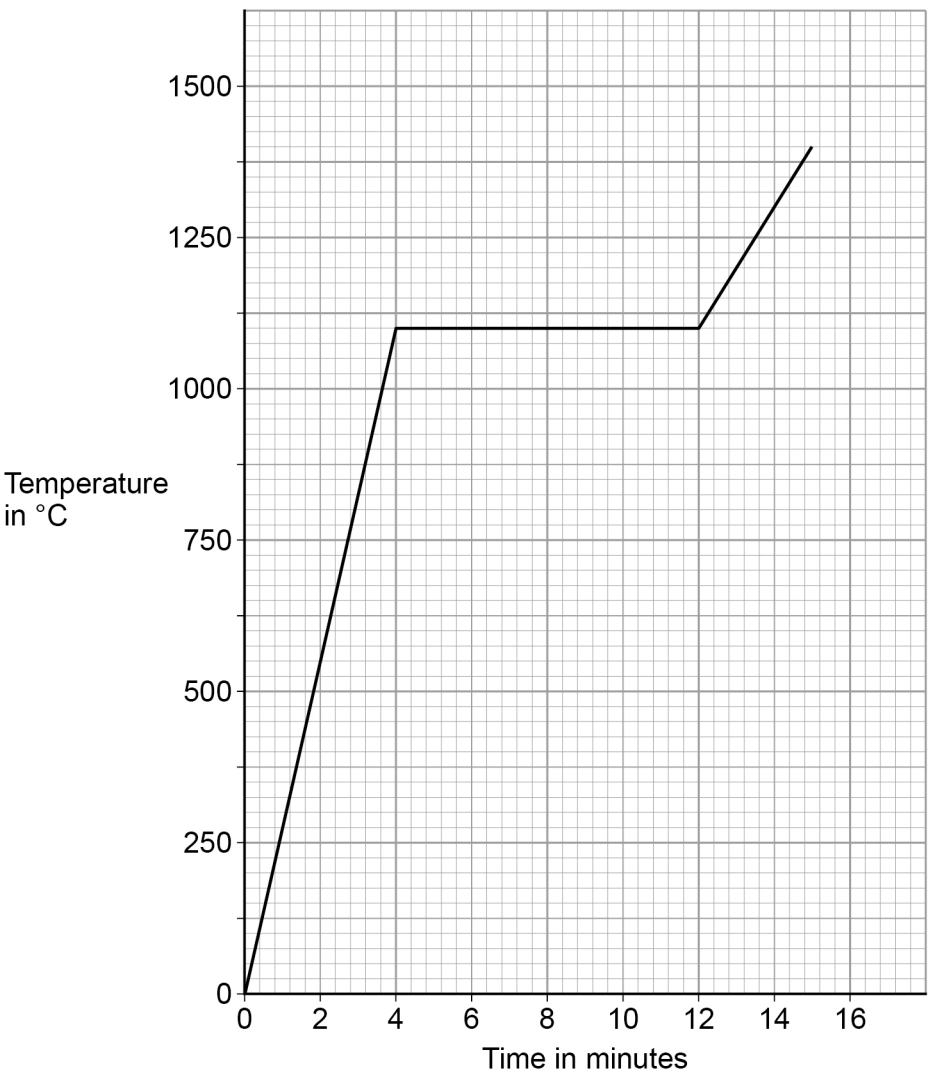
Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐

Question 3 continues on the next page

Figure 5 shows how the temperature of a small sample of gold changes as it is heated from a solid to a liquid.

Figure 5



0 3 . 4 What is the melting point of the gold?

[1 mark]

Melting point = _____ °C

0 3 . 5 How many minutes did it take for all of the gold in the sample to change from solid to liquid?

[1 mark]

Time taken = _____ minutes

6.7.2.1 Electromagnetism

Question 03 · continued

0 3 . 6 What does the gradient of the graph in **Figure 5** represent?

[1 mark]

Tick (✓) **one** box.

- The internal energy of the gold ☐
- The rate of change of temperature of the gold ☐
- The specific heat capacity of the gold ☐

7

Turn over for the next question

6.7.2.1 Electromagnetism

Question 04

June 2019 | 8464/P/2F | Original Q5

0 5 The Sun emits all types of electromagnetic waves.

Figure 7 shows the electromagnetic spectrum.

Figure 7

Radio waves	Microwaves	Infrared	Visible light	Ultraviolet	X-rays	Gamma rays

0 5 . 1 Complete the sentences.

Choose answers from the box.

[3 marks]

frequency	**mass**	**power**
velocity		**wavelength**

In a vacuum, all electromagnetic waves travel at the same _____ .

Gamma waves have the greatest _____ .

Radio waves have the greatest _____ .

0 5 . 2 Explain why it is important that the Earth's atmosphere absorbs gamma rays emitted by the Sun.

[2 marks]

_____

_____

_____

_____

0 5 . 3 Some microwaves are **not** absorbed by the Earth's atmosphere.

Why is this useful?

[1 mark]

_____

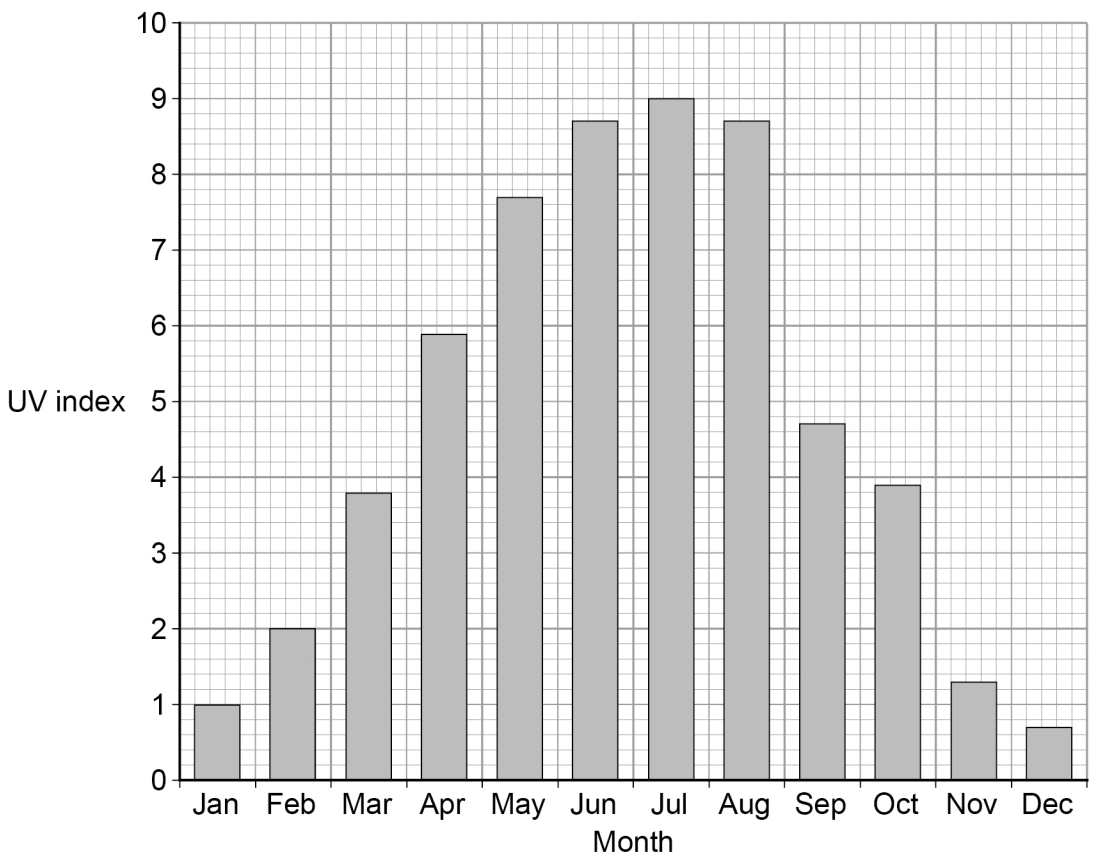
Question 04 · continued

Some ultraviolet (UV) radiation from the Sun passes through the atmosphere and reaches the surface of the Earth.

The amount of UV radiation that reaches the surface of the Earth can be measured on a scale called the UV index.

Figure 8 shows the average midday UV index in the UK for 1 year.

Figure 8



0 5 . 4 Why is exposure to UV radiation harmful to humans?

[1 mark]

6.7.2.1 Electromagnetism

Question 04 · continued

0 5 . 5 Compare the risk from UV radiation at different times of year in the UK.

Use data from **Figure 8**.

[2 marks]

9

Turn over for the next question

6.7.2.1 Electromagnetism

Question 05

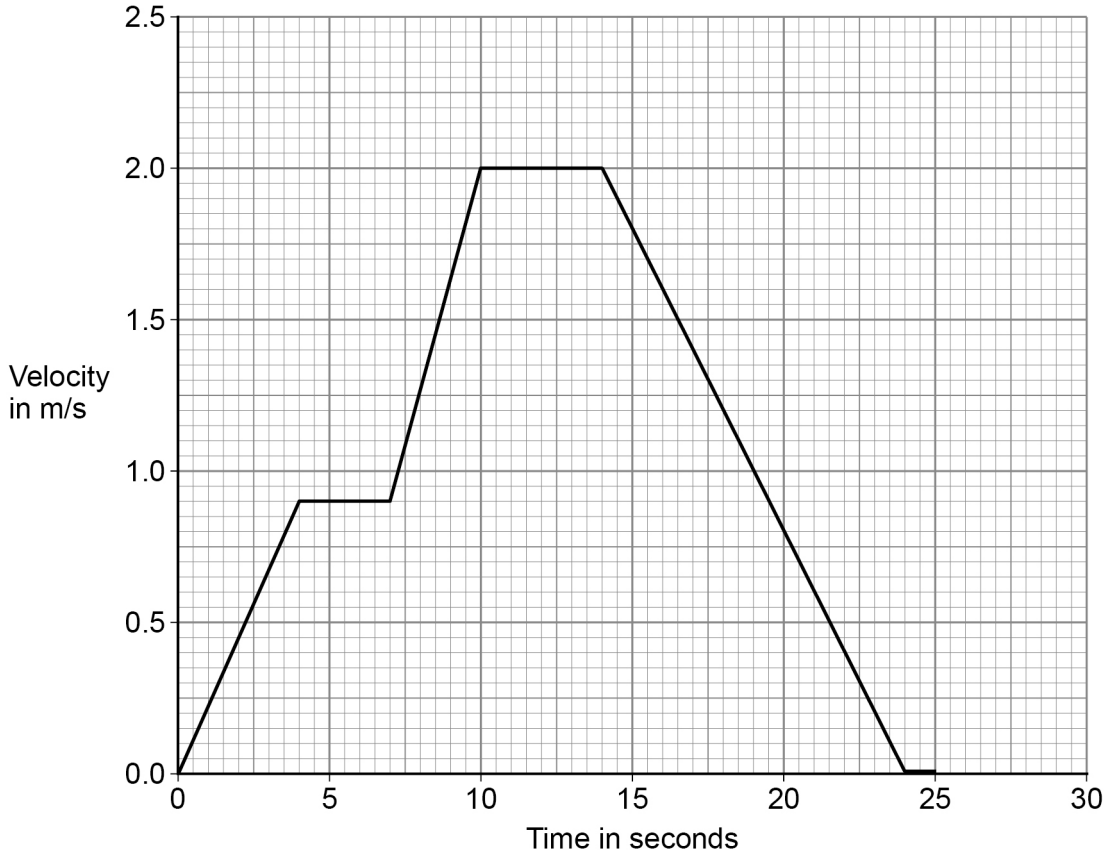
0 6 **Figure 9** shows a runner using a smart watch and a mobile phone to monitor her run.

Figure 9



Figure 10 is a velocity–time graph for part of the runner's warm-up.

Figure 10



6.7.2.1 Electromagnetism

Question 05 · continued

0 6 . 1 Determine the total time for which the velocity of the runner was increasing.

[2 marks]

Time = _____ s

0 6 . 2 Determine the deceleration of the runner.

[2 marks]

Deceleration = _____ m/s^2

Question 6 continues on the next page

6.7.2.1 Electromagnetism

Question 05 · continued

The smart watch and mobile phone are connected to each other by a system called Bluetooth.

Bluetooth is wireless and uses electromagnetic waves for communication.

0 6 . 3 Suggest why the phone and watch being connected by a wireless system is an advantage when running.

[1 mark]

0 6 . 4 Write down the equation that links frequency, wave speed and wavelength.

[1 mark]

0 6 . 5 The electromagnetic waves have a frequency of 2 400 000 000 Hz

The speed of electromagnetic waves is 300 000 000 m/s

Calculate the wavelength of the electromagnetic waves.

[3 marks]

Wavelength = _____ m

6.7.2.1 Electromagnetism

Question 05 · continued

0 6 . 6 **Table 3** shows some information about four types of Bluetooth.

Table 3

Type	Power in milliwatts	Range in metres
1	100	100
2	2.50	10.0
3	1.00	1.00
4	0.50	0.50

Mobile phones use type **2** Bluetooth to communicate with other devices.

Suggest **two** reasons why.

[2 marks]

1 _____

_____

2 _____

_____

11

6.7.2.1 Electromagnetism

Question 06

November 2020 | 8464/P/2F | Original Q3

0 3 X-rays and gamma rays are types of electromagnetic waves.

X-rays are used for medical imaging.

0 3 . 1 Which substance will **not** absorb X-rays?

[1 mark]

Tick (✓) **one** box.

Bone ☐ Metal ☐ Skin ☐

Table 1 shows the effect of exposure to different doses of radiation.

Table 1

Dose in mSv	Effect on the human body
100	slightly increased risk of cancer
1000	5% increased risk of cancer
5000	high risk of death

0 3 . 2 During one X-ray a person receives a dose of 0.100 mSv

Why is this dose unlikely to harm the person?

[1 mark]

0 3 . 3 A doctor takes an X-ray photograph of a person.

When taking the X-ray photograph, the doctor stands behind a screen.

Suggest why.

[1 mark]

6.7.2.1 Electromagnetism

Question 06 · continued

0 3 . 4 Which of the following are gamma rays used for?

[1 mark]

Tick (✓) **one** box.

- Cooking food ☐
- Energy-efficient lamps ☐
- Sterilising medical equipment ☐

0 3 . 5 Why are gamma rays and X-rays harmful to humans?

[1 mark]

Tick (✓) **one** box.

- They are ionising ☐
- They are radioactive ☐
- They travel at the speed of light ☐

0 3 . 6 Electromagnetic waves are also used in communications.

Describe how microwaves and visible light are used in communications.

[4 marks]

Microwaves _____

_____

_____

_____

Visible light _____

_____

_____

_____

9

6.7.2.1 Electromagnetism

Question 07

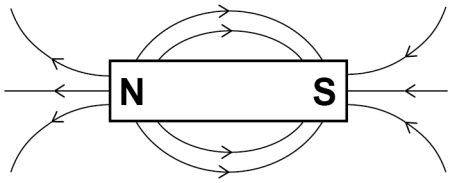
November 2021 | 8464/P/2F | Original Q2

0 2 Magnets attract some metals.

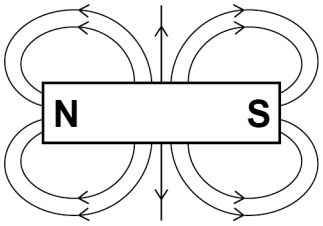
0 2 . 1 Which diagram shows the correct magnetic field pattern for a bar magnet?

[1 mark]

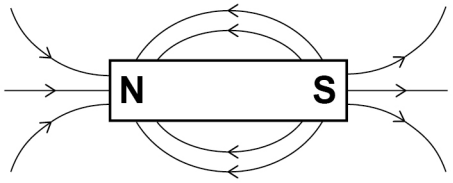
Tick (✓) **one** box.



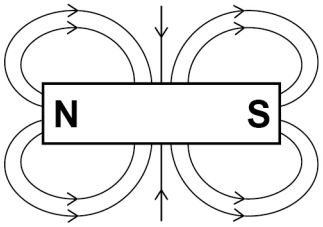
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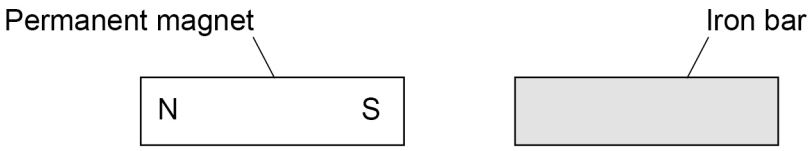
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6.7.2.1 Electromagnetism

Question 07 · continued

Figure 3 shows an iron bar near a permanent magnet.

Figure 3



The iron bar becomes an induced magnet.

0 2 . 2 Label the poles on the iron bar.

[1 mark]

0 2 . 3 The magnet is turned around so that the north pole is closest to the iron bar.

Which statement about the iron bar is true?

[1 mark]

Tick (✓) **one** box.

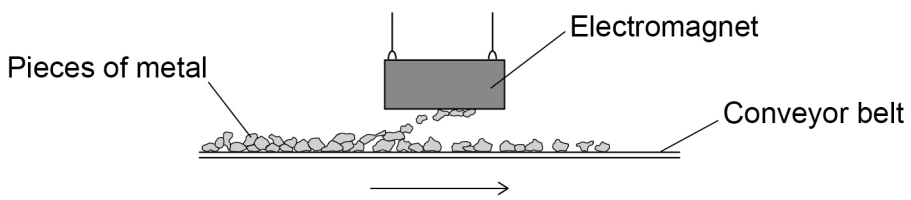
- The iron bar does not experience a magnetic force. ☐
- The iron bar experiences a magnetic force of attraction. ☐
- The iron bar experiences a magnetic force of repulsion. ☐

Question 2 continues on the next page

6.7.2.1 Electromagnetism

Figure 4 shows an electromagnet being used to separate pieces of different types of metal on a conveyor belt.

Figure 4



0 2 . 4 Which **two** of the following types of metal would be attracted to the electromagnet?

[2 marks]

Tick (✓) **two** boxes.

- Aluminium ☐
- Copper ☐
- Magnesium ☐
- Nickel ☐
- Steel ☐

0 2 . 5 What is an advantage of using an electromagnet instead of a permanent magnet to separate the types of metal?

[1 mark]

Tick (✓) **one** box.

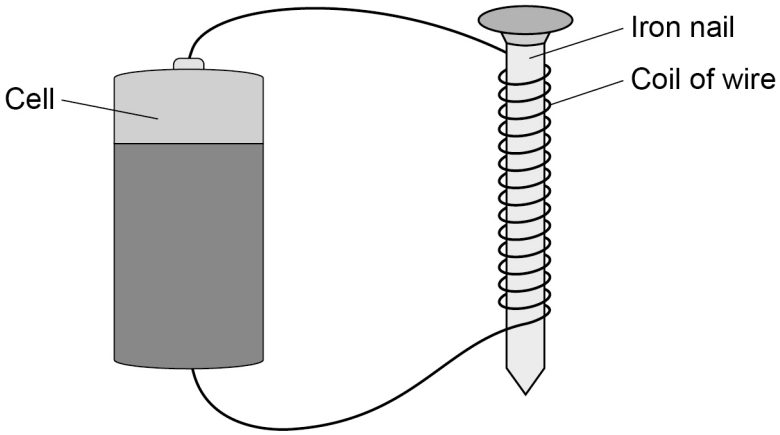
- An electromagnet attracts more types of metal than a permanent magnet. ☐
- An electromagnet can be switched on and off. ☐
- An electromagnet transfers less energy than a permanent magnet. ☐

6.7.2.1 Electromagnetism

Question 07 · continued

Figure 5 shows a simple electromagnet.

Figure 5



0 2 . 6 What is the purpose of the iron nail inside the coil of wire?

[1 mark]

Tick (✓) **one** box.

The iron nail makes the magnetic field stronger. ☐

The iron nail reduces the magnetic field to zero. ☐

The iron nail reverses the magnetic field. ☐

0 2 . 7 Which of the following would increase the strength of the electromagnet?

[1 mark]

Tick (✓) **one** box.

Use a greater current. ☐

Use a shorter nail. ☐

Use a thinner wire. ☐

8

6.7.2.1 Electromagnetism

Question 08

June 2022 | 8464/P/2F | Original Q1

0 1 There are different types of electromagnetic waves.

0 1 . 1 What do all electromagnetic waves transfer?

[1 mark]

Tick (✓) **one** box.

Charge ☐

Energy ☐

Matter ☐

Sound ☐

0 1 . 2 Complete the sentence.

Choose answers from the box.

[2 marks]

charge	**frequency**	**speed**	**wavelength**

Different types of electromagnetic waves have a different _____

and a different _____ .

0 1 . 3 **Figure 1** shows the electromagnetic spectrum.

Figure 1

Radio waves	Microwaves	Infrared	**A**	Ultraviolet	X-rays	**B**

Give the names of parts **A** and **B** of the electromagnetic spectrum.

[2 marks]

A _____

B _____

6.7.2.1 Electromagnetism

Question 08 · continued

0 1 . 4 Different types of electromagnetic waves have different uses.

Draw **one** line from each type of electromagnetic wave to its use.

[3 marks]

Type of electromagnetic wave	Use
Microwaves	Electrical heaters
Ultraviolet	Energy efficient lamps
X-rays	Imaging bones
	Satellite communications

8

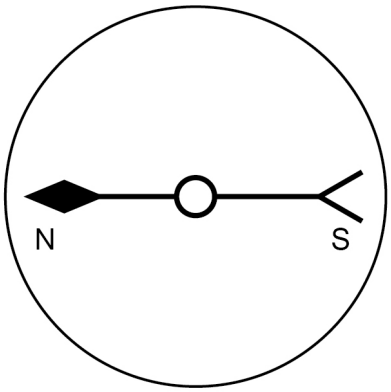
6.7.2.1 Electromagnetism

Question 09

June 2022 | 8464/P/2F | Original Q4

0 4 **Figure 5** shows a compass.

Figure 5



0 4 . 1 Why does the compass always point in the same direction when it is **not** near a magnet?

[1 mark]

Tick (✓) **one** box.

- The compass is not magnetic. ☐
- The Earth has a magnetic field. ☐
- There is no force acting on the compass. ☐

0 4 . 2 What material could the needle of the compass be made from?

[1 mark]

Tick (✓) **one** box.

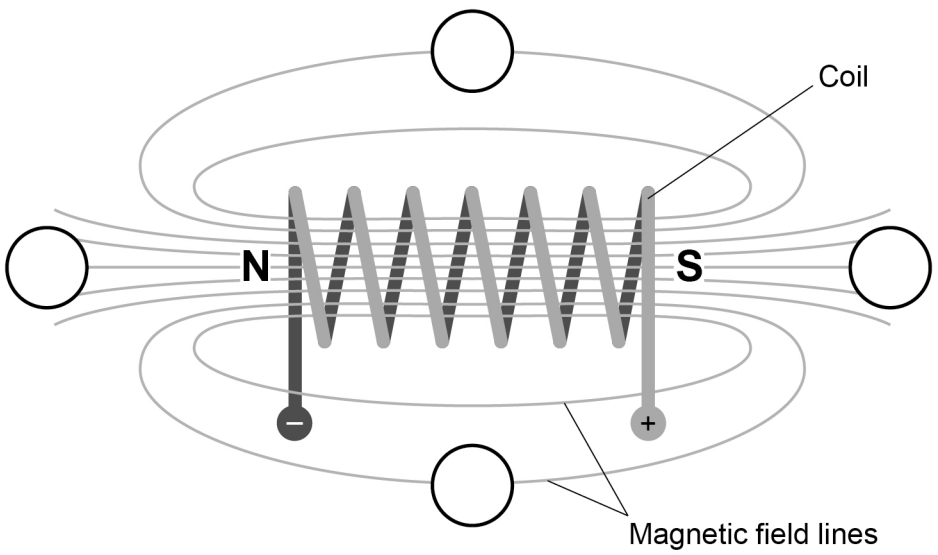
- Aluminium ☐
- Copper ☐
- Plastic ☐
- Steel ☐

Figure 6 shows a coil of wire.

There is a current in the coil.

The circles show the position of four compasses.

Figure 6



0 4 . 3 Which statement describes the magnetic field around the coil?

[1 mark]

Tick (✓) **one** box.

The field has the same strength at all points. ☐

The field is stronger further away from the coil. ☐

The field is strongest at the ends of the coil. ☐

0 4 . 4 Draw **one** arrow in **each** circle on **Figure 6** to show the direction of the magnetic field at that point.

[2 marks]

6.7.2.1 Electromagnetism

Question 09 · continued

0 4 . 5 Give **two** ways the magnetic field around the coil could be made stronger.

[2 marks]

1 _____

_____

2 _____

_____

7

Turn over for the next question

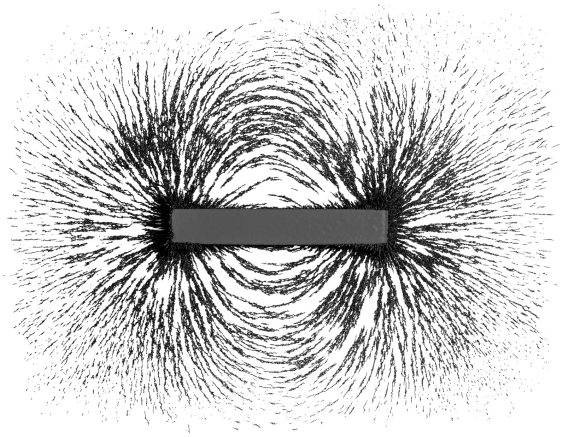
6.7.2.1 Electromagnetism

Question 10

June 2023 | 8464/P/2F | Original Q3

0 3 **Figure 4** shows iron filings sprinkled around a bar magnet.

Figure 4



0 3 . 1 Why are the iron filings attracted to the bar magnet?

[1 mark]

Tick (✓) **one** box.

Iron is a metal. ☐

Iron is charged. ☐

Iron is heavy. ☐

Iron is magnetic. ☐

Question 3 continues on the next page

6.7.2.1 Electromagnetism

Question 10 · continued

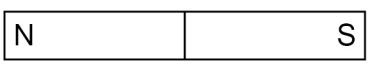
0 3 . 2 **Figure 5** shows a bar magnet.

Draw magnetic field lines to show the magnetic field pattern around the bar magnet.

You should add arrows to the field lines to show the direction of the magnetic field.

[2 marks]

Figure 5



0 3 . 3 **Figure 6** shows two bar magnets.

Figure 6



The magnets attract each other.

What conclusion can be made about the two poles marked **X** and **Y**?

[1 mark]

Tick (✓) **one** box.

They are both north poles. ☐

They are both south poles. ☐

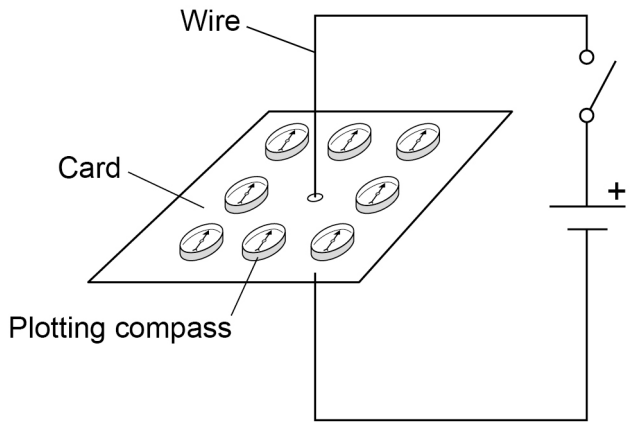
They are opposite poles. ☐

6.7.2.1 Electromagnetism

Question 10 · continued

Figure 7 shows some plotting compasses around a wire. There is no current in the wire.

Figure 7



0 3 . 4 Why do the plotting compasses all point in the same direction?

[1 mark]

0 3 . 5 When the switch is closed there is a current in the wire.

The current creates a magnetic field.

What shape are the magnetic field lines around the wire?

[1 mark]

Tick (✓) **one** box.

- Circular ☐
- Rectangular ☐
- Square ☐
- Triangular ☐

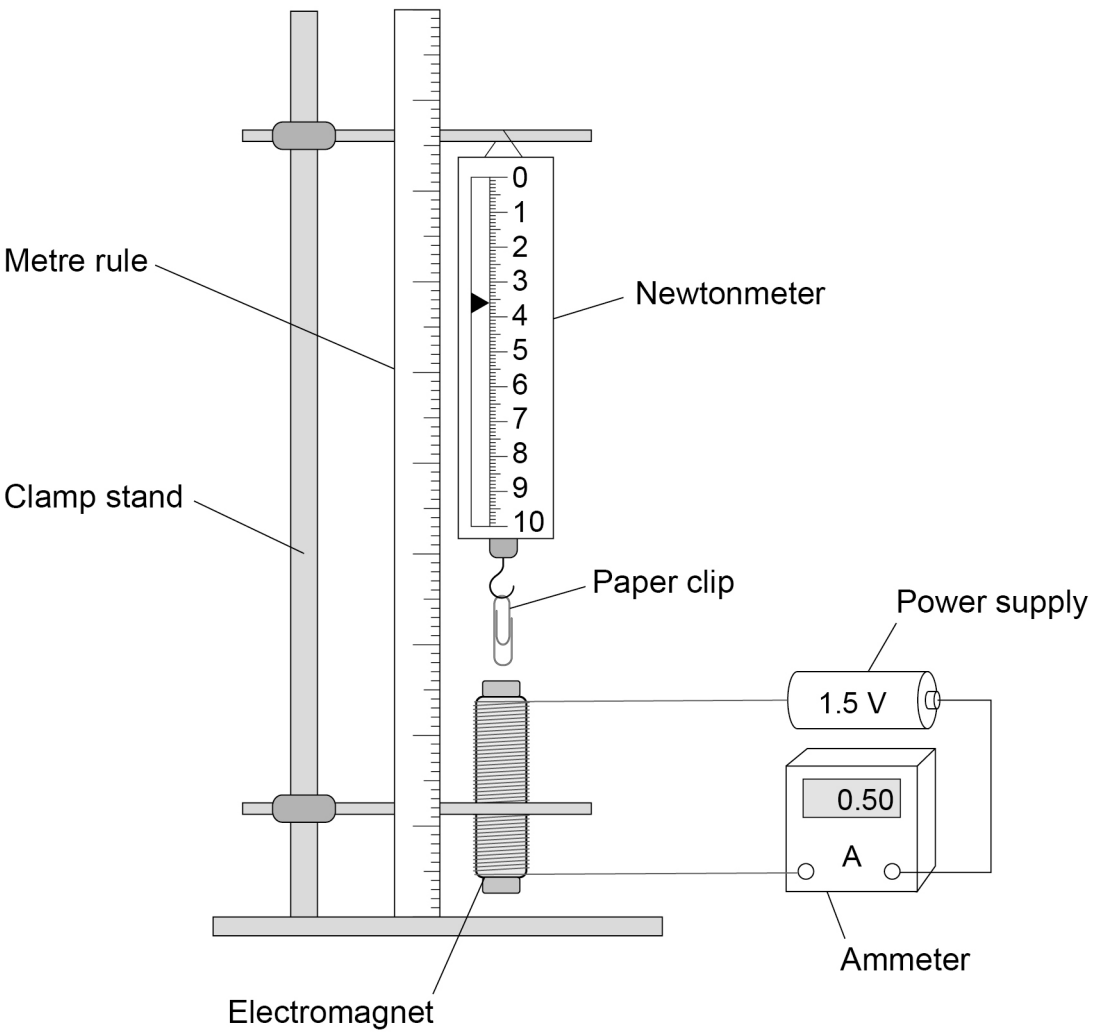
Question 10 · continued

A student investigated the force exerted by an electromagnet on a paper clip.

The student varied the distance between the paper clip and the electromagnet.

Figure 8 shows the equipment used.

Figure 8



The student recorded the reading on the newtonmeter for several different distances.

6.7.2.1 Electromagnetism

Question 10 · continued

0 3 . 6 The current in the electromagnet was the same for each distance.

Complete the sentence.

Choose the answer from the box.

[1 mark]

a control	**the dependent**	**the independent**

In the investigation, the current was _____ variable.

0 3 . 7 What is the size of the downward force on the paper clip in **Figure 8**?

[1 mark]

Force = _____ N

0 3 . 8 The distance between the paper clip and the electromagnet is **increased**.

What happens to the size of the downward force?

[1 mark]

_____

9

6.7.2.1 Electromagnetism

Question 11

June 2023 | 8464/P/2F | Original Q6

0 6 The Sun emits a continuous spectrum of electromagnetic waves.

Figure 14 names some of the groups of waves in the electromagnetic spectrum.

Figure 14

A	**B**	Infrared	Visible light	Ultraviolet	**C**	Gamma rays

0 6 . 1 Name groups **A**, **B** and **C** in **Figure 14**.

[2 marks]

A _____

B _____

C _____

0 6 . 2 Give **one** similarity and **one** difference between the properties of ultraviolet waves and gamma rays.

[2 marks]

Similarity _____

_____

Difference _____

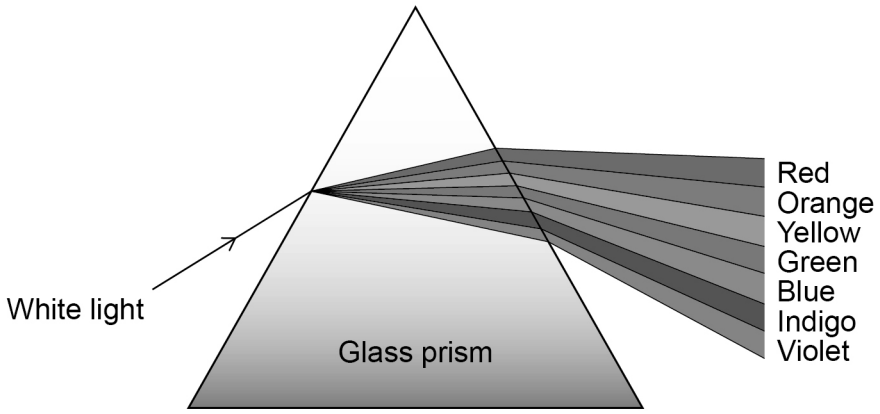
_____

6.7.2.1 Electromagnetism

Question 11 · continued

Figure 15 shows white light split into a spectrum of different colours by a glass prism.

Figure 15



0 6 . 3 Light changes direction when it enters the glass prism.

What name is given to this process?

[1 mark]

Question 6 continues on the next page

6.7.2.1 Electromagnetism

Question 11 · continued

Use the Physics Equations Sheet to answer questions **06.4** and **06.5**.

0 6 . 4 Write down the equation that links frequency (f), wavelength (λ) and wave speed (v).

[1 mark]

0 6 . 5 The wave in the middle of the spectrum has a wavelength of 5.0×10^{-7} m.

wave speed of light = 3.0×10^{8} m/s

Calculate the frequency of the wave.

[3 marks]

Frequency = _____ Hz

9

6.7.2.1 Electromagnetism

Question 12

June 2025 | 8464/P/2F | Original Q2

0 2 Food colouring can be used to change the colour of water.

A student investigated how the colour of water affects the time taken for the water to cool.

This is the method used.

1. Put 200 cm^3 of hot water into a conical flask.

2. Add four drops of food colouring to the water.

3. Place a digital thermometer in the water.

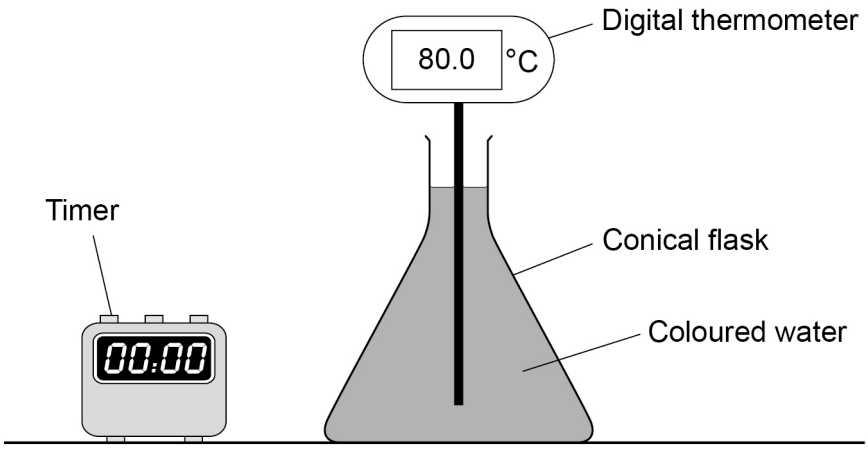
4. Start a timer when the temperature of the water is 80.0 °C.

5. Record the time taken for the water to cool to 65.0 °C.

6. Repeat steps 1 to 5 using different colours of food colouring.

Figure 3 shows the apparatus.

Figure 3



0 2 . 1 What was the independent variable in this investigation?

[1 mark]

Tick (✓) **one** box.

Colour of water ☐

Final temperature of water ☐

Volume of water ☐

6.7.2.1 Electromagnetism

Question 12 · continued

0 2 . 2 Which of the following was a control variable in this investigation?

[1 mark]

Tick (✓) **one** box.

Initial temperature of water ☐

Time taken for water to cool ☐

Type of thermometer used ☐

0 2 . 3 What equipment should have been used to make sure 200 cm^3 of water was put in the conical flask?

[1 mark]

Tick (✓) **one** box.

Beaker ☐

Measuring cylinder ☐

Metre rule ☐

0 2 . 4 The student also tested water with no food colouring.

The temperature of the water changed from 80.0 °C to 65.0 °C in a time of 5.0 minutes.

Calculate the average rate of change of temperature of the water.

Use the equation:

$$\text{average rate of change of temperature} = \frac{\text{change in temperature}}{\text{time taken}}$$

[2 marks]

Average rate of change of temperature = _____ °C/minute

Table 1 shows the results for the different coloured water.

Table 1

Colour of water	Rate of change of temperature in °C/minute
Red	6.1
Yellow	5.0
Green	4.3
Blue	4.0
Violet	3.7

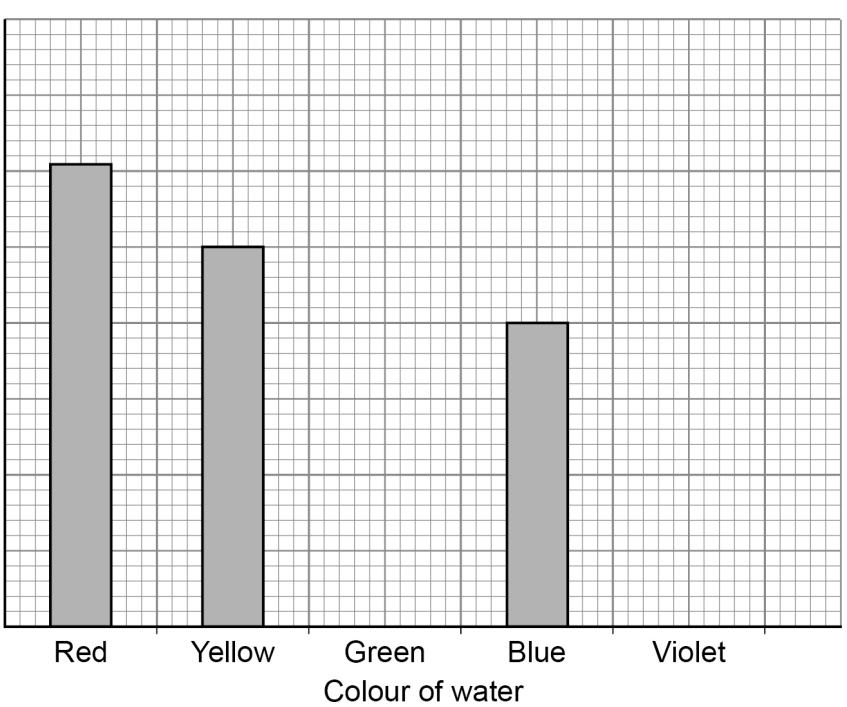
0 2 . 5 Complete **Figure 4**.

You should:

- label the *y*-axis
- add a scale to the *y*-axis
- draw bars for the green water and the violet water.

[3 marks]

Figure 4



6.7.2.1 Electromagnetism

Question 12 · continued

0 2 . 6 In the visible spectrum, orange light is between red light and yellow light.

Estimate the rate of change of temperature if orange food colouring was used.

Use **Table 1**.

[1 mark]

Estimated rate of change of temperature = _____ °C/minute

0 2 . 7 Complete the sentence.

Choose the answer from the box.

[1 mark]

infrared	**ultraviolet**	**x-rays**

The results show that the colour of the water affects the rate at which the water emits _____.

0 2 . 8 Complete the sentence.

Choose the answer from the box.

[1 mark]

energy	**rarefactions**	**temperature**

The water in each conical flask cools down because the electromagnetic radiation emitted by the water transfers _____.

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6.7.2.1 Electromagnetism

Question 13

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0 5 Some homes are connected to the internet using satellites.

Electromagnetic waves are used to transmit data between Earth and the satellites.

0 5 . 1 Which electromagnetic waves are used to transfer data between Earth and satellites?

[1 mark]

Tick (✓) **one** box.

- Gamma rays ☐
- Microwaves ☐
- Ultraviolet ☐
- Visible light ☐

0 5 . 2 Which of the following electromagnetic waves has the greatest frequency?

[1 mark]

Tick (✓) **one** box.

- Gamma rays ☐
- Microwaves ☐
- Ultraviolet ☐
- Visible light ☐

Question 5 continues on the next page

Question 13 · continued

0 5 . 3 What is meant by the 'period of a wave'?

[1 mark]

Tick (✓) **one** box.

The distance travelled by a wave in one second ☐

The number of waves passing a fixed point each second ☐

The time taken for one wave to pass a fixed point ☐

0 5 . 4 Data is transmitted to the satellites by electromagnetic waves with a frequency of 48 GHz.

Calculate the period of waves with a frequency of 48 GHz.

Use the Physics Equations Sheet.

Choose the unit from the box.

[4 marks]

J	N/kg	s

Period = _____ Unit _____

6.7.2.1 Electromagnetism

Question 13 · continued

0 5 . 5 The satellites receive and transmit data using electromagnetic waves with different frequencies.

Give **one** property that is the same for electromagnetic waves with different frequencies.

[1 mark]

0 5 . 6 Most homes are connected to the internet using cables.

Suggest **one** reason why homes in some areas of the UK are connected to the internet by satellites.

[1 mark]

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