AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 6.7.2.1

Electromagnetism

Past-paper questions

Tier	**Higher**
Question groups	**12**
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

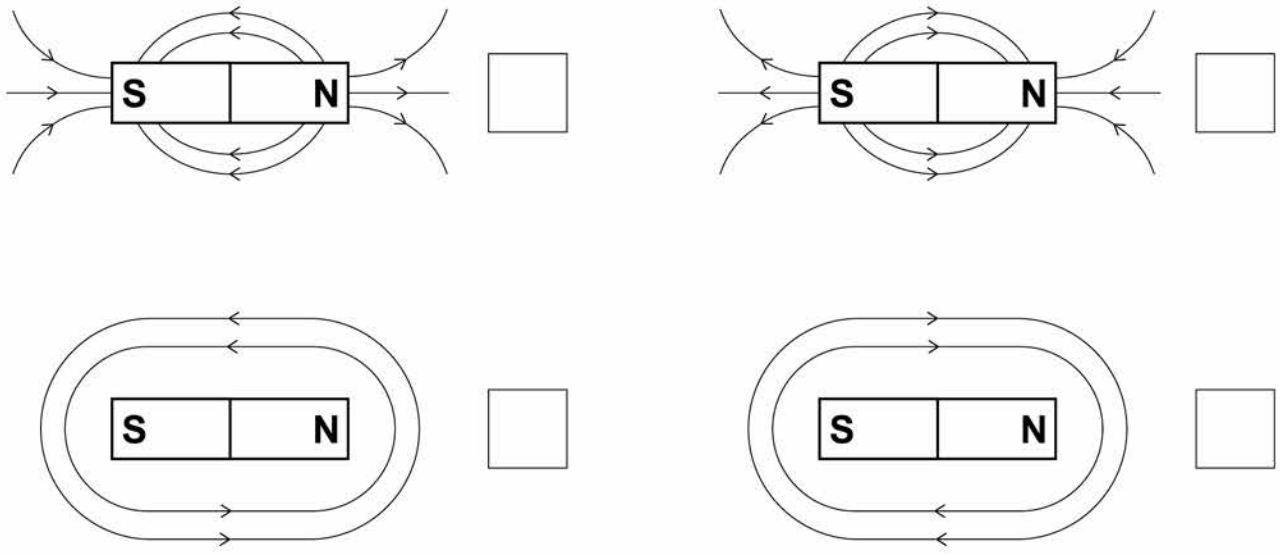
June 2018 | 8464/P/2H | Original Q2

0 2 A magnet produces a magnetic field.

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

[1 mark]

Tick **one** box.



0 2 . 2 **Figure 3** shows three metal blocks.

The blocks are not labelled.

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

Figure 3



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

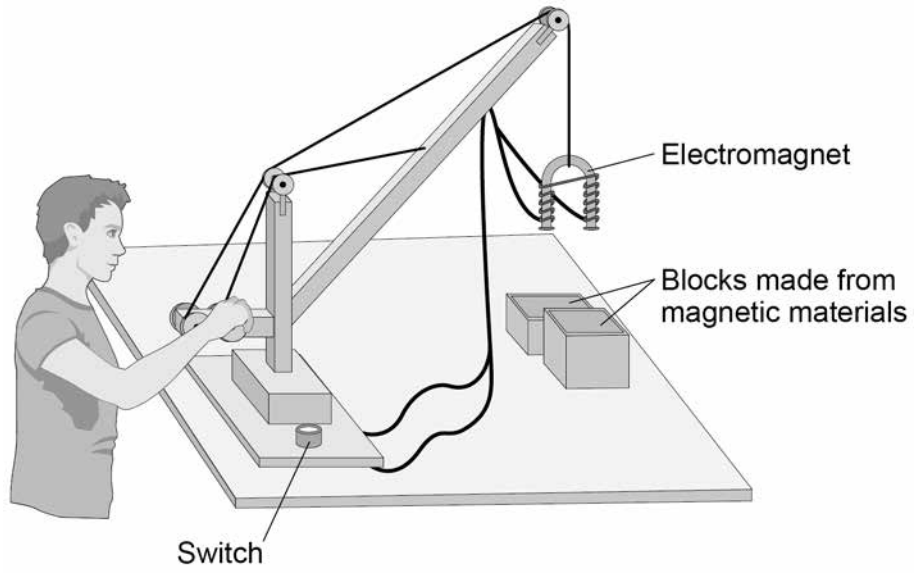
[3 marks]

6.7.2.1 Electromagnetism

Question 01 · continued

0 2 . 3 **Figure 4** shows a toy crane.

Figure 4



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]

10

6.7.2.1 Electromagnetism

Question 02

June 2018 | 8464/P/2H | Original Q5

0 5 A car aerial receives radio waves from a radio transmitter.

Radio waves are transverse waves.

Sound waves are longitudinal waves.

0 5 . 1 Describe the difference between transverse waves and longitudinal waves.

[2 marks]

0 5 . 2 The radio waves have a frequency of 4.8×10^9 Hz

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

Calculate the wavelength of the radio waves.

Give your answer to 2 significant figures.

[3 marks]

Wavelength = _____ m

Question 5 continues on the next page

6.7.2.1 Electromagnetism

Question 02 · continued

0 5 . 3 Describe how the radio waves reaching the car aerial produce signals in the electrical circuit of the car radio.

[3 marks]

8

6.7.2.1 Electromagnetism

Question 03

June 2019 | 8464/P/2H | Original Q1

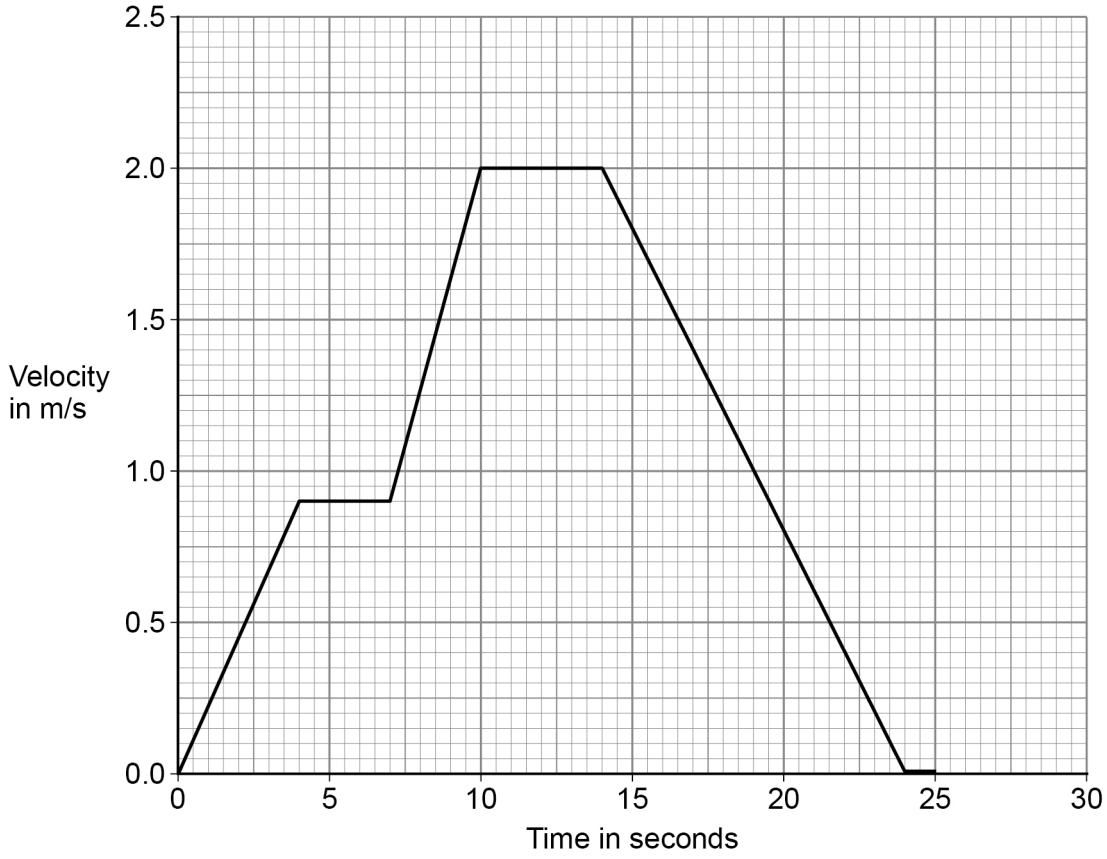
0 1 **Figure 1** shows a runner using a smart watch and a mobile phone to monitor her run.

Figure 1



Figure 2 is a velocity–time graph for part of the runner's warm-up.

Figure 2



6.7.2.1 Electromagnetism

Question 03 · continued

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

[2 marks]

Time = _____ s

0 1 . 2 Determine the deceleration of the runner.

[2 marks]

Deceleration = _____ m/s^2

Question 1 continues on the next page

6.7.2.1 Electromagnetism

Question 03 · 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 1 . 3 Suggest why the phone and watch being connected by a wireless system is an advantage when running.

[1 mark]

0 1 . 4 Write down the equation that links frequency, wave speed and wavelength.

[1 mark]

0 1 . 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 03 · continued

0 1 . 6 **Table 1** shows some information about four types of Bluetooth.

Table 1

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

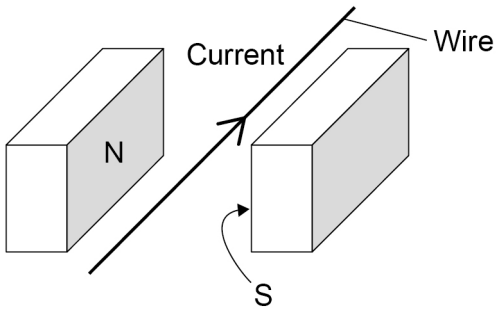
6.7.2.1 Electromagnetism

Question 04

0 4 **Figure 6** shows a wire in a magnetic field.

The direction of the current in the wire is shown.

Figure 6

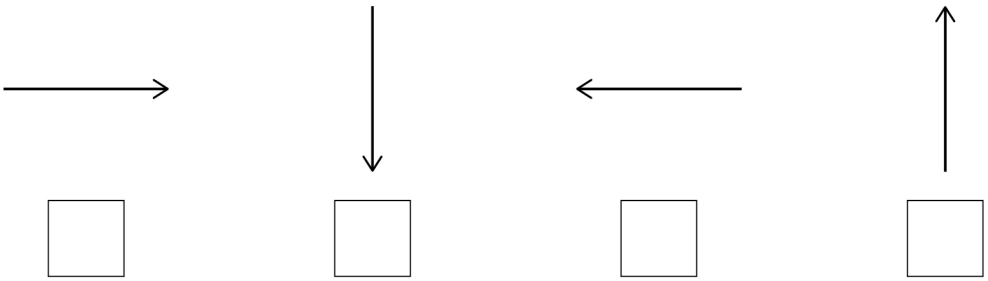


0 4 . 1 There is a force on the wire due to the current in the magnetic field.

In which direction is the force on the wire?

[1 mark]

Tick (✓) **one** box.



0 4 . 2 Give **two** ways that the direction of the force on the wire could be reversed.

[2 marks]

1 _____

2 _____

Question 4 continues on the next page

6.7.2.1 Electromagnetism

Question 04 · continued

0 4 . 3 The length of the wire in the magnetic field is 0.050 m

The force on the wire is 0.072 N

magnetic flux density = 360 mT

Calculate the current in the wire.

Use the Physics Equations Sheet.

[4 marks]

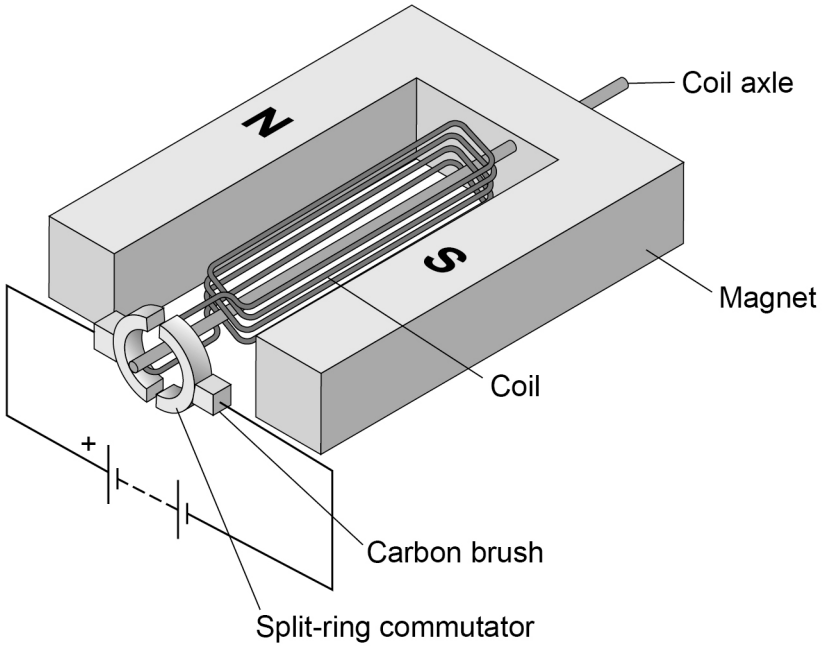
Current = _____ A

6.7.2.1 Electromagnetism

Question 04 · continued

0 4 . 4 **Figure 7** shows a simple motor.

Figure 7



Explain why the coil rotates when there is a current in the coil.

[4 marks]

11

6.7.2.1 Electromagnetism

Question 05

November 2020 | 8464/P/2H | Original Q5

0 5 X-rays form part of the electromagnetic spectrum.

Radiographers use X-rays to produce images of bones inside the body.

0 5 . 1 Explain why X-rays can be used to produce images of the bones inside the body.

[2 marks]

0 5 . 2 **Table 2** shows the effect of exposure to different doses of radiation.

Table 2

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

During an X-ray a person receives a dose of 0.5 mSv

The radiographer takes many X-ray images each day.

Explain why the radiographer stands behind a protective screen when taking an X-ray image.

[3 marks]

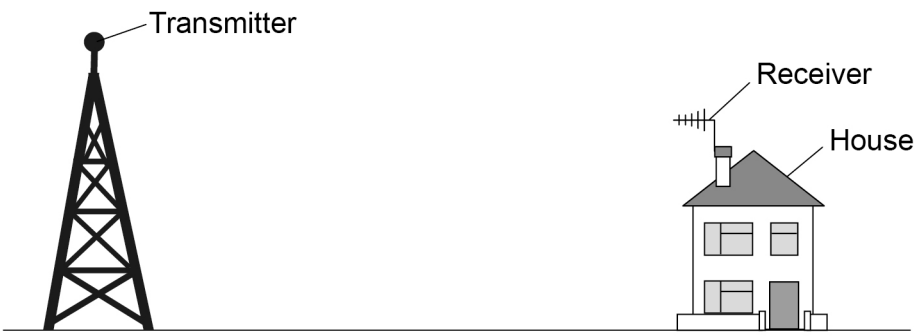
6.7.2.1 Electromagnetism

Question 05 · continued

0 5 . 3 Radio waves form part of the electromagnetic spectrum.

Figure 10 shows one use of radio waves.

Figure 10



Explain how electrical signals in the transmitter produce a signal in the receiver.

[3 marks]

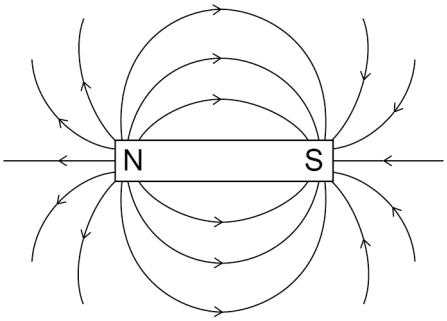
8

6.7.2.1 Electromagnetism

Question 06

0 4 **Figure 4** shows the magnetic field pattern around a permanent magnet.

Figure 4



0 4 . 1 Where is the magnetic field of the magnet the strongest?

[1 mark]

0 4 . 2 How does **Figure 4** show that the strength of the magnetic field is not the same at all places?

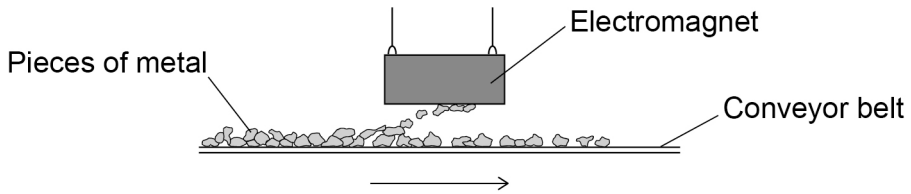
[1 mark]

6.7.2.1 Electromagnetism

Question 06 · continued

Figure 5 shows an electromagnet being used to separate iron and steel from non-magnetic metals.

Figure 5



0 4 . 3 Explain **one** reason why an electromagnet is used instead of a permanent magnet.

[2 marks]

0 4 . 4 Pieces of iron and steel are attracted to the electromagnet.

Name **two** other metals that would be attracted to the electromagnet.

[2 marks]

1 _____

2 _____

0 4 . 5 The design of the electromagnet **cannot** be changed.

Give **two** ways the force exerted by the electromagnet on a piece of iron or steel could be increased.

[2 marks]

1 _____

2 _____

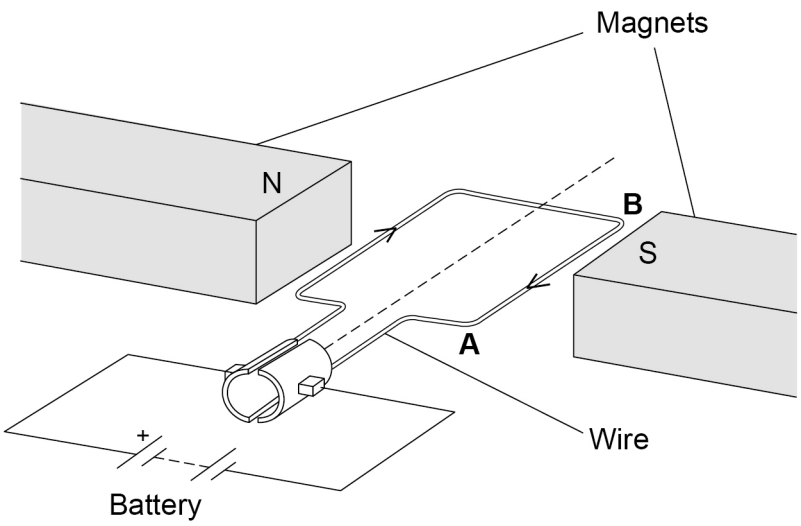
6.7.2.1 Electromagnetism

Question 06 · continued

The conveyor belt that moves the pieces of metal is driven by an electric motor.

Figure 6 shows a simple electric motor.

Figure 6



6.7.2.1 Electromagnetism

Question 06 · continued

0 4 . 6 The length of the wire **AB** in the magnetic field is 120 mm.

There is a current of 4.0 A in the wire. The length of wire **AB** experiences a force of 0.36 N.

Calculate the magnetic flux density between the magnets.

Give the unit.

[5 marks]

Magnetic flux density = _____ Unit _____

Question 4 continues on the next page

6.7.2.1 Electromagnetism

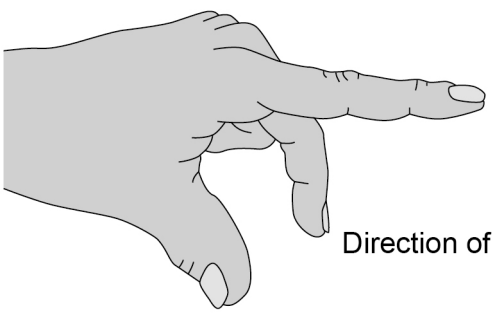
Question 06 · continued

0 4 . 7 Fleming's left-hand rule can be used to determine the direction of the force on wire **AB**.

Complete the labels on **Figure 7** to show Fleming's left-hand rule.

[2 marks]

Figure 7



Direction of _____

Direction of _____

Direction of _____

15

6.7.2.1 Electromagnetism

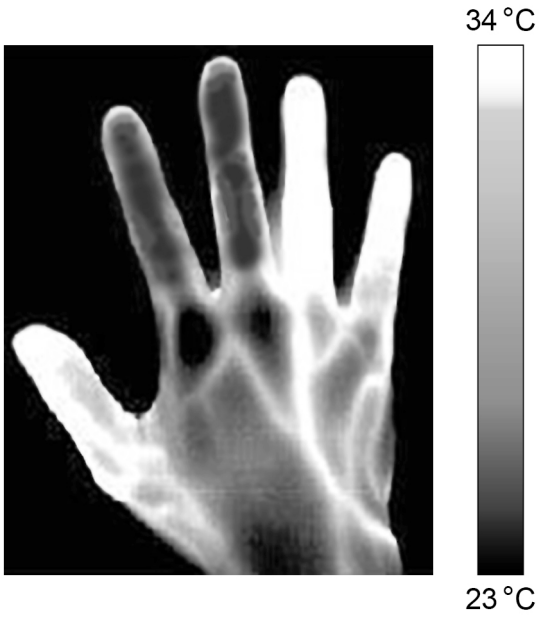
Question 07

November 2021 | 8464/P/2H | Original Q5

0 5 Different parts of the electromagnetic spectrum are used in medical imaging.

Figure 8 shows an image of a person's hand taken with an infrared camera.

Figure 8



0 5 . 1 Explain why the infrared camera is able to show that parts of the hand are at different temperatures.

[2 marks]

Question 5 continues on the next page

6.7.2.1 Electromagnetism

Question 07 · continued

0 5 . 2 Infrared has a range of wavelengths from 700 nm to 1 mm.

Which part of the electromagnetic spectrum would have waves with a wavelength of 6.5×10^{-7} m?

[1 mark]

Tick (✓) **one** box.

- Infrared ☐
- Microwaves ☐
- Radio waves ☐
- Visible light ☐

6.7.2.1 Electromagnetism

Question 07 · continued

0 5 . 3 **Figure 9** shows X-rays and gamma rays being used for medical imaging.

Figure 9

X-rays **Gamma rays**





To use X-rays for medical imaging, a machine produces a very brief burst of X-rays.

To use gamma rays for medical imaging, a radioactive isotope is injected into the patient's blood. The isotope is circulated around the body in the blood. The isotope emits gamma rays.

Compare the potential risks to a patient of using X-rays and gamma rays for medical imaging.

[4 marks]

Question 5 continues on the next page

6.7.2.1 Electromagnetism

Question 07 · continued

X-rays are produced by colliding high-energy electrons into a metal target.

The electrons have high energy because they are accelerated to high speeds.

Only a small proportion of the kinetic energy of an electron is converted into an X-ray when it collides with the metal target.

0 5 . 4 An electron is accelerated through a distance of 15 mm.

The work done on the electron is 1.2×10^{-13} J.

Calculate the force on the electron.

[3 marks]

Force = _____ N

0 5 . 5 The metal target is made from tungsten.

Tungsten has the highest melting point of any metal.

Explain why using tungsten as the metal target enables the X-ray machine to be more powerful.

[3 marks]

13

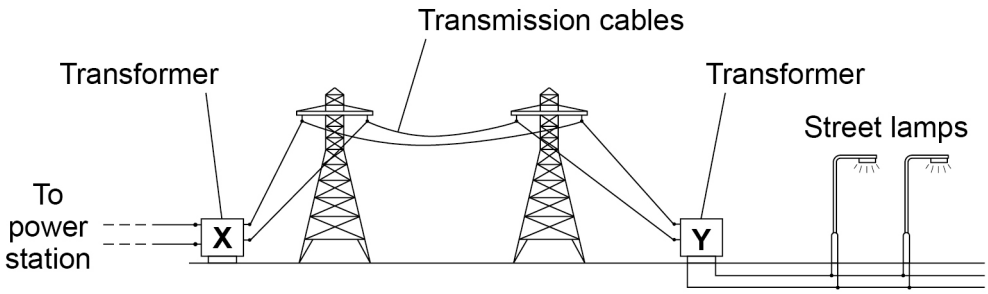
6.7.2.1 Electromagnetism

Question 08

June 2023 | 8464/P/1H | Original Q3

0 3 **Figure 7** shows how the National Grid transfers energy from a power station to some street lamps.

Figure 7



0 3 . 1 Explain how transformer **X** increases the efficiency of the National Grid.

[3 marks]

Question 08 · continued

0 3 . 2 The potential difference across the primary coil in transformer **Y** is 400 000 V.

The potential difference across the secondary coil is 11 000 V.

The current in the primary coil is 660 A.

Calculate the current in the secondary coil of transformer **Y**.

Use the Physics Equations Sheet.

[3 marks]

Current in the secondary coil = _____ A

0 3 . 3 Why is the current in each street lamp less than the current in the secondary coil in transformer **Y**?

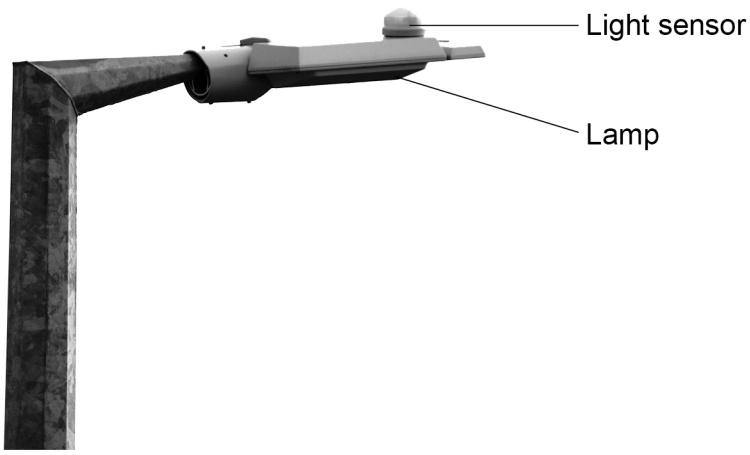
[1 mark]

Tick (✓) **one** box.

- Current is used up in the cables between **Y** and each street lamp. ☐
- Some of the current is dissipated to the surroundings. ☐
- The cables between **Y** and the street lamps have electrical resistance. ☐
- The street lamps are connected in parallel. ☐

0 3 . 4 **Figure 8** shows the top of a street lamp.

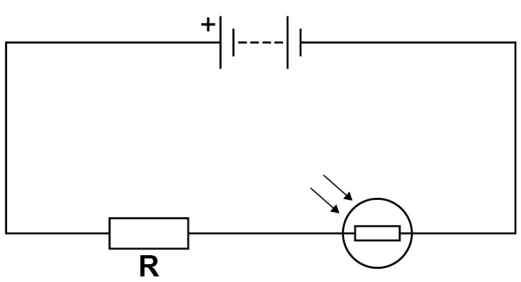
Figure 8



The light sensor detects if it is day or night.

Figure 9 shows part of the circuit in the light sensor.

Figure 9



Explain what happens to the potential difference across resistor **R** as the light intensity decreases.

[3 marks]

6.7.2.1 Electromagnetism

Question 08 · continued

0 3 . 5 When the current in resistor **R** is 20 mA, the power transferred by resistor **R** is 6.0 W.

Calculate the resistance of resistor **R**.

Use the Physics Equations Sheet.

[4 marks]

Resistance = _____ Ω

14

6.7.2.1 Electromagnetism

Question 09

June 2023 | 8464/P/2H | Original Q1

0 1 The Sun emits a continuous spectrum of electromagnetic waves.

Figure 1 names some of the groups of waves in the electromagnetic spectrum.

Figure 1

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

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

[2 marks]

A _____

B _____

C _____

0 1 . 2 Give **one** similarity and **one** difference between the properties of ultraviolet waves and gamma rays.

[2 marks]

Similarity _____

_____

Difference _____

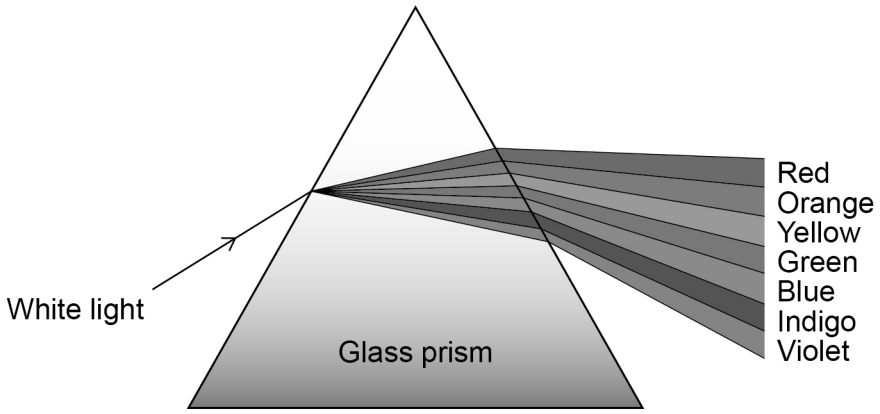
_____

6.7.2.1 Electromagnetism

Question 09 · continued

Figure 2 shows white light split into a spectrum of different colours by a glass prism.

Figure 2



0 1 . 3 Light changes direction when it enters the glass prism.

What name is given to this process?

[1 mark]

Question 1 continues on the next page

6.7.2.1 Electromagnetism

Question 09 · continued

Use the Physics Equations Sheet to answer questions **01.4** and **01.5**.

0 1 . 4 Write down the equation that links frequency (f), wavelength (λ) and wave speed (v).

[1 mark]

0 1 . 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 10

June 2024 | 8464/P/2H | Original Q3

0 3 Electromagnetic waves are grouped according to their wavelength and frequency.

Electromagnetic waves are transverse waves and can travel through a vacuum.

0 3 . 1 Give one **other** property that is the same for all types of electromagnetic wave.

[1 mark]

0 3 . 2 What is meant by 'transverse wave'?

[1 mark]

0 3 . 3 Which group of electromagnetic waves is used for satellite communications?

[1 mark]

0 3 . 4 Visible light is the only group of electromagnetic waves that the human eye can detect.

Which colour of visible light has the shortest wavelength?

[1 mark]

6.7.2.1 Electromagnetism

Question 10 · continued

0 3 . 5 The three highest frequency groups of electromagnetic waves are hazardous.

Describe a risk linked to each group of high frequency electromagnetic wave.

[2 marks]

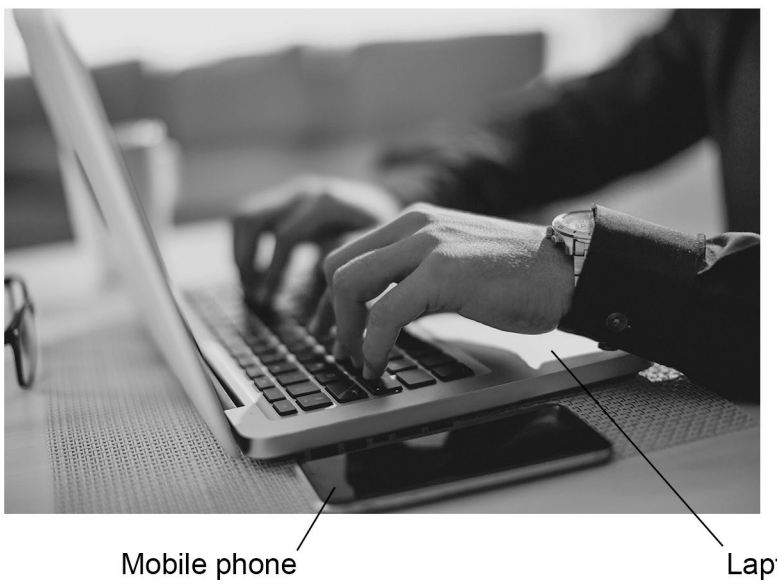
Question 3 continues on the next page

6.7.2.1 Electromagnetism

Question 10 · continued

Figure 5 shows a person using a mobile phone to allow a laptop to access the Internet.

Figure 5



The electromagnetic waves emitted by the mobile phone send information to the laptop.

0 3 . 6 The electromagnetic waves emitted by the mobile phone have a period of 4.0×10^{-10} s.

Calculate the frequency of the waves.

Use the Physics Equations Sheet.

Give your answer in standard form.

[3 marks]

Frequency (in standard form) = _____ Hz

6.7.2.1 Electromagnetism

Question 10 · continued

0 3 . 7 The electromagnetic waves are produced by oscillations in the transmitter of the mobile phone.

Explain how oscillations in the transmitter enable information to be transferred to the detector in the laptop.

[4 marks]

13

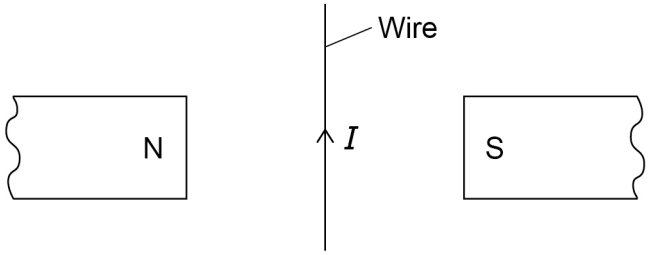
6.7.2.1 Electromagnetism

Question 11

0 4 **Figure 6** shows two magnets and a wire.

There is a current in the wire.

Figure 6



0 4 . 1 A force acts on the wire in **Figure 6**.

What is the direction of the force on the wire?

[1 mark]

Tick (✓) **one** box.

- Into the page ☐
- Out of the page ☐
- To the left ☐
- To the right ☐

6.7.2.1 Electromagnetism

Question 11 · continued

0 4 . 2 The length of the wire in the magnetic field between the magnets is 80 mm.

The current in the wire is 4.6 A.

The force on the wire is 0.092 N.

Calculate the magnetic flux density between the magnets.

Use the Physics Equations Sheet.

Give the unit.

[4 marks]

Magnetic flux density = _____ Unit _____

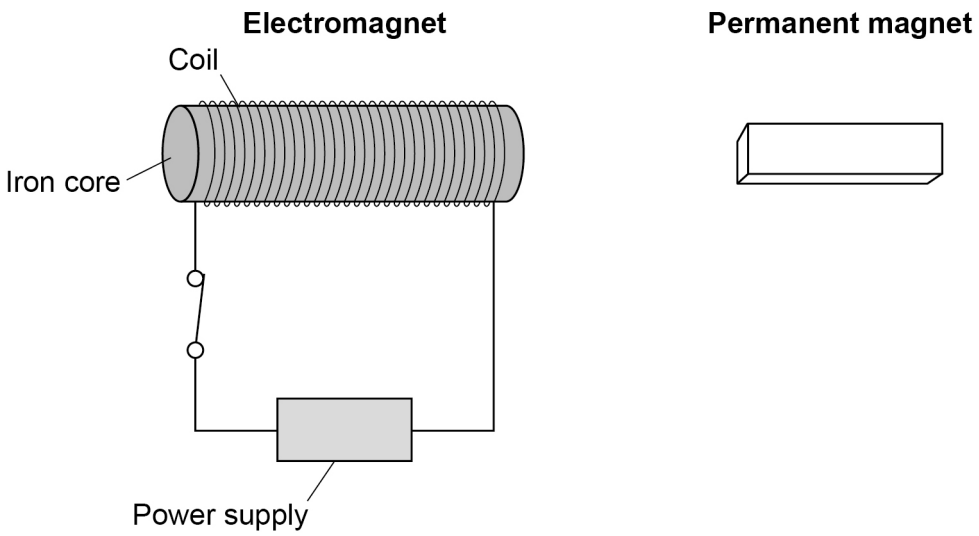
Question 4 continues on the next page

6.7.2.1 Electromagnetism

Question 11 · continued

Figure 7 shows an electromagnet close to a permanent magnet.

Figure 7



0 4 . 3 The electromagnet exerts a force on the permanent magnet.

The permanent magnet exerts an equal and opposite force on the electromagnet.

Which law is this an example of?

[1 mark]

Tick (✓) **one** box.

Newton's first law ☐

Newton's second law ☐

Newton's third law ☐

6.7.2.1 Electromagnetism

Question 11 · continued

0 4 . 4 Give **two** changes to the electromagnet that would increase the force exerted on the permanent magnet.

[2 marks]

1 _____

_____

2 _____

_____

0 4 . 5 Give **two** changes to the electromagnet that would reverse the direction of the force exerted on the permanent magnet.

[2 marks]

1 _____

_____

2 _____

_____

10

6.7.2.1 Electromagnetism

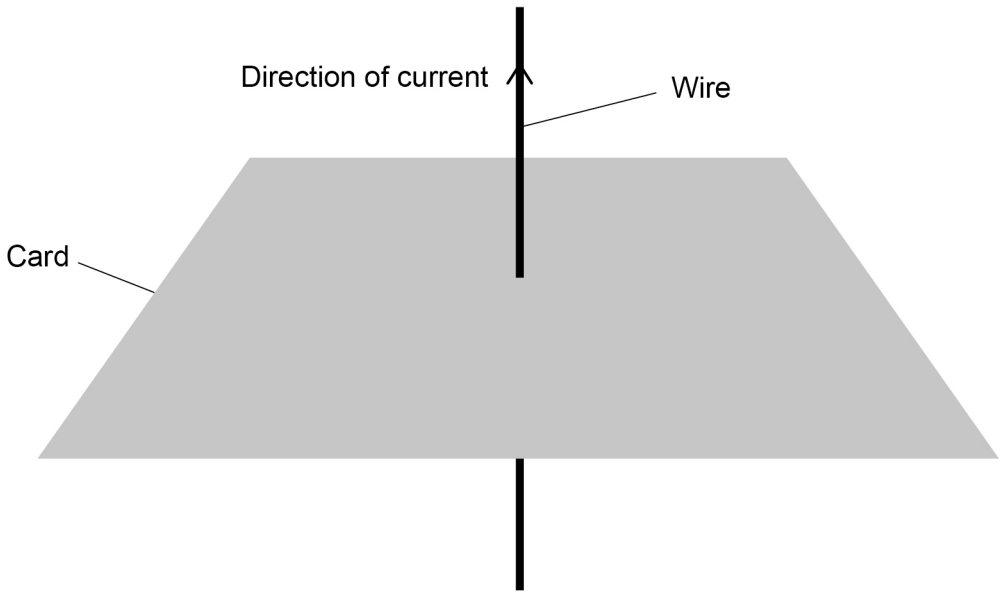
Question 12

0 4 When there is a current in a wire, there is a magnetic field around the wire.

0 4 . 1 **Figure 5** shows a wire passing through a piece of card.

There is a current in the wire.

Figure 5



Draw **two** magnetic field lines on the card in **Figure 5** to show the magnetic field pattern around the wire.

[2 marks]

6.7.2.1 Electromagnetism

Question 12 · continued

0 4 . 2 A student positioned a straight wire in the magnetic field between two magnets.

The wire was perpendicular to the magnetic field.

There was a current of 0.56 A in the wire.

The magnetic force on the wire was 2.1 mN.

The length of wire in the magnetic field was 0.050 m.

Calculate the magnetic flux density of the magnetic field between the magnets.

Use the Physics Equations Sheet.

Give the unit.

[5 marks]

Magnetic flux density = _____ Unit _____

Question 4 continues on the next page

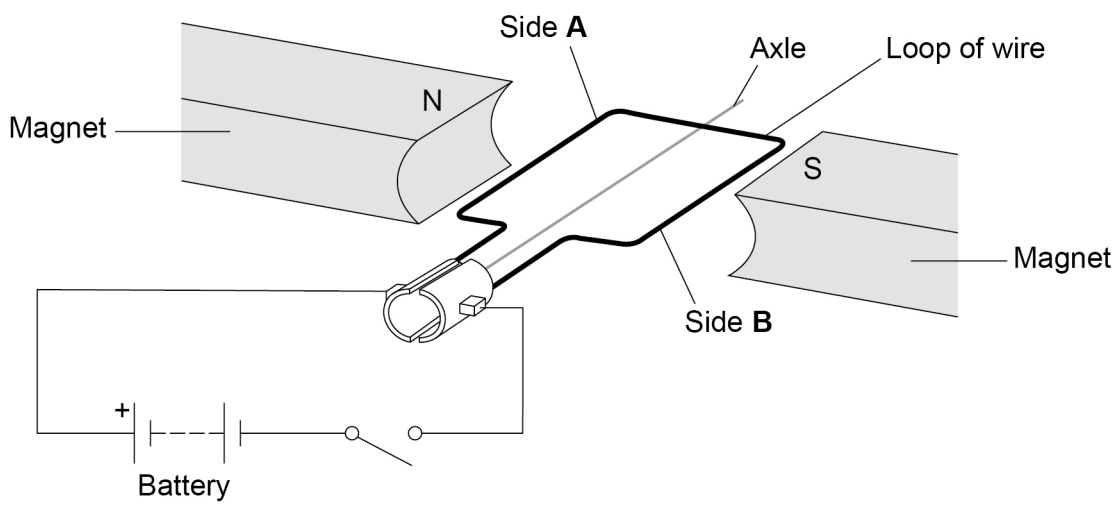
0 4 . 3 The student replaced the straight wire with a loop of wire.

The loop of wire was on an axle so that the loop could rotate.

The student connected the loop of wire to a battery and a switch.

Figure 6 shows the apparatus.

Figure 6



6.7.2.1 Electromagnetism

Question 12 · continued

When the switch is closed, magnetic forces on the loop make the loop begin to rotate.

Explain how.

You should refer to side **A** and side **B** of the loop of wire in **Figure 6**.

[5 marks]

Extra space

12