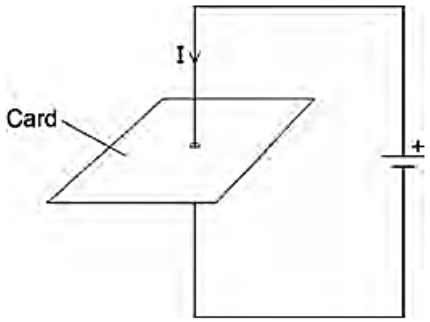
Electromagnetic induction GCSE AQA Higher Physics Past Papers Questions

01.

Figure 10 shows a straight wire passing through a piece of card.

A current (I) is passing down through the wire.

Figure 10



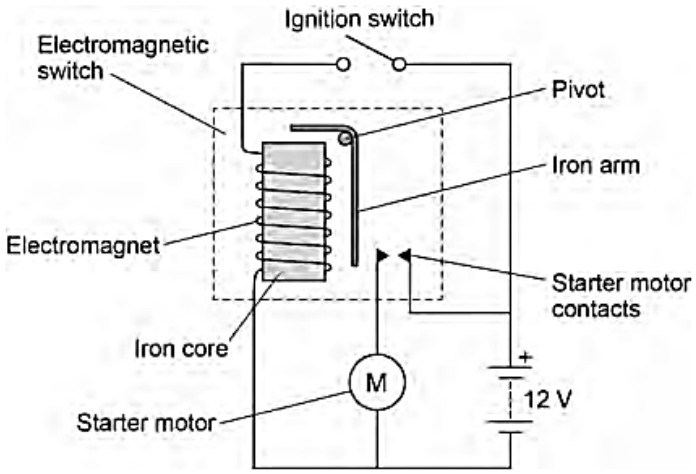
. 1 Describe how you could show that a magnetic field has been produced around the wire.

[2 marks]

2 **Figure 11** shows the ignition circuit used to switch the starter motor in a car on.

The circuit includes an electromagnetic switch.

Figure 11



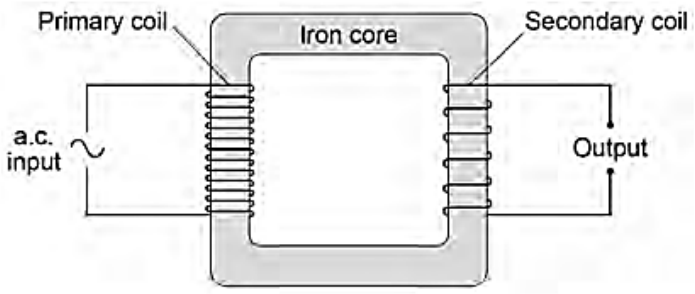
Explain how the ignition circuit works.

[4 marks]

02.

Figure 12 shows the construction of a simple transformer.

Figure 12



. 1 Why is iron a suitable material for the core of a transformer?

[1 mark]

Tick **one** box.

It is a metal. ☐

It will not get hot. ☐

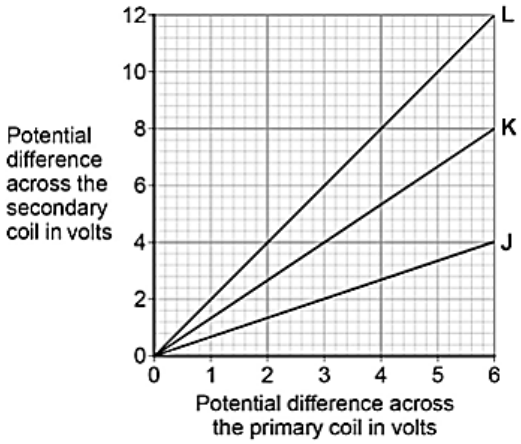
It is easily magnetised. ☐

It is an electrical conductor. ☐

A student makes three simple transformers, **J**, **K** and **L**.

Figure 13 shows how the potential difference across the secondary coil of each transformer varies as the potential difference across the primary coil of each transformer is changed.

Figure 13



2 How can you tell that transformer **J** is a step-down transformer?

[1 mark]

3 Each of the transformers has 50 turns on the primary coil.

Calculate the number of turns on the secondary coil of transformer **L**.

Use the correct equation from the Physics Equations Sheet.

[3 marks]

Number of turns on the secondary coil = _____

03. Waves may be either longitudinal or transverse.

. 1 Describe the difference between a longitudinal and a transverse wave.

[2 marks]

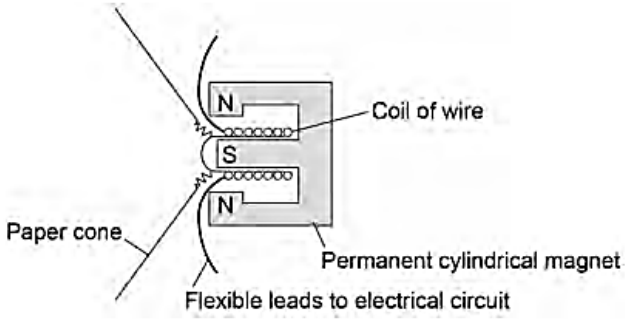
2 Describe **one** piece of evidence that shows when a sound wave travels through the air it is the wave and not the air itself that travels.

[1 mark]

3 **Figure 19** shows the parts of a moving-coil loudspeaker.

A coil of wire is positioned in the gap between the north and south poles of the cylindrical magnet.

Figure 19



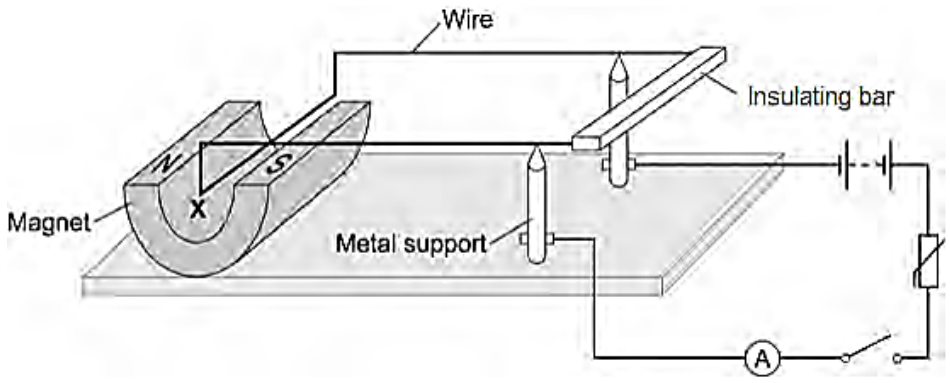
Explain how the loudspeaker converts current in an electrical circuit to a sound wave.

[6 marks]

04.

Figure 20 shows a piece of apparatus called a current balance.

Figure 20



When the switch is closed, the part of the wire labelled **X** experiences a force and moves downwards.

1 What is the name of the effect that causes the wire **X** to move downwards?

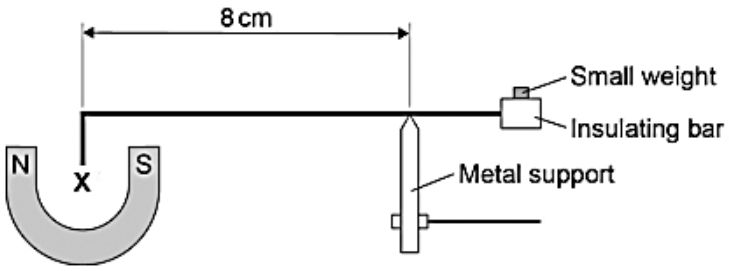
[1 mark]

2 Suggest one change you could make to the apparatus in **Figure 20** that would increase the size of the force that wire **X** experiences.

[1 mark]

Figure 21 shows how a small weight placed on the insulating bar makes the wire **X** go back and balance in its original position.

Figure 21



3 The wire **X** is 5 cm long and carries a current of 1.5 A.

The small weight causes a clockwise moment of 4.8×10^{-4} Nm.

Calculate the magnetic flux density where the wire **X** is positioned

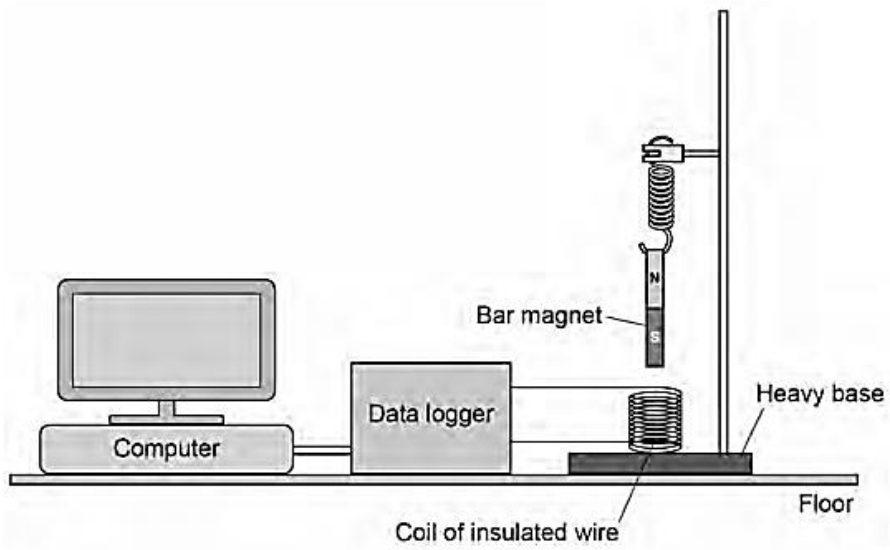
Give the unit.

[6 marks]

Magnetic flux density = _____ Unit _____

05. **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.

Why does the movement of the bar magnet induce a potential difference across the coil?

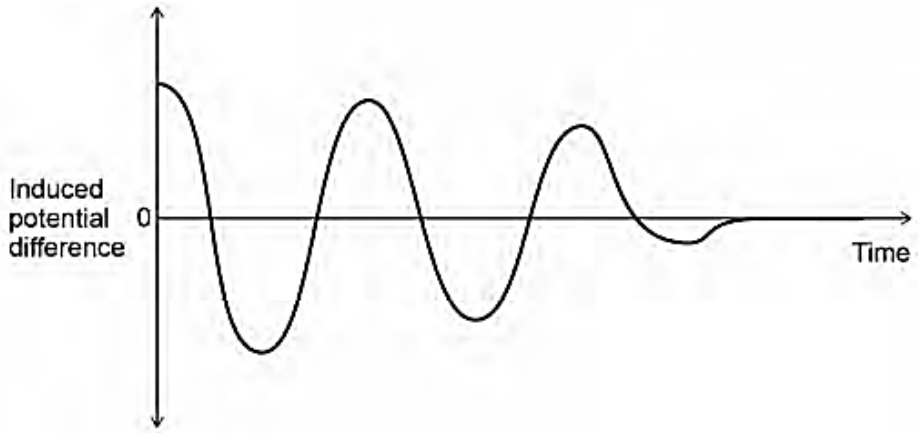
[1 mark]

Why is the induced potential difference across the coil alternating?

[1 mark]

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. ☐

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 _____

_____

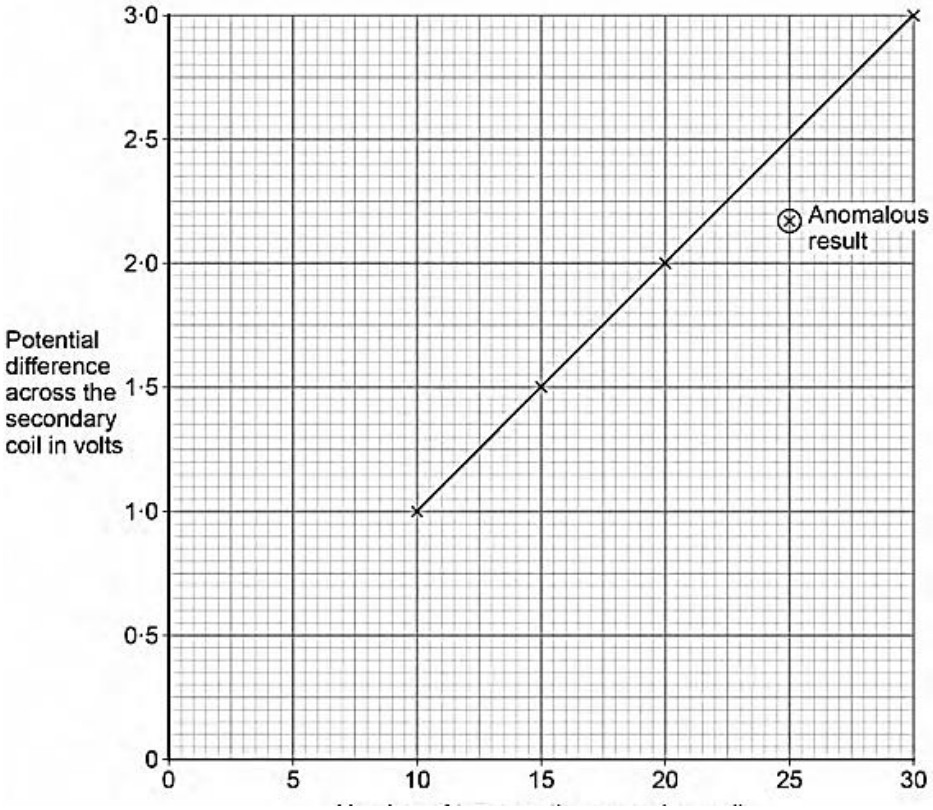
13

06. A student used a simple transformer to investigate how the number of turns on the secondary coil affects the potential difference (p.d.) across the secondary coil.

The student kept the p.d. across the primary coil fixed at 2V.

Figure 12 shows the results collected by the student.

Figure 12



. 1 **Figure 12** contains one anomalous result.

Suggest **one** possible reason why this anomalous result occurred.

[1 mark]

. 2 The transformer changes from being a step-down to a step-up transformer.

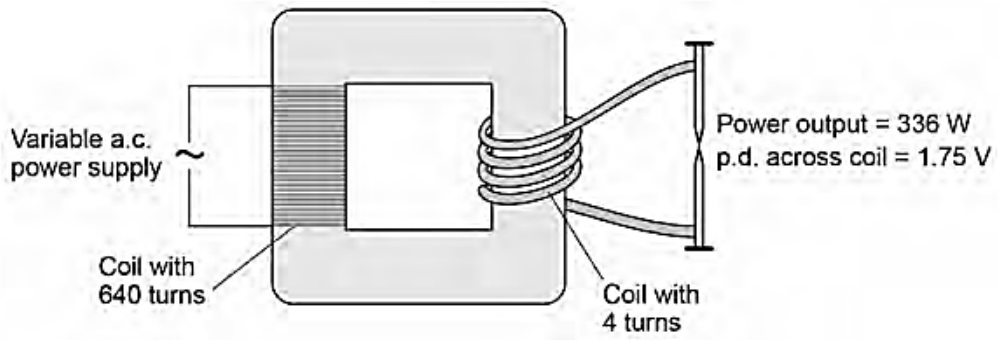
How can you tell from **Figure 12** that this happens?

[1 mark]

A spot-welder is a device that uses a transformer to produce a large current to join sheets of metal together.

Figure 13 shows a transformer demonstrating how a large current can heat and join two nails together.

Figure 13



. 3 How does the amount of infrared radiation emitted by the nails change when the power supply is switched on?

[1 mark]

. 4 Calculate the current from the power supply needed to provide a power output of 336 W.

Use the data in **Figure 13**.

The transformer is 100% efficient.

[5 marks]

Current = _____ A

8

07.

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

[2 marks]

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 ☐

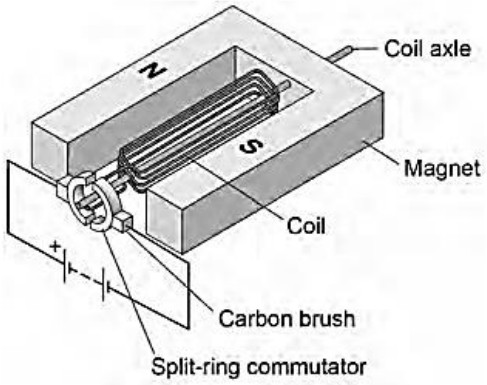
4×10^{-3} T ☐

4×10^{-6} T ☐

4×10^{-9} T ☐

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 mark

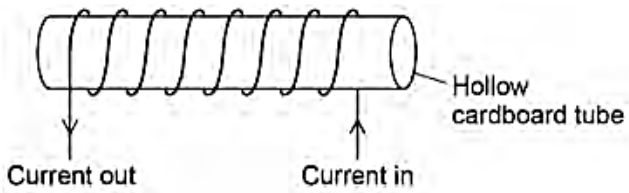
08. _____

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

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

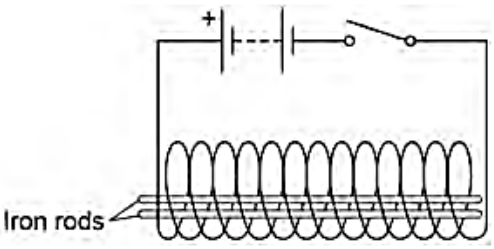
[2 marks]

Figure 5



. 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]

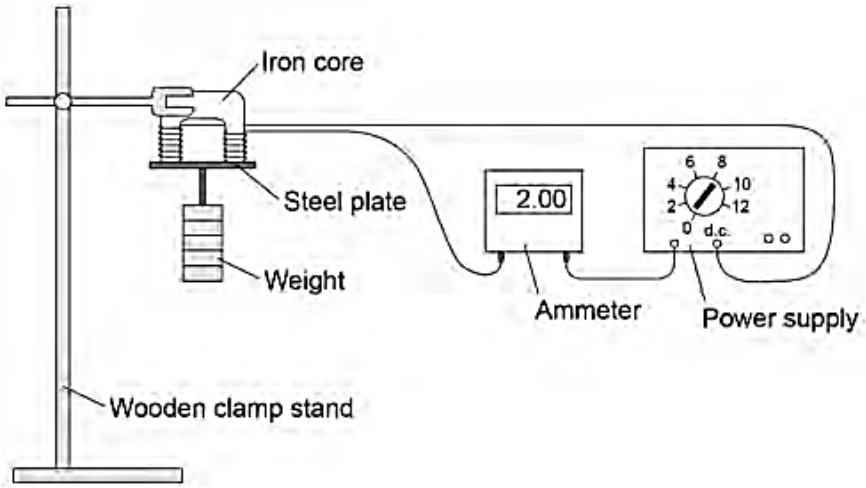
_____

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.

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

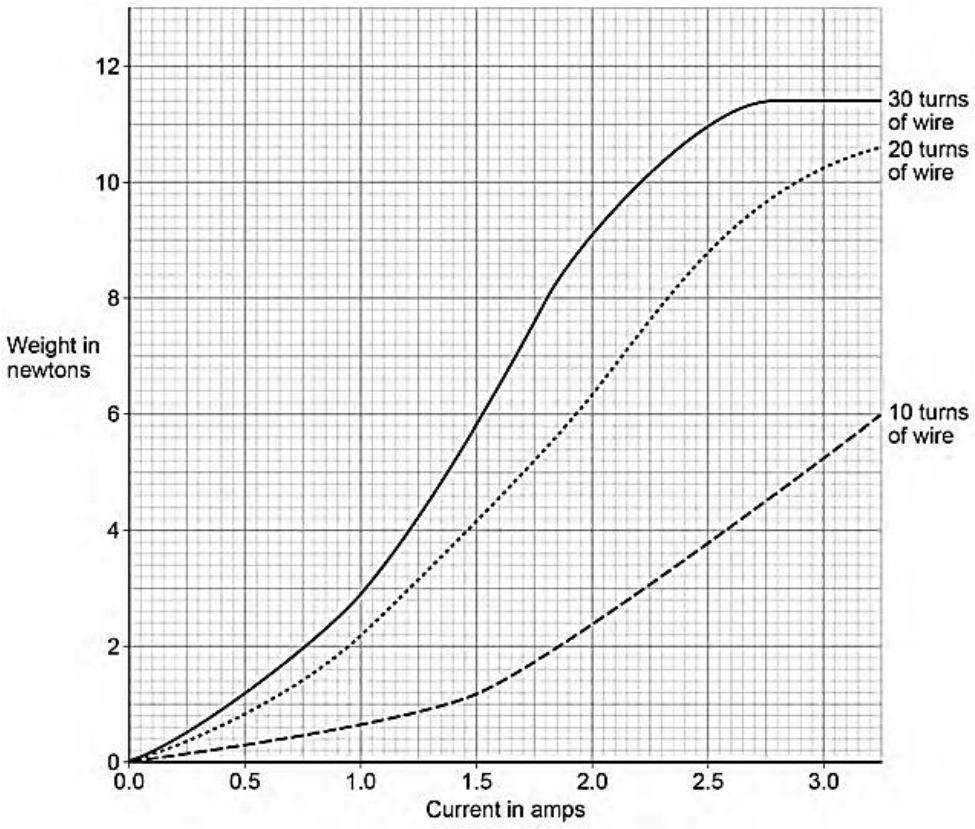
Explain why the method used by the student is **not** valid for this investigation.

[2 marks]

A second student repeated the investigation using the same equipment.

Figure 8 shows the second student's results.

Figure 8



. **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]

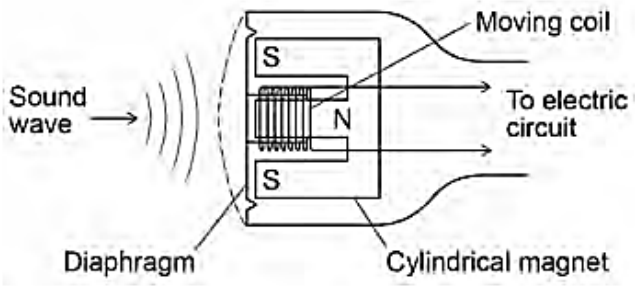
. 5 How does increasing the number of turns of wire from 10 to 20 affect the strength of the electromagnet, compared to increasing the number of turns of wire from 20 to 30?

[1 mark]

09.

Figure 18 shows the parts of a moving-coil microphone.

Figure 18



4 What is the function of a microphone?

[1 mark]

10.

Explain how a moving-coil microphone works.

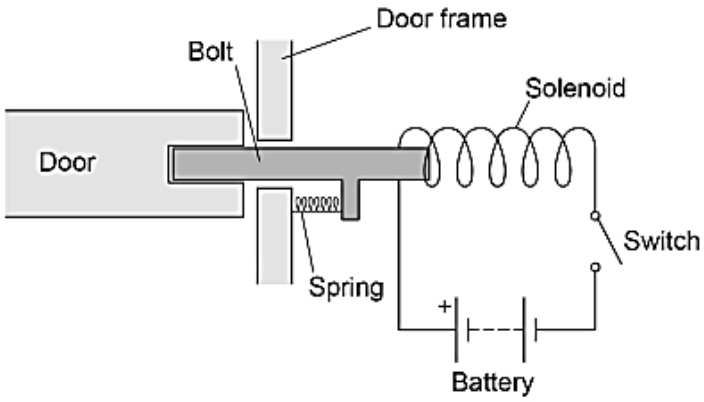
[4 marks]

11

11.

Figure 6 shows a diagram of the lock. The door unlocks when the switch is closed.

Figure 6



Which material should the bolt be made from?

[1 mark]

Tick (✓) **one** box.

Aluminium ☐

Brass ☐

Copper ☐

Iron ☐

12.

Explain why the door unlocks when the switch is closed.

[3 marks]

13.

When the door unlocks, a force of 2.88 N is applied to the spring.

The spring extends by 1.50 cm.

Calculate the spring constant of the spring.

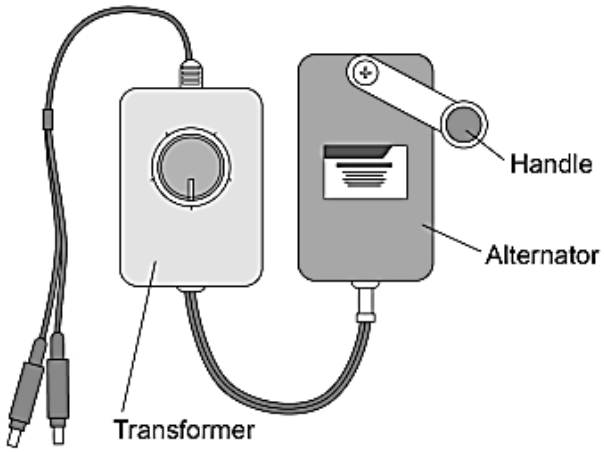
[4 marks]

Spring constant = _____ N/m

14.

Figure 10 shows a portable power supply.

Figure 10



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]

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.

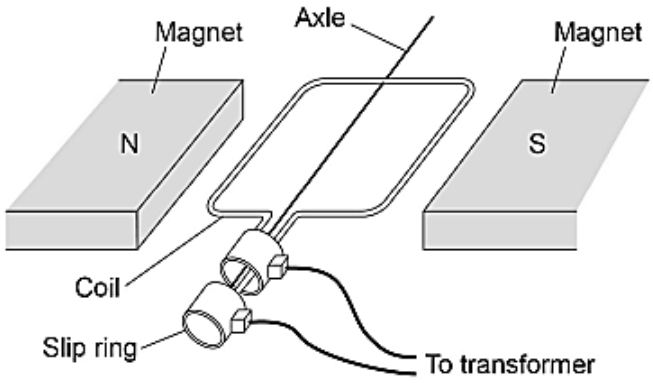
Calculate the number of turns needed on the secondary coil.

[3 marks]

Number of turns on the secondary coil = _____

Figure 11 shows the inside parts of the alternator.

Figure 11



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 Suggest the purpose of the slip rings.

[1 mark]

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

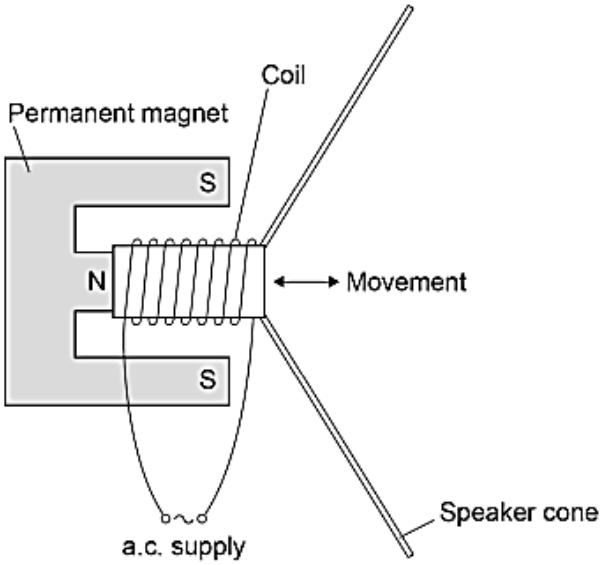
Explain why the handle of the alternator becomes much easier to turn.

[3 marks]

15. A student made a moving-coil loudspeaker.

Figure 15 shows a diagram of the loudspeaker.

Figure 15



1 What is the name of the effect used by the moving-coil loudspeaker to produce sound waves?

[1 mark]

_____

2 Explain how a moving-coil loudspeaker produces a sound wave.

[4 marks]

3 A student investigated how the loudness of sound from the loudspeaker depends on:

- the number of turns on the coil
- the frequency of the supply.

Table 2 shows the results.

Table 2

Number of turns	Frequency of supply in Hz	Loudness of sound in arbitrary units
100	200	32
200	400	47
300	600	63

Explain why the results **cannot** be used to make a valid conclusion.

[2 marks]

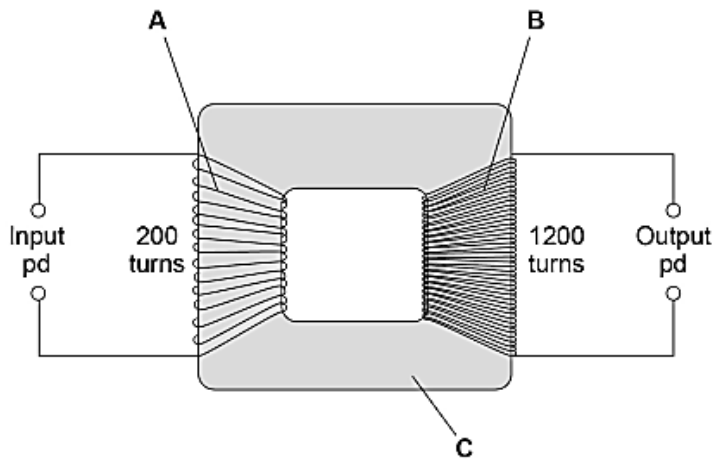
7

16.

The National Grid uses transformers to change potential difference (pd).

Figure 12 shows a transformer.

Figure 12



. 1 Identify the parts of the transformer labelled in **Figure 12**.

[2 marks]

A _____

B _____

C _____

. 2 There is an alternating input pd of 230 V.

Determine the output pd.

Use the Physics Equations Sheet.

[3 marks]

_____

_____

_____

_____

_____

Output pd = _____ V

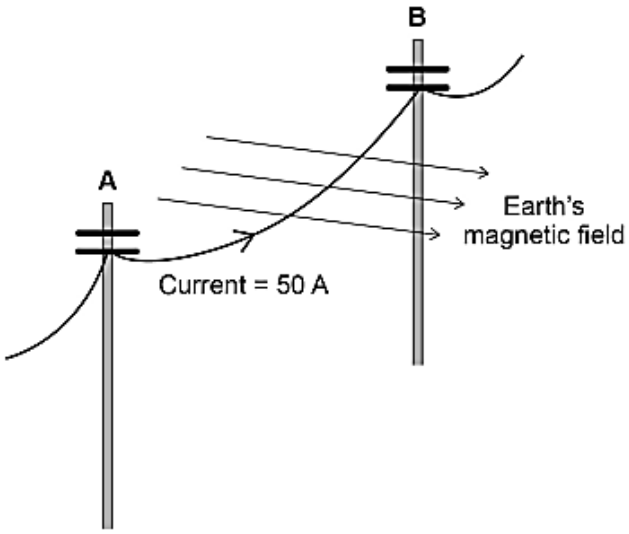
. 3 The input pd causes an alternating current.

Explain why there is an alternating current in the output when the transformer is connected to a circuit.

[3 marks]

Figure 13 shows a large cable supported by two wooden poles. The cable is connected to an electricity supply.

Figure 13



4 There is a force on the cable due to the Earth's magnetic field when the current is in the direction **A** to **B**.

What is the direction of this force?

[1 mark]

Tick (✓) **one** box.

Down ☐

Left ☐

Right ☐

Up ☐

5 The cable experiences a force of 0.045 N due to the Earth's magnetic field.

magnetic flux density = 60 μT

current = 50 A

Calculate the length of the cable between **A** and **B**.

Use the Physics Equations Sheet.

[4 marks]

Length = _____ m

. 6 State **one** assumption you made in your calculation.

[1 mark]

14

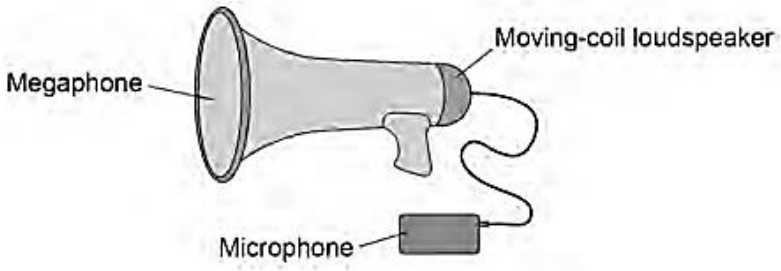
Turn over for the next question

17.

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

Figure 10 shows a megaphone and microphone.

Figure 10



1 Complete the sentence.

[1 mark]

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

2 The loudspeaker contains a permanent magnet.

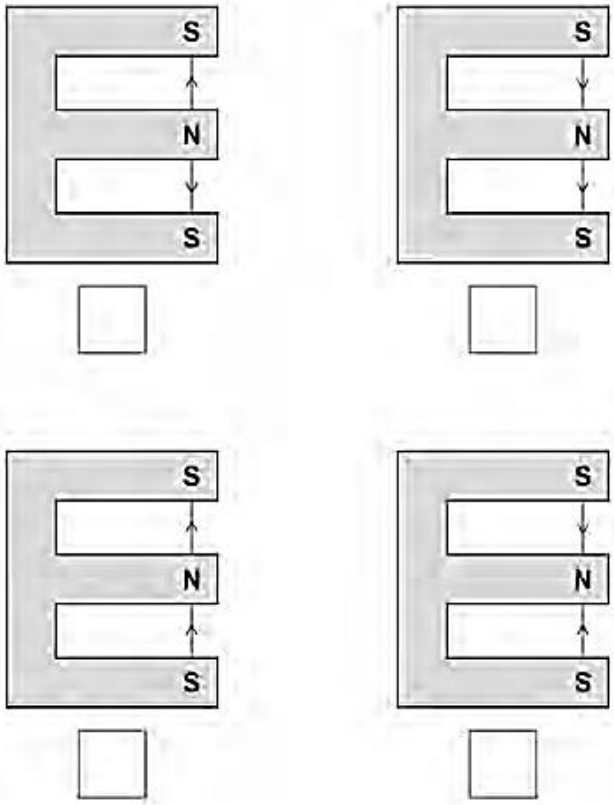
Which diagram in **Figure 11** shows the direction of the magnetic field between the north pole and the south pole of the magnet?

The magnets are shown in cross-section.

[1 mark]

Tick (✓) **one** box.

Figure 11



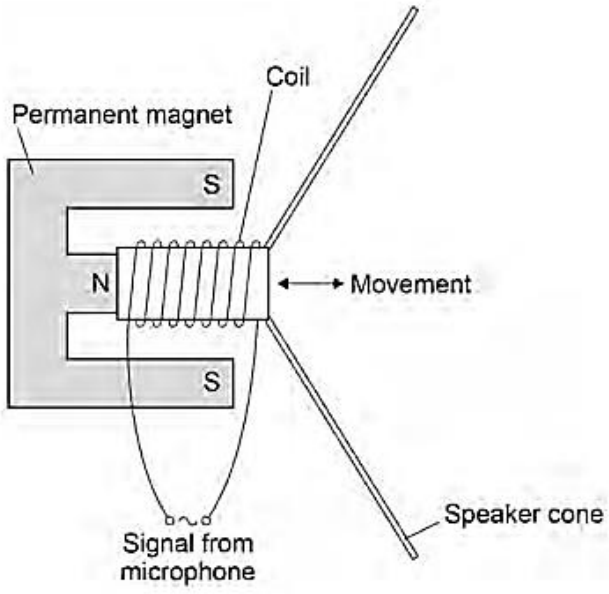
3 Some magnets are permanent magnets and some are induced magnets.

What is an induced magnet?

[1 mark]

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

Figure 12



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 ☐

. 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]

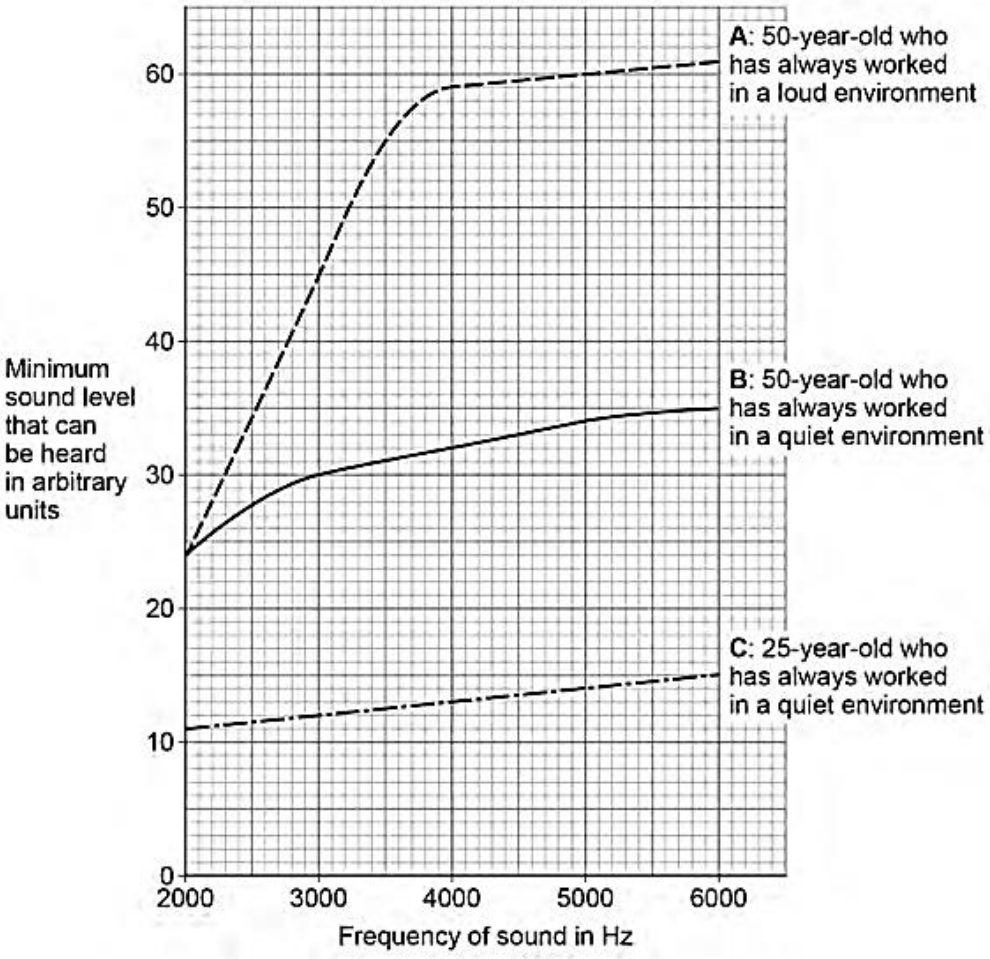
Magnetic flux density = _____ T

. 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

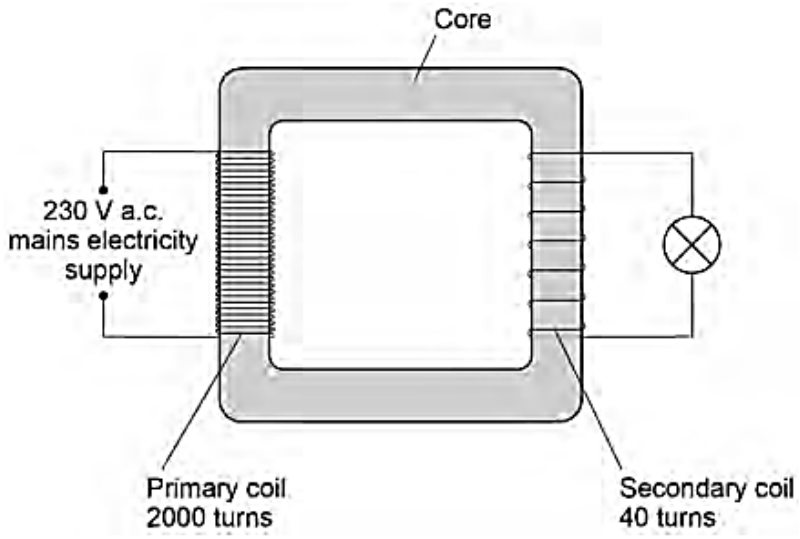


Compare how different factors affect the minimum sound level that these people can hear.

[4 marks]

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

Figure 21



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

Give the reason for using this material.

[2 marks]

Material _____

Reason _____

_____

. 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.

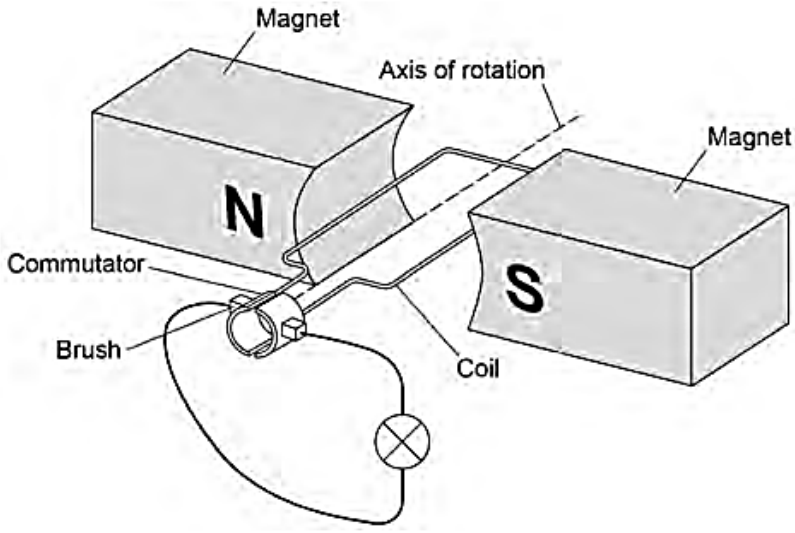
[5 marks]

Current in the secondary coil = _____ A

19. A dynamo is used to generate an electric current.

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

Figure 22



. 1 The coil is rotated.

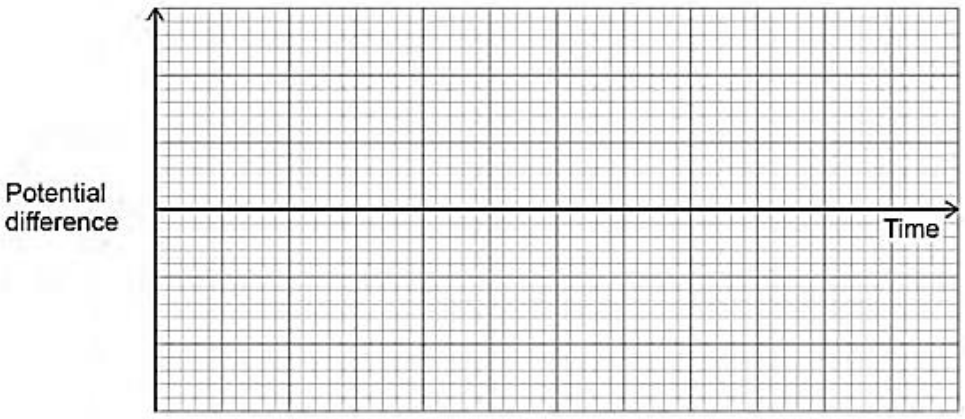
Explain why a direct current is induced in the coil.

[5 marks]

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



3 The lamp is disconnected from the dynamo.

Explain why the dynamo becomes much easier to turn.

[3 marks]

9