Name: _____

Magnetism part 1 AQA Triple Physics

Class: _____

Date: _____

Time: **74 minutes**

Marks: **72 marks**

Comments:

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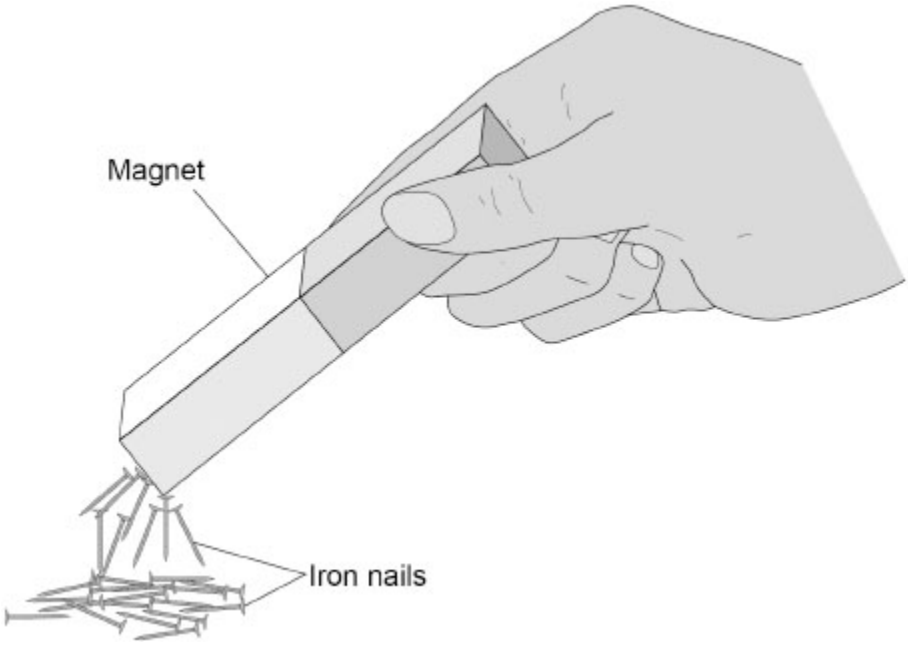
1. **Figure 1** shows iron nails being attracted to a magnet.

Figure 1



(a) Iron is a magnetic material.

Which **two** of the following are also magnetic materials?

Tick (✓) **two** boxes.

Cobalt ☐

Copper ☐

Gold ☐

Steel ☐

Zinc ☐

(2)

(b) The iron nails become magnets when they are attracted to the bar magnet.

Complete the sentence.

Choose the answer from the box.

electromagnets	**induced magnets**	**permanent magnets**

The iron nails become _____.

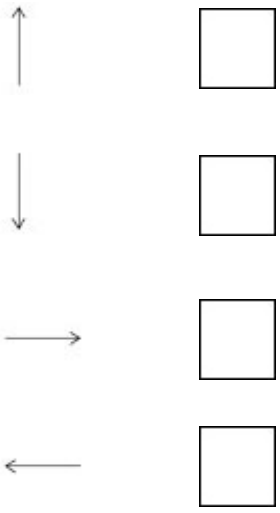
(1)

(c) **Figure 2** shows two bar magnets next to each other.

Figure 2

Which arrow shows the direction of the magnetic field between the magnets?

Tick (✓) **one** box.



(1)

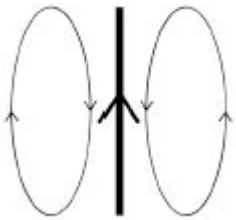
Figure 3 shows the direction of the current in a wire.

The current causes a magnetic field around the wire.

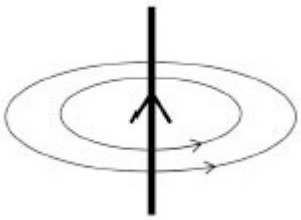
Figure 3

(d) Which of the following shows the magnetic field pattern around the wire?

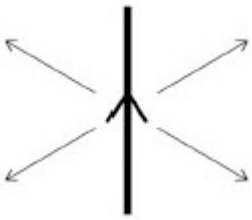
Tick (✓) **one** box.



☐



☐



☐

(1)

(e) What **two** changes would increase the strength of the magnetic field around the wire?

1 _____

_____

2 _____

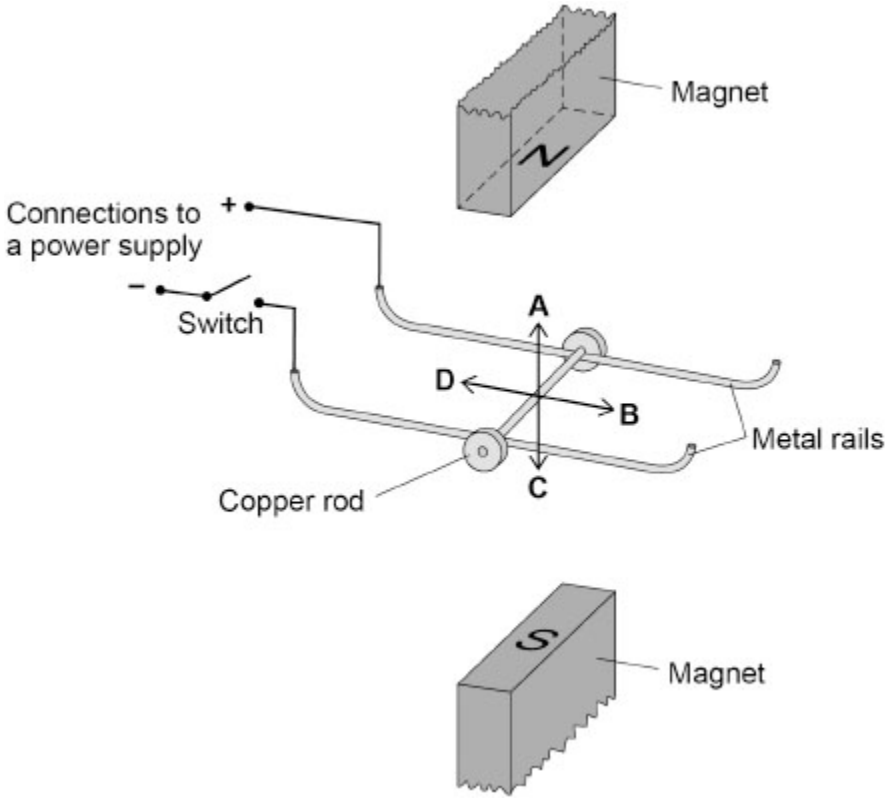
_____

(2)

(Total 7 marks)

2. **Figure 1** shows some apparatus used to demonstrate the motor effect.

Figure 1



When the switch is closed the copper rod accelerates.

(a) What direction is the acceleration of the copper rod?

Tick (✓) **one** box.

A ☐

B ☐

C ☐

D ☐

(1)

(b) 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.

Initial acceleration = _____ m/s^2

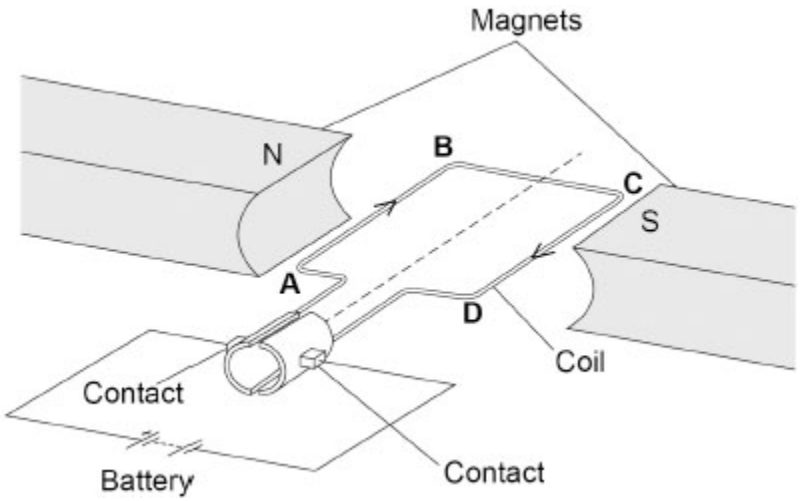
(5)

Figure 2 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 2



(c) Explain how these magnetic fields cause the coil to continuously rotate.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(d) In **Figure 2** 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.

_____

_____

_____

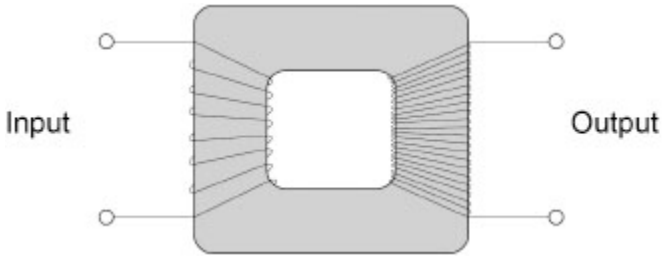
_____

(2)

(Total 12 marks)

3. Transformers are used to change alternating potential differences.

The figure below shows a transformer.



(a) Why is the core of the transformer made from iron?

_____

_____

(1)

(b) 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.

_____

_____

_____

_____

_____

_____

_____

Potential difference = _____ V

(4)

(c) 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)

(Total 8 marks)

4. Some metals are magnetic and others are non-magnetic.

(a) Which of the following metals is magnetic?

Tick (✓) **one** box.

Aluminium ☐

Cobalt ☐

Copper ☐

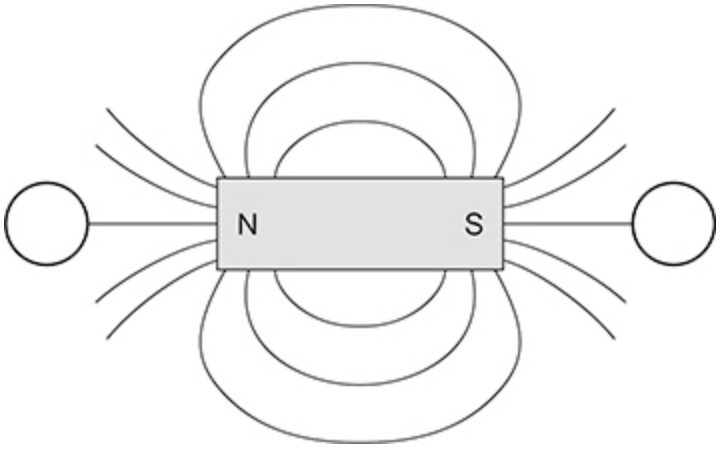
Zinc ☐

(1)

(b) **Figure 1** shows magnetic field lines around a bar magnet.

The circles represent plotting compasses.

Figure 1

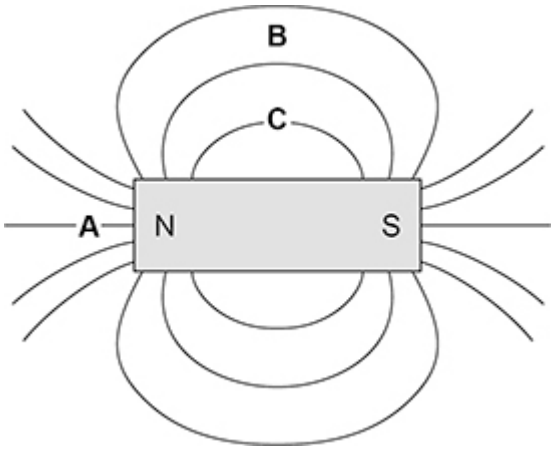


Draw **one** arrow in each circle on **Figure 1** to show the direction of the magnetic field at each place.

(2)

(c) **Figure 2** shows magnetic field lines around a bar magnet.

Figure 2



Which letter shows where the magnetic field is strongest?

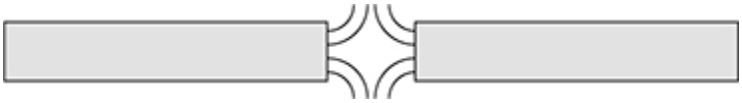
Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐

(1)

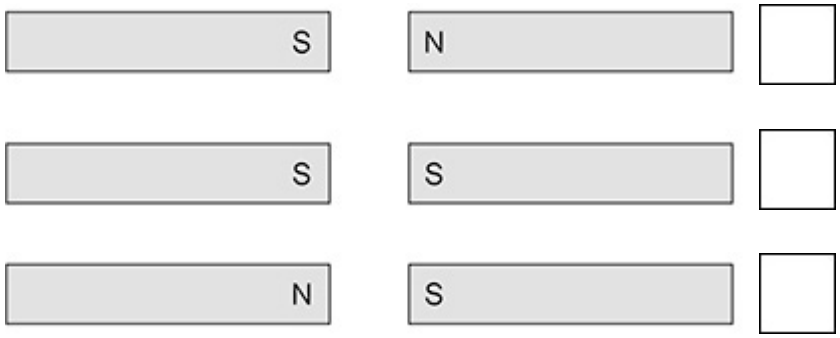
(d) **Figure 3** shows the magnetic field lines between two bar magnets.

Figure 3



Which diagram shows how the magnets are arranged in **Figure 3**?

Tick (✓) **one** box.



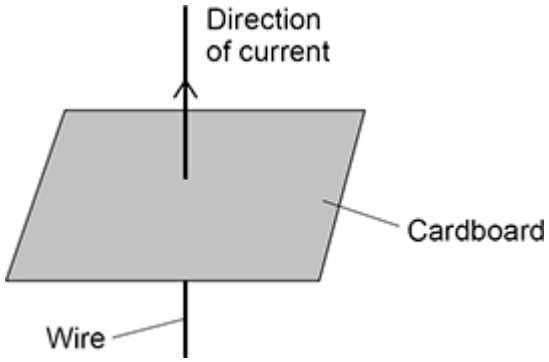
(1)

A teacher demonstrates how a current in a wire creates a magnetic field around the wire.

Figure 4 shows the wire passing through a piece of cardboard.

The current can be switched on and off.

Figure 4



(e) Describe how the teacher can use a plotting compass to demonstrate the magnetic effect of the current in the wire.

_____

_____

_____

_____

_____

_____

(2)

(f) The teacher decreases the current in the wire.

How does the strength of the magnetic field around the wire change?

Tick (✓) **one** box.

Decreases	☐
Stays the same	☐
Increases	☐

(1)

(g) The teacher reverses the direction of the current in the wire.

What happens to the magnetic field around the wire?

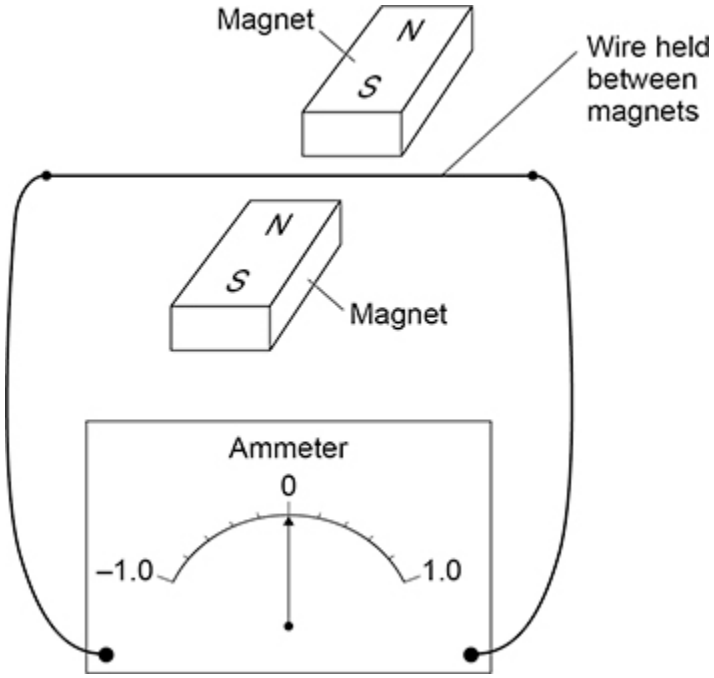
_____

(1)

(Total 9 marks)

5. **Figure 1** shows some apparatus used by a teacher in a demonstration.

Figure 1



The teacher moved the wire upwards between the magnets.

The needle on the ammeter deflected to a value of +0.4 mA and then returned to zero.

(a) What effect did this demonstrate?

_____

(1)

(b) Explain why a current was detected when the wire in **Figure 1** was moved upwards.

_____

_____

_____

_____

_____

_____

(3)

(c) The teacher reversed the direction of the magnetic field.

The teacher replaced the wire in its original position.

The teacher moved the wire upwards in the same way as before.

What was the deflection of the needle on the ammeter?

Tick (✓) **one** box.

The needle will deflect to –0.4 mA. ☐

The needle will not move. ☐

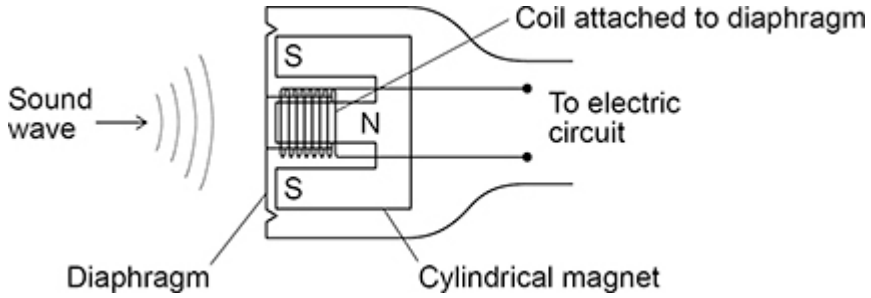
The needle will deflect to +0.4 mA. ☐

(1)

(d) **Figure 2** shows a sound wave incident on the diaphragm of a moving-coil microphone.

The inside of the microphone includes a small coil of wire and a magnet.

Figure 2



Explain why the sound waves have an effect on the electric circuit.

_____

_____

_____

_____

_____

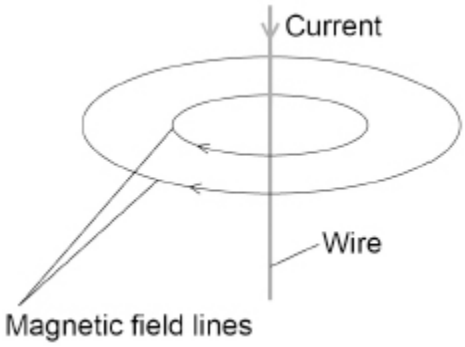
_____

(3)

(Total 8 marks)

6. **Figure 1** shows the magnetic field pattern produced when there is a current in a wire.

Figure 1



(a) What do the arrows on the magnetic field lines represent?

_____

_____

(1)

(b) How could the strength of the magnetic field be increased?

Tick (✓) **one** box.

Change the direction of the current in the wire ☐

Increase the current in the wire ☐

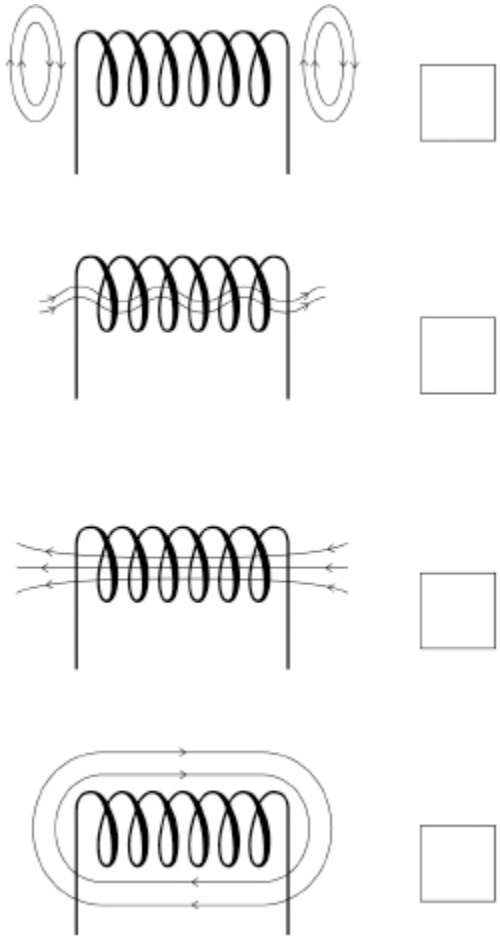
Increase the temperature of the wire ☐

(1)

(c) The wire is coiled to make a solenoid.

Which diagram in **Figure 2** shows the magnetic field pattern produced when there is a current in the solenoid?

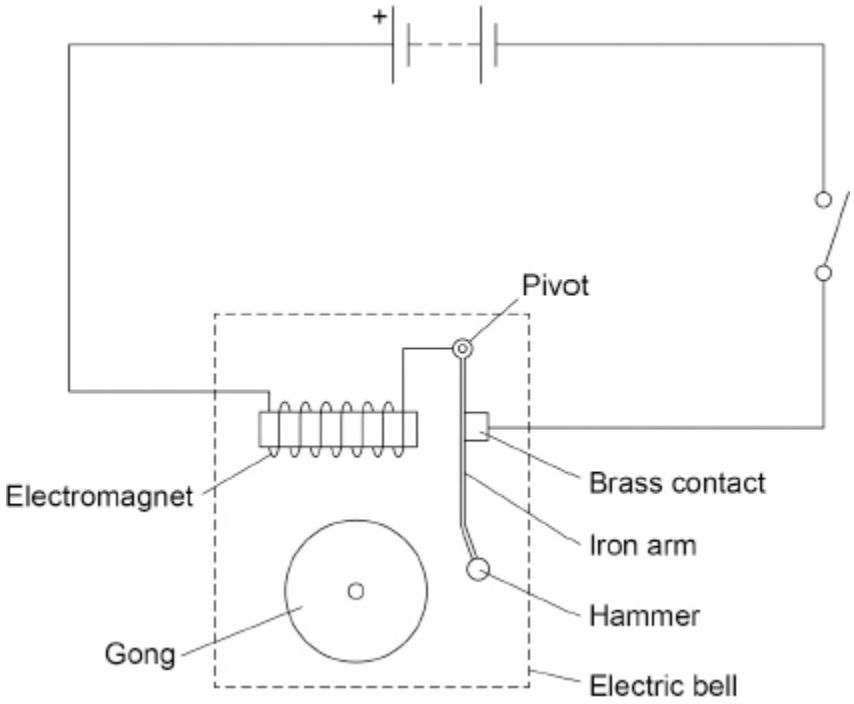
Figure 2



(1)

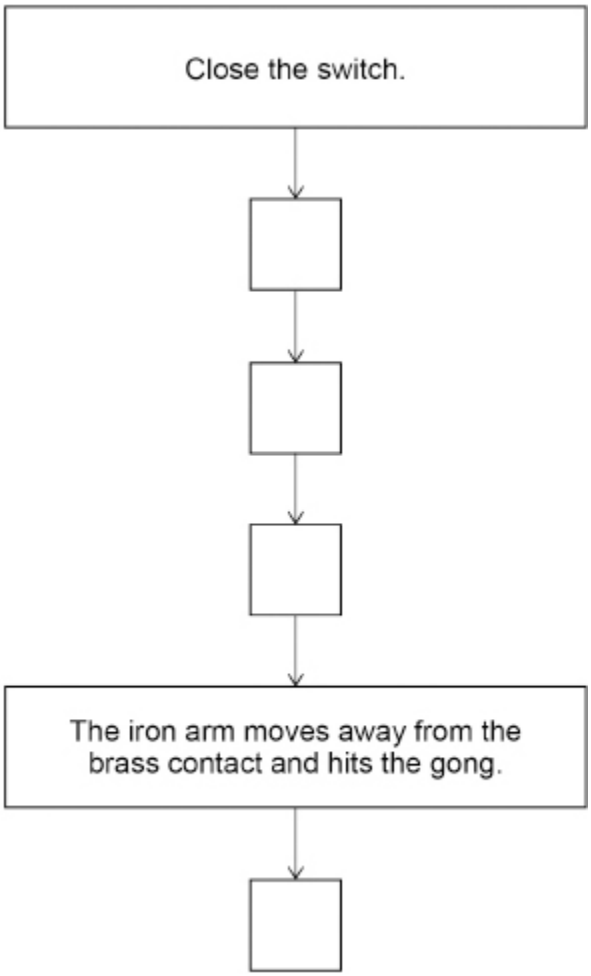
Figure 3 shows the parts of an electric bell.

Figure 3



(d) **Figure 4** shows an incomplete sequence of how the bell works.

Figure 4



Write **one** letter in each box to show the correct sequence.

Use each letter once.

A A magnetic field is created around the electromagnet.

B A resultant force acts on the iron arm causing it to move towards the electromagnet.

C The iron arm returns to its original position.

D There is a current in the circuit.

(2)

(e) Which of the following would increase the resultant force on the iron arm?

Tick (✓) **one** box.

Decrease the distance between the electromagnet and the iron arm ☐

Decrease the number of cells in the circuit ☐

Decrease the number of turns on the electromagnet ☐

(1)

(f) The iron arm of the bell vibrates with a frequency of 6.25 Hz.

Calculate the period of the iron arm.

Use the equation:

$$\text{period} = \frac{1}{\text{frequency}}$$

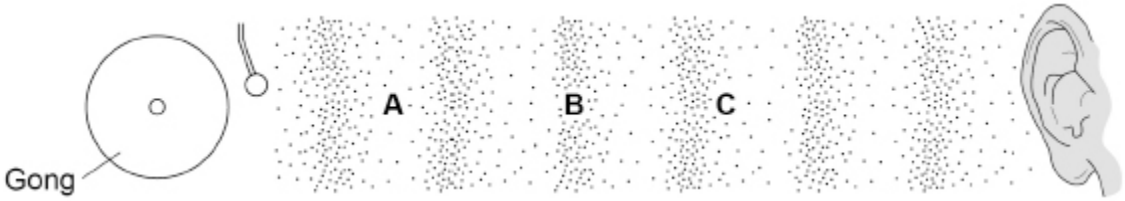
Period = _____ s

(2)

(g) The sound waves produced by the bell are longitudinal waves.

Figure 5 shows the position of the air particles at one point in time as the sound waves travel through the air.

Figure 5



Which letter represents an area of compression?

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐

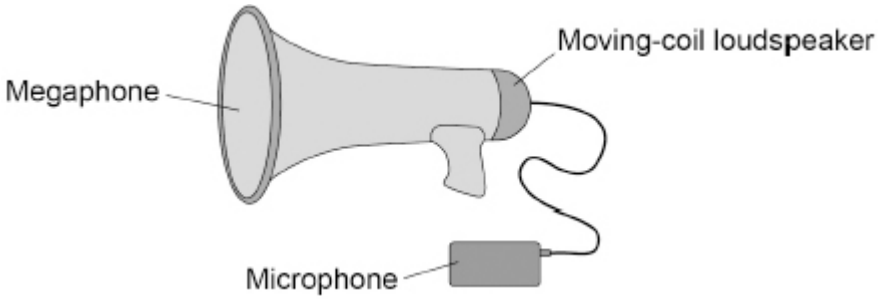
(1)

(Total 9 marks)

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

Figure 1 shows a megaphone and microphone.

Figure 1



(a) Complete the sentence.

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

(1)

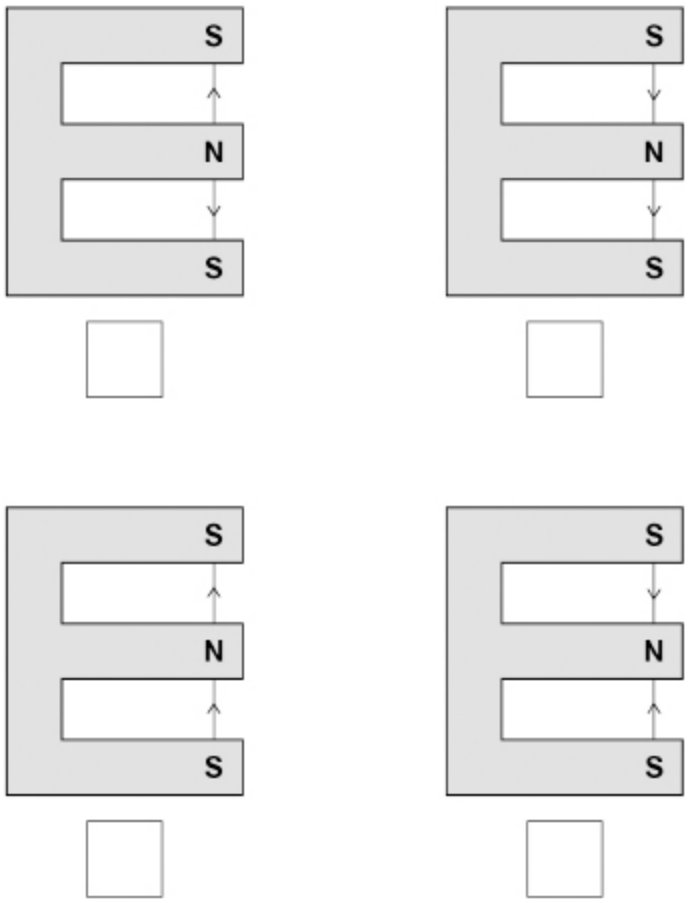
(b) The loudspeaker contains a permanent magnet.

Which diagram in **Figure 2** 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.

Tick (✓) **one** box.

Figure 2



(1)

(c) Some magnets are permanent magnets and some are induced magnets.

What is an induced magnet?

_____

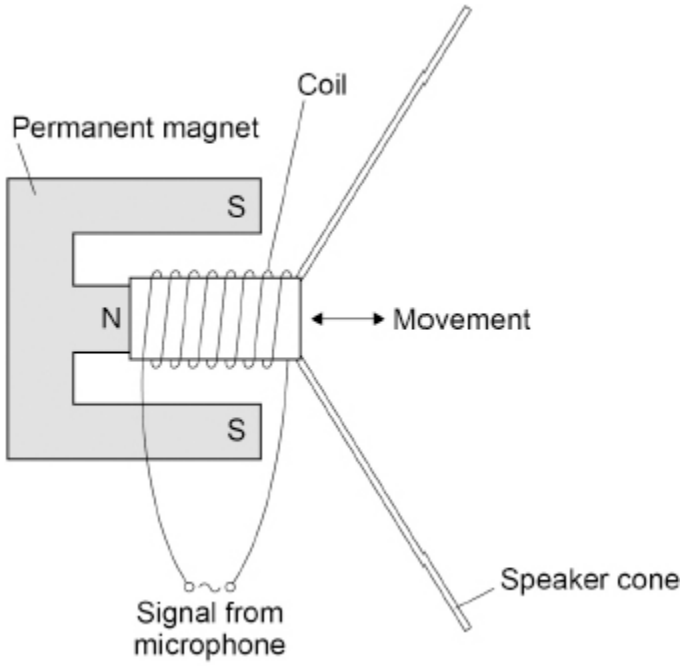
_____

_____

(1)

Figure 3 shows the parts of the loudspeaker in the megaphone.

Figure 3



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

(d) What is the name of the effect that causes the coil to move?

Tick (✓) **one** box.

Electromagnet effect ☐

Induction effect ☐

Motor effect ☐

Speaker effect ☐

(1)

(e) 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.

Magnetic flux density = _____ T

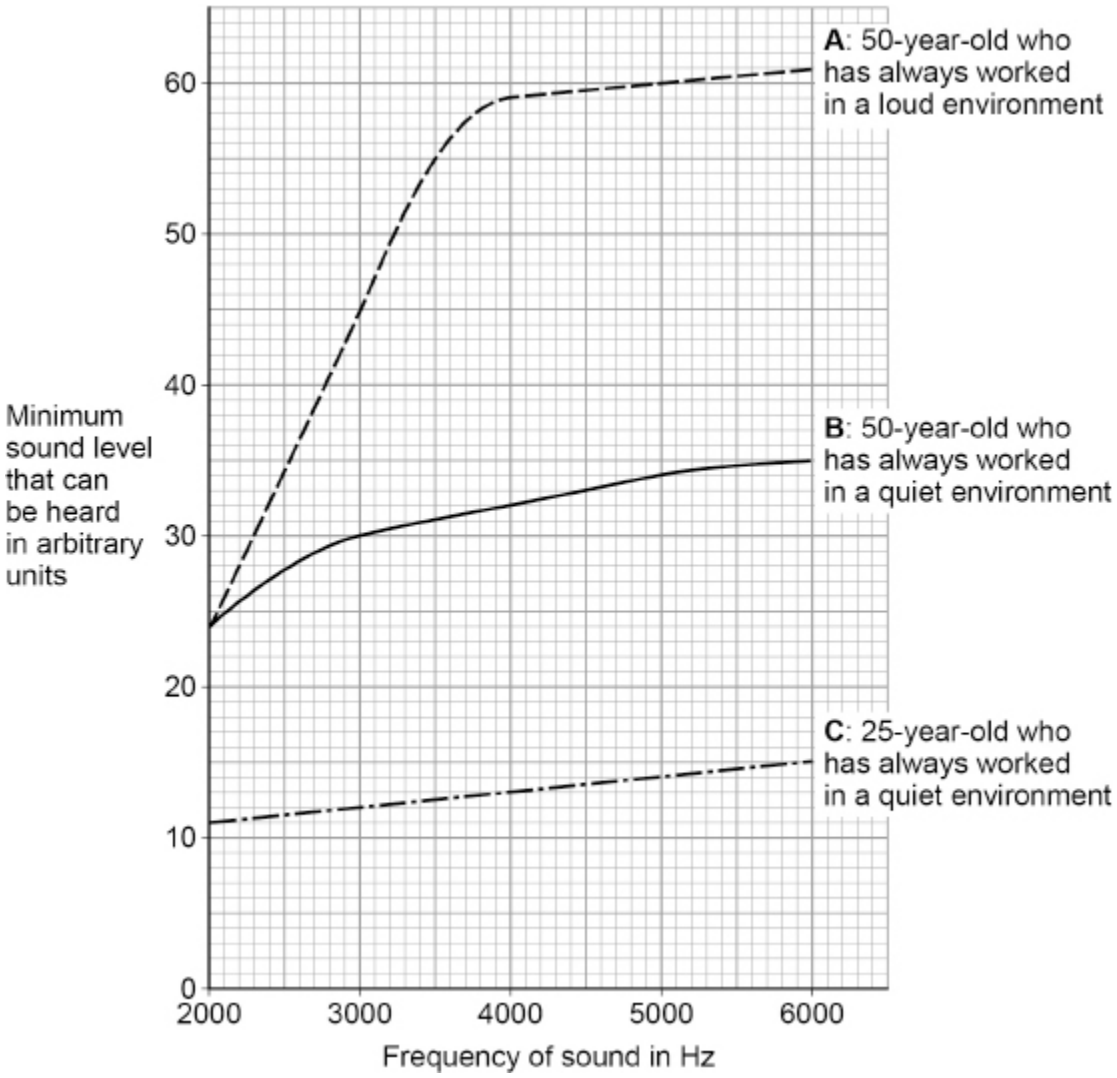
(4)

(f) Megaphones can produce very loud sounds.

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

Figure 4 shows how frequency affects the minimum sound level that can be heard by three different people, **A**, **B** and **C**.

Figure 4

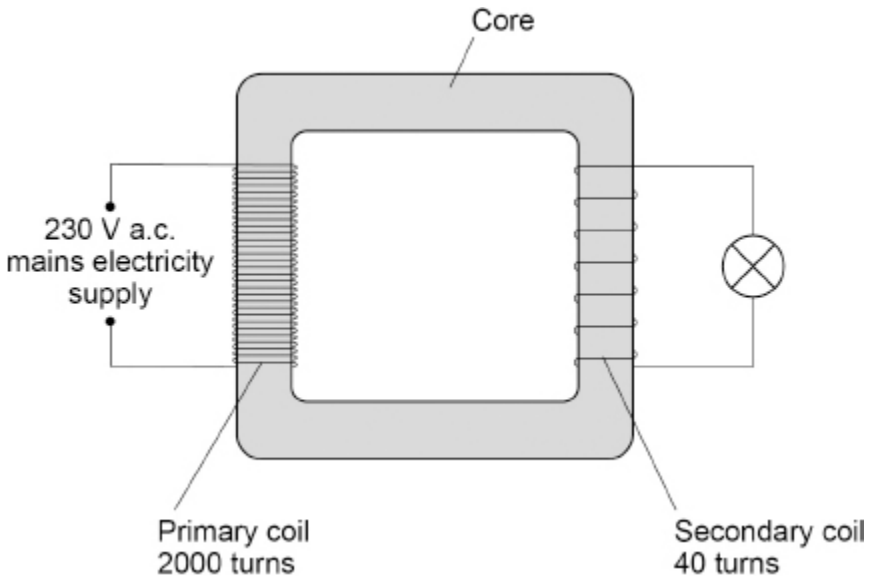


Compare how different factors affect the minimum sound level that these people can hear.

(4)

(Total 12 marks)

8. The figure below shows a transformer used to power a lamp using the mains electricity supply.



(a) What material is used to make the core of the transformer?

Give the reason for using this material.

Material _____

Reason _____

_____

(2)

(b) 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.

_____

_____

_____

_____

_____

_____

_____

_____

_____

Current in the secondary coil = _____ A

(5)

(Total 7 marks)

Mark schemes

1.

(a) cobalt

1

steel

1

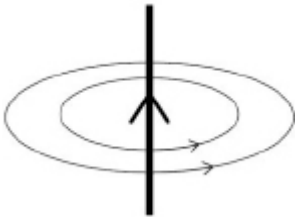
(b) induced magnets

1

(c) ←

1

(d)



1

increase the current

1

shape the wire into a solenoid

1

[7]

2.

(a) B

1

(b) $F = 0.30 \times 2.0 \times 0.070$

1

$F = 0.042$ (N)

the equation $F = BIl$ must have been used to score subsequent marks

1

$0.042 = 0.005 \times a$

subsequent marks may be awarded if an incorrectly / not converted mass is used

1

$$a = \frac{0.042}{0.005}$$

1

$a = 8.4$ (m/s^2)

1

(c) (the interaction of) the magnetic fields produce forces on the sides of the coil (AB and CD)

*do **not** accept answers describing a generator*

1

AB and CD move in opposite directions

1

(each half-revolution) the ends of the coil swap from one contact to the other

allow 'split ring commutator' for ends of the coil'

1

(so) current in each side of the coil is reversed, so the forces on each side of the coil are reversed

1

(d) there is no current in the wire

1

(so) there is no (magnetic) force acting (therefore there is no moment)

MP2 is dependent on MP1

1

[12]

3.

(a) iron is easily magnetised (and demagnetised)

ignore magnetic unqualified

allow it is magnetically soft

*do **not** accept iron is a conductor*

1

(b) V_s = 400 000 V

subsequent marks may be awarded if an incorrectly / not converted Vs is used

1

$$\frac{V_p}{400\,000} = \frac{345}{6000}$$

1

$V_p = 0.0575 \times 400\,000$

1

23 000 (V)

1

(c) (the ac in the primary) causes a changing magnetic field in the core

1

the secondary coil cuts through the (changing) magnetic field

1

inducing a pd (across the ends of the secondary coil)

or

so a pd is induced (across the ends of the secondary coil)

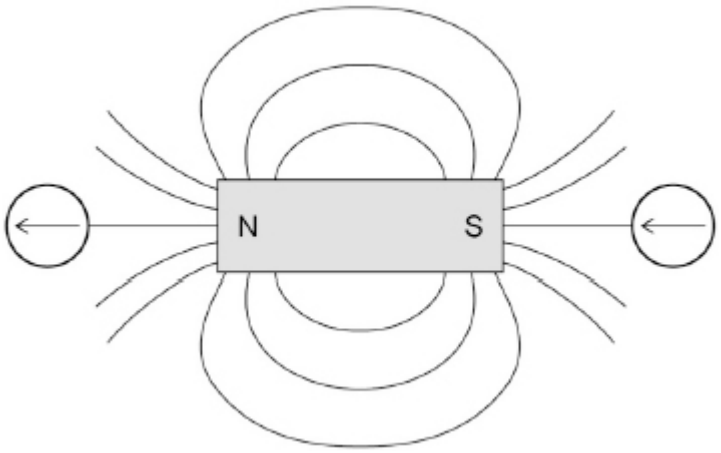
1

[8]

4. (a) cobalt

1

(b)



2 arrows pointing left

allow 1 mark for 1 correct arrow

2

(c) A

1

(d) S-S

1

(e) switching the current on / off

1

causes the compass needle to move

OR

moving the compass (around the wire) (1)

changes the direction of the compass needle (1)

MP2 dependent on MP1

1

(f) decreases

1

(g) it reverses (direction)

allow it changes direction

allow it goes clockwise

1

[9]

5. (a) generator (effect)

allow electromagnetic induction

1

(b) wire cuts through the magnetic field (between the magnets)

1

a potential difference was induced (across the wire)

1

as it was part of complete circuit (there was a current in the circuit)

1

(c) the needle will deflect to –0.4 mA

1

(d) (the pressure variations in) the sound (waves) cause the diaphragm to vibrate

allow air particles collide with diaphragm causing it to vibrate

diaphragm moves is insufficient

do not accept moves the diaphragm up and down

1

the diaphragm causes the coil / wire to vibrate

do not accept moves the coil / wire up and down

1

(the coil repeatedly changes direction) inducing an alternating current (in the circuit)

*if MP1 and MP2 do not score, allow sound (waves) cause the coil / wire to vibrate for **1** mark*

1

[8]

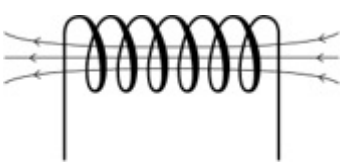
6. (a) direction (of the magnetic field)

1

(b) increase the current in the wire

1

(c)



1

(d) **D A B C**

*allow **1** mark for D B A C*

2

(e) decrease the distance between the electromagnet and the iron arm

1

(f) $\text{period} = \frac{1}{6.25}$

1

period = 0.16 (s)

1

(g) **B**

1

[9]

7. (a) current

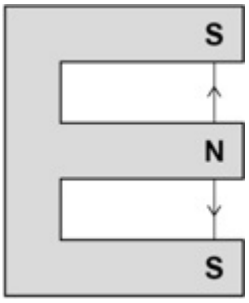
allow charge flow

or

potential difference

1

(b)



1

(c) an induced magnet is a material that becomes a magnet when it is placed in a magnetic field

allow 'when close to another magnet' for 'when it is placed in a magnetic field'

or

an induced magnet loses most / all of its magnetism (quickly) when removed from a magnetic field

allow 'no magnets are nearby' for 'removed from a magnetic field'

'temporary magnet' alone is insufficient

1

(d) motor effect

1

(e) 16 mA = 0.016 A

allow 1.6 × 10^{-2} (A)

1

0.013 = *B* × 0.016 × 6.5

allow correct substitution using incorrectly / not converted current

1

$$B = \frac{0.013}{0.016 \times 6.5}$$

allow correct re-arrangement using incorrectly / not converted current

1

B = 0.125 (T)

allow correct calculation using incorrectly / not converted current

allow 0.13 (T)

1

(f) **Level 2**: Scientifically relevant features are identified; the way(s) in which they are similar / different is made clear and (where appropriate) the magnitude of the similarity / difference is noted.

3-4

Level 1: Relevant features are identified and differences noted.

1-2

No relevant content

0

Indicative content:

- for all three people, the minimum sound level that can be heard increases as frequency increases

Age

- the minimum sound level that can be heard increases with age
- between 2000 and 3000 Hz the minimum sound level that can be heard increases more in **B** compared to **C**
- **C** has very little variation in the minimum sound level that can be heard at all frequencies

Working in a loud environment:

- increases the minimum sound level that can be heard at all frequencies above 2000 Hz compared to working in a quiet environment
- the minimum sound level that can be heard increases more as frequency increases from 2000 to 4000 Hz compared to working in a quiet environment
- doesn't affect the minimum sound level that can be heard at 2000 Hz

to access **level 2** the answer must include at least **one** comparison for age **and one** comparison for working in a loud environment, using supporting data/information from the graph

[12]

8. (a) iron

allow nickel / cobalt

do not allow steel

1

it is easily magnetised (and demagnetised)

allow it is a magnetic material

1

MP 2 is dependent on MP 1

(b) $\frac{230}{V_s} = \frac{2000}{40}$

1

$V_s = \frac{40}{2000} \times 230$

subsequent marks can only be awarded if the first equation is correct and has been used

1

$V_s = 4.6$ (V)

1

$V_s = 4.6 \times I_s = 6.9$

this mark may be awarded if the pd is incorrectly calculated

1

$I_s = 1.5$ A

allow a correctly calculated I_s using an incorrectly calculated pd

1

OR

$6.9 = I_p \times 230$ (1)

$I_p = \frac{6.9}{230}$ (1)

subsequent marks can only be awarded if the first equation is correct and has been used

$I_p = 0.03$ (A) (1)

$$I_s = 0.03 \times \frac{2000}{40} \quad (1)$$

this mark may be awarded if I_p is incorrectly calculated

$I_s = 1.5$ (A) (1)

allow a correctly calculated I_s using an incorrectly calculated I_p

1

[7]