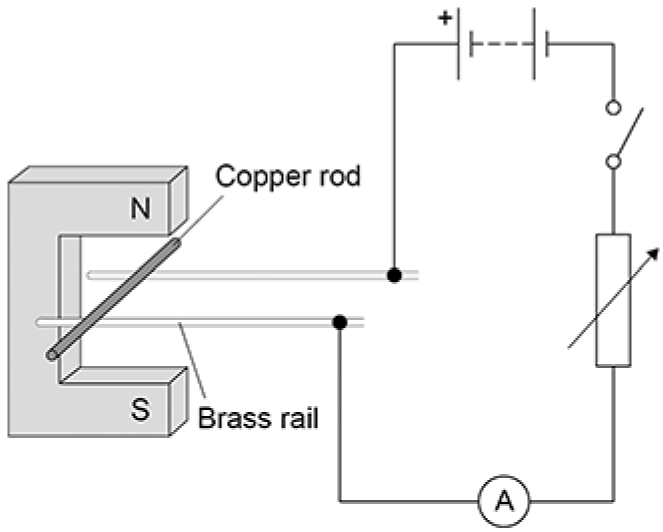
1. A teacher demonstrated how a magnetic field can cause a copper rod to accelerate.

The teacher placed the copper rod on two brass rails in a magnetic field.

The copper rod was able to move.

The figure below shows the equipment used.



(a) The teacher closes the switch and the copper rod accelerates.

Explain how Fleming's left hand rule can be used to predict the direction in which the copper rod will move.

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(5)

(b) Suggest **two** changes to the equipment that would increase the force on the copper rod.

1 ____

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2 ____

____

(2)

(c) The teacher closed the switch and the copper rod accelerated uniformly from rest for 0.15 s.

The current in the copper rod was 1.7 A.

mass of copper rod = 4.0 g

length of copper rod in the magnetic field = 0.050 m

magnetic flux density = 0.30 T

Calculate the maximum possible velocity of the copper rod when it left the magnetic field.

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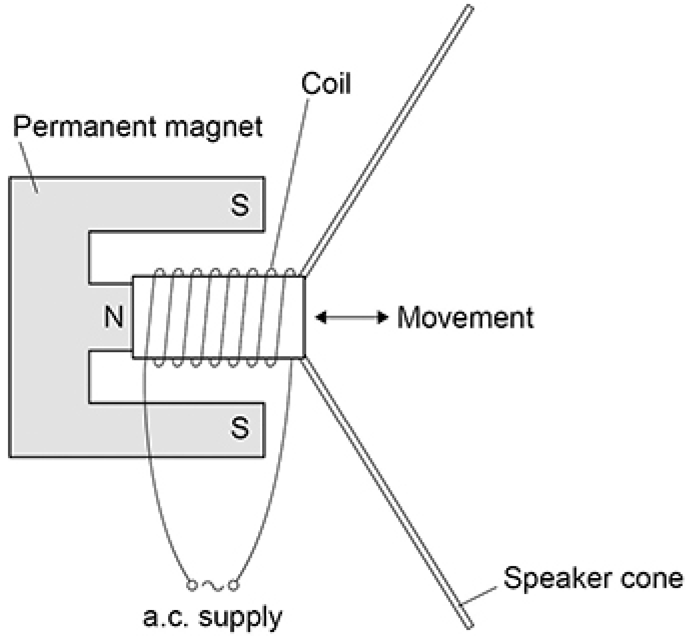
Maximum velocity = ________________ m/s

(6)

(Total 13 marks)

2. A student made a moving-coil loudspeaker.

The figure below shows a diagram of the loudspeaker.



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

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(1)

(b) Explain how a moving-coil loudspeaker produces a sound wave.

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(4)

(c) 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.

The table below shows the results.

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.

____

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____

(2)
(Total 7 marks)

3. A door is fitted with a security lens and a lock.

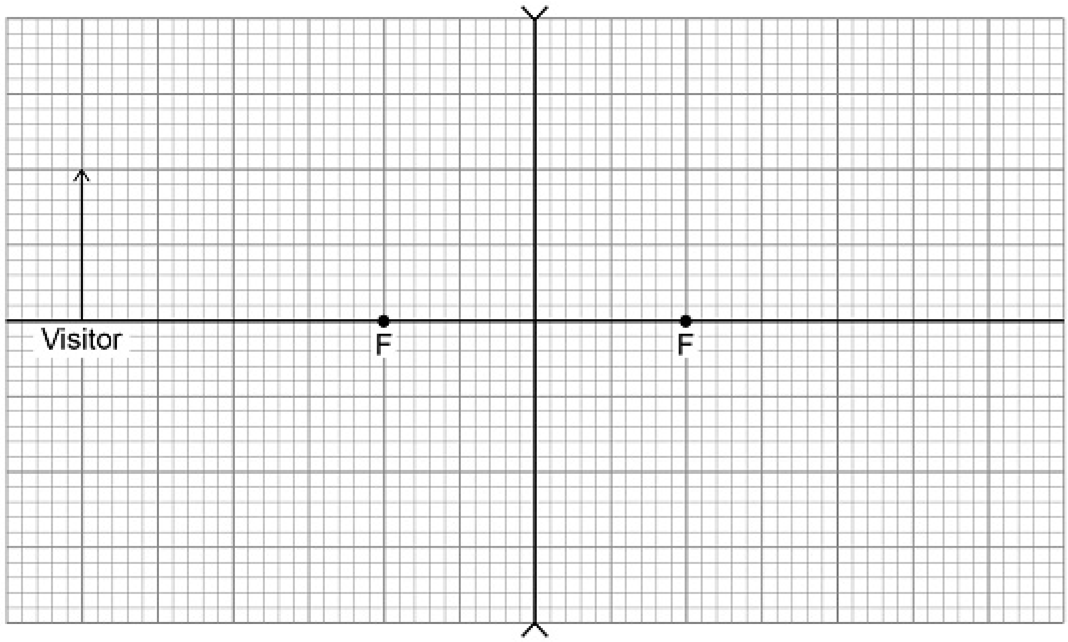
The security lens allows a person to see a visitor before opening the door.

The security lens is concave.

(a) The diagram below is an incomplete ray diagram representing a visitor standing near the security lens.

Complete the diagram to show how an image of the visitor is formed by the concave lens.

Draw an arrow to represent the image.



(3)

(b) The visitor moves further away from the security lens in the door.

How does the size of the image change?

Tick (✓) **one** box.

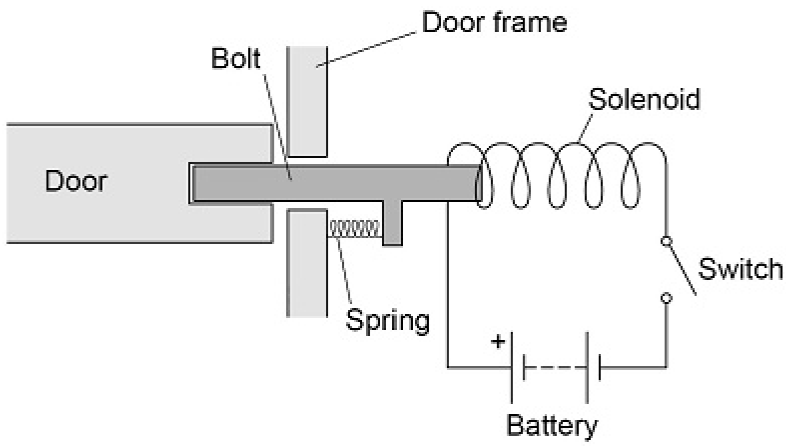
Decreases ☐

Increases ☐

Stays the same ☐

(1)

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



(c) Which material should the bolt be made from?

Tick (✓) **one** box.

Aluminium ☐

Brass ☐

Copper ☐

Iron ☐

(1)

(d) Explain why the door unlocks when the switch is closed.

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(3)

(e) 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.

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Spring constant = ________________ N/m

(4)

(f) Give **two** ways the resultant force on the bolt could be increased.

1 ___

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2 ___

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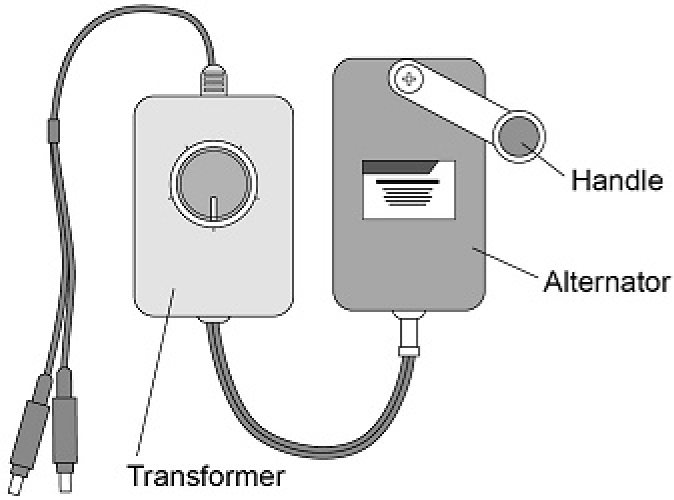
(2)

(Total 14 marks)

4. **Figure 1** shows a portable power supply.

Figure 1



(a) 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.

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(2)

(b) 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.

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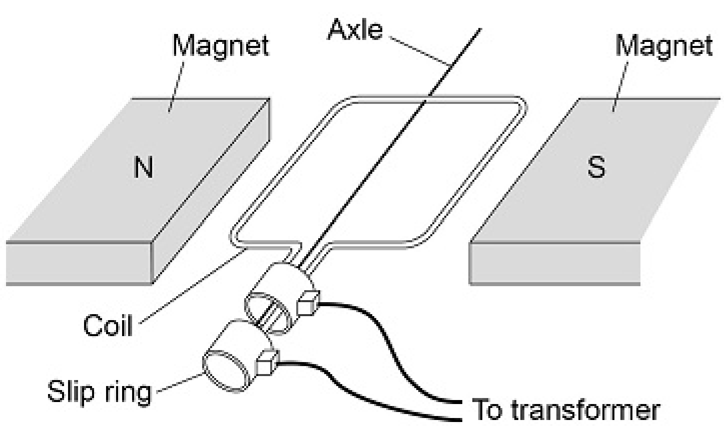
Number of turns on the secondary coil = ________________

(3)

Figure 2 shows the inside parts of the alternator.

Figure 2



(c) The handle of the alternator is turned, causing the coil to rotate.

Explain why an alternating current is induced in the coil.

(5)

(d) Suggest the purpose of the slip rings.

(1)

(e) 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)

(Total 14 marks)

5. (a) The table below gives the frequencies in the hearing ranges of five different animals.

Animal	**Frequencies of hearing range**
Cat	55 Hz to 77 kHz
Chicken	125 Hz to 2 kHz
Dog	20 Hz to 30 kHz
Gerbil	56 Hz to 60 kHz
Horse	55 Hz to 33 kHz

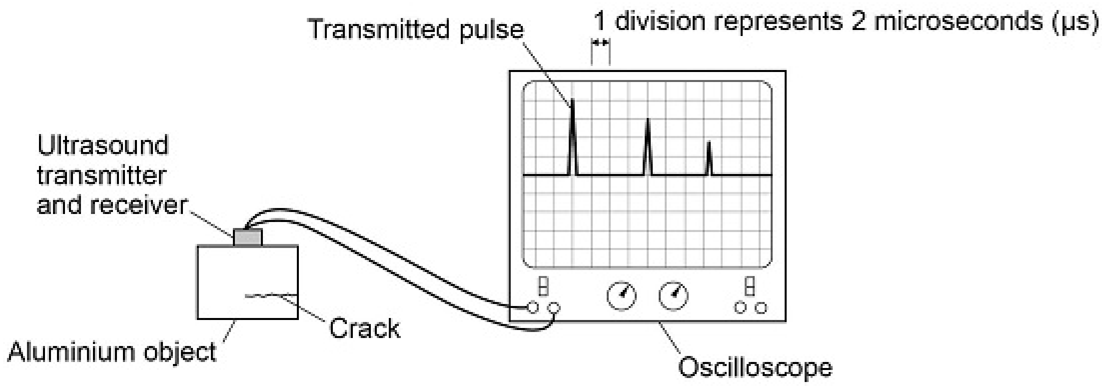
Which **one** of the animals from the table would not be able to hear ultrasound?

____

(1)

Figure 1 shows ultrasound being used to detect a hidden crack in a solid aluminium object. The transmitted and reflected pulses of ultrasound are shown on the screen.

Figure 1



(b) Which of the following is the same as 2 microseconds?

Tick (✓) **one** box.

2×10^{3} s ☐

2×10^{-3} s ☐

2×10^{-6} s ☐

2×10^{-9} s ☐

(1)

(c) Ultrasound travels at 6300 m/s in aluminium.

Determine the depth of the crack below the top surface of the aluminium.

Use information from **Figure 1**.

Give your answer to two significant figures.

___

___

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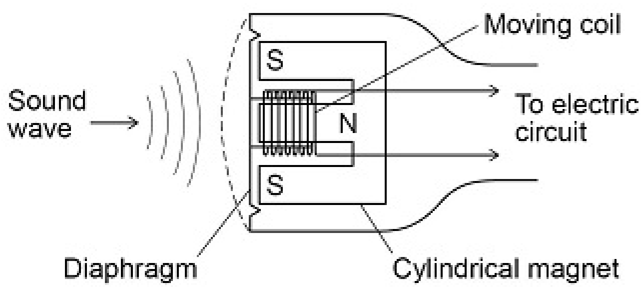
___

Depth = ___ m

(4)

Figure 2 shows the parts of a moving-coil microphone.

Figure 2



(d) What is the function of a microphone?

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(1)

(e) Explain how a moving-coil microphone works.

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(4)

(Total 11 marks)

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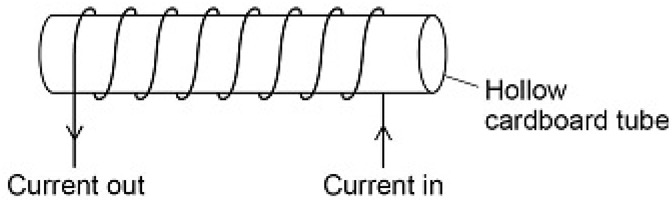
6. (a) **Figure 1** shows a solenoid.

Draw the magnetic field of the solenoid on **Figure 1**.

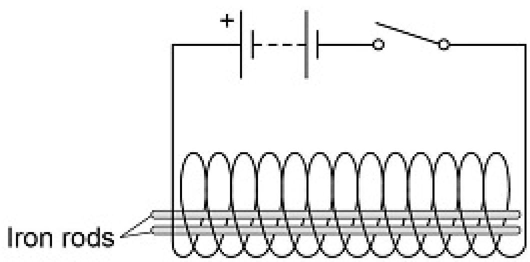
Figure 1



(2)

(b) **Figure 2** shows two iron rods placed inside a solenoid.

Figure 2



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

____

____

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____

(2)

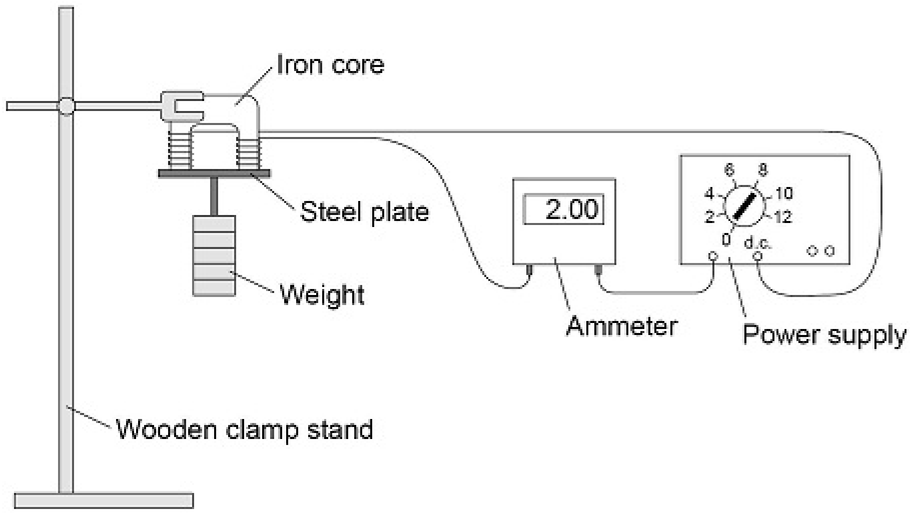
A student investigated the strength of an electromagnet.

The student investigated how the strength depended on:

- the current in the wire
- the number of turns of wire around the iron core.

Figure 3 shows the equipment used.

Figure 3



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

(c) The following table shows the results.

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.

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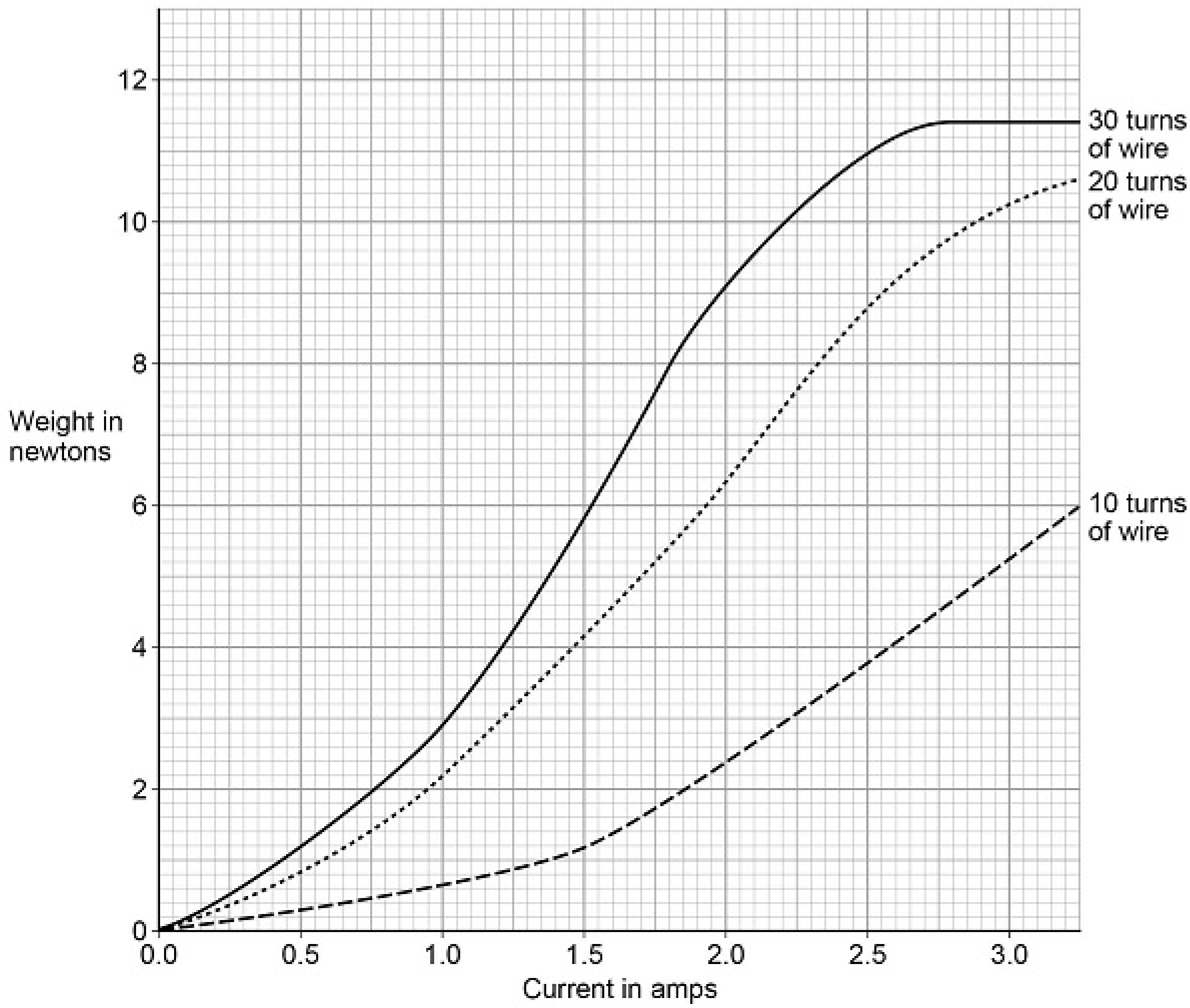
(2)

A second student repeated the investigation using the same equipment.

Figure 4 shows the second student's results.

Figure 4



(d) How does increasing the current in the wire affect the strength of the electromagnet, when the electromagnet has 30 turns of wire?

____

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____

____

(1)

(e) 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?

____

____

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(1)

(Total 8 marks)

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

(a) Which **one** of the statements about P-waves and S-waves is correct?

Tick **one** box.

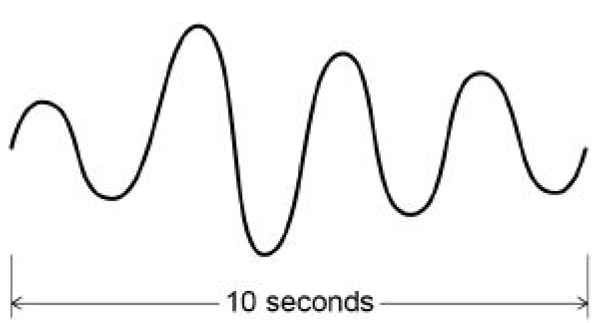
P-waves and S-waves are transverse.	☐
P-waves and S-waves are longitudinal.	☐
P-waves are transverse and S-waves are longitudinal.	☐
P-waves are longitudinal and S-waves are transverse.	☐

(1)

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

Figure 1 shows the vibration recorded by a seismometer for one P-wave.

Figure 1



(b) Calculate the frequency of the P-wave shown in **Figure 1**.

Frequency = ____________________ Hz

(1)

(c) Write down the equation which links frequency, wavelength and wave speed.

(1)

(d) The P-wave shown in **Figure 1** is travelling at 7200 m/s.

Calculate the wavelength of the P-wave.

Wavelength = ____________________ m

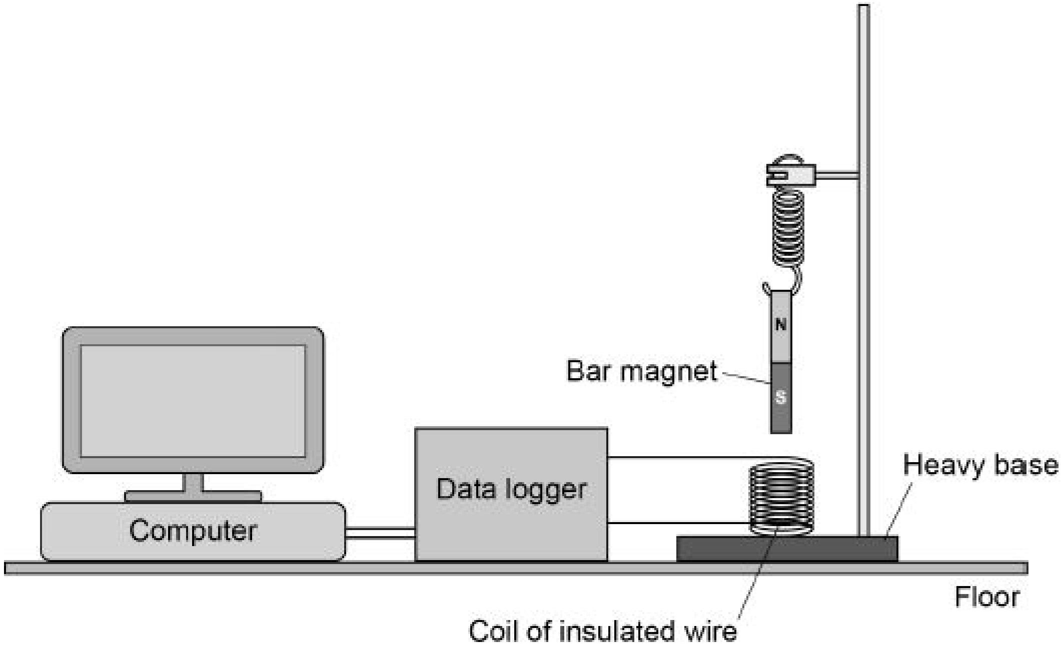
(3)

(e) Explain why the study of seismic waves provides evidence for the structure of the Earth's core.

(2)

Figure 2 shows a simple seismometer made by a student.

Figure 2



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

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

____

____

(1)

(g) Why is the induced potential difference across the coil alternating?

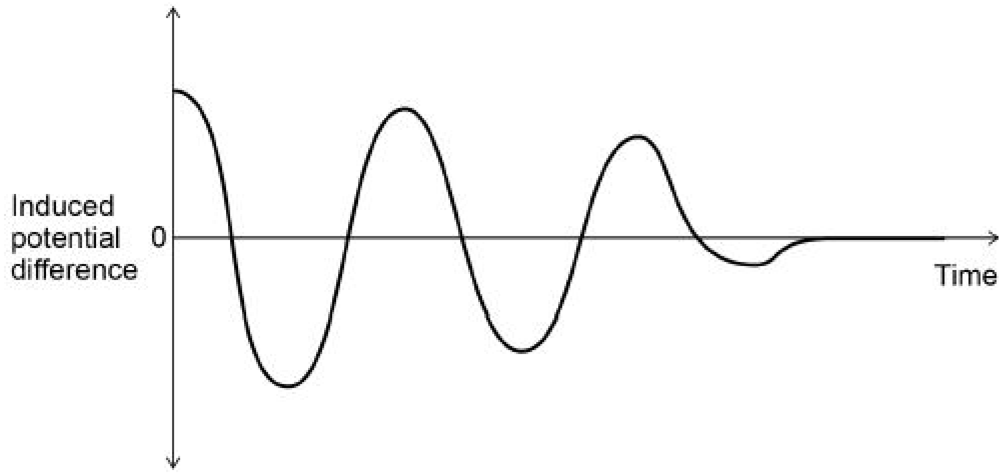
____

____

(1)

(h) **Figure 3** shows how the potential difference induced across the coil varies after the bar magnet has been released.

Figure 3



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

Tick **one** box.

Accelerating upwards.	☐
Constant speed upwards.	☐
Decelerating downwards.	☐
Stationary.	☐

(1)

(i) The seismometer cannot detect small vibrations.

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

1. ____

____

2. ____

____

(2)

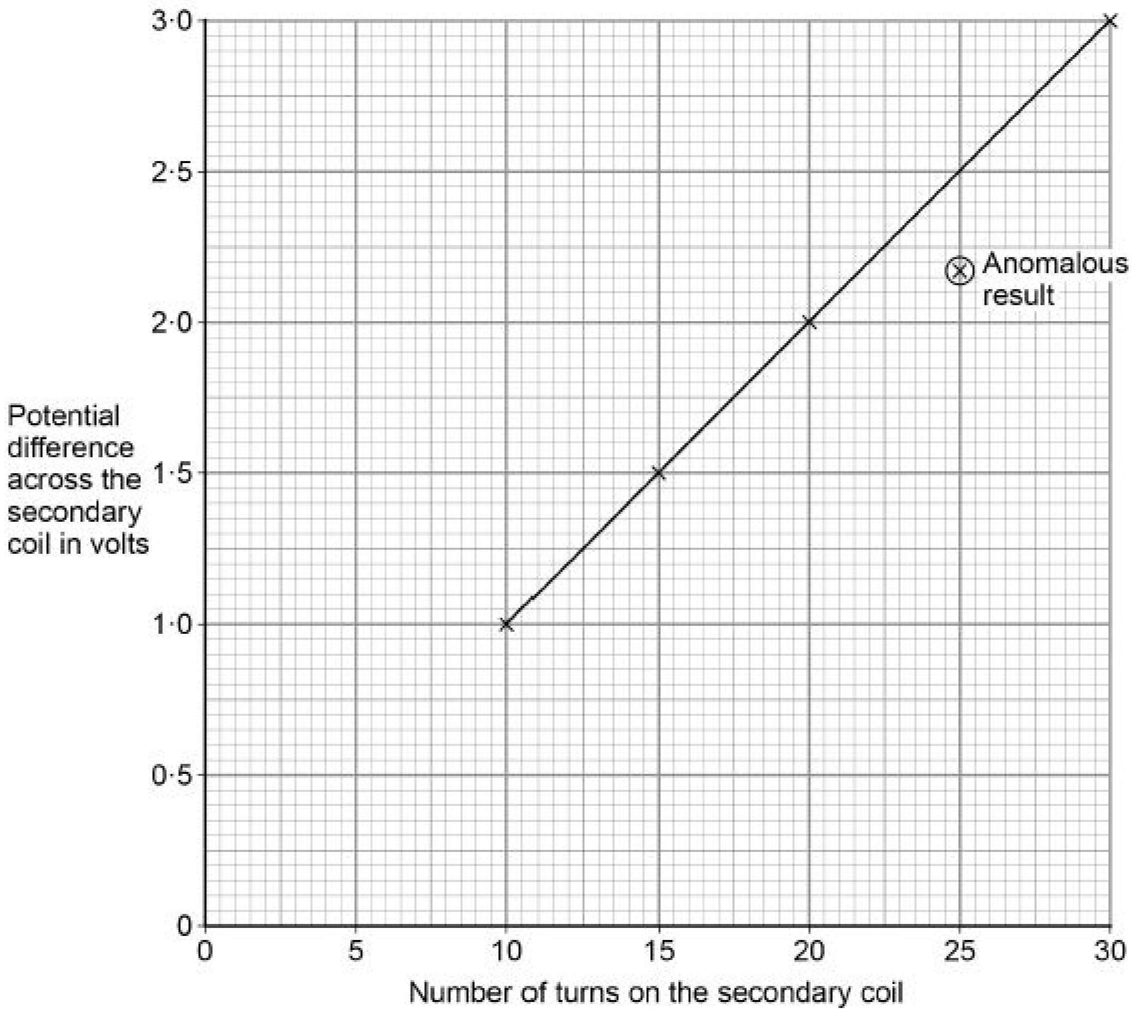
(Total 13 marks)

8. 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 1 shows the results collected by the student.

Figure 1



(a) **Figure 1** contains one anomalous result.

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

____

____

(1)

(b) The transformer changes from being a step-down to a step-up transformer.

How can you tell from **Figure 1** that this happens?

___

___

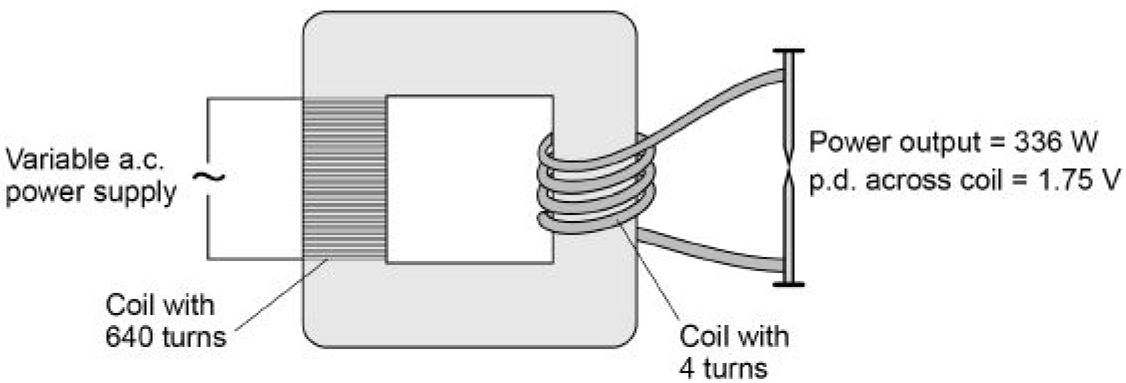
___

(1)

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

Figure 2 shows a transformer demonstrating how a large current can heat and join two nails together.

Figure 2



(c) How does the amount of infrared radiation emitted by the nails change when the power supply is switched on?

___

___

(1)

(d) Calculate the current from the power supply needed to provide a power output of 336 W.

Use the data in **Figure 2**.

The transformer is 100% efficient.

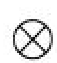
Current = ____________________ A

(5)

(Total 8 marks)

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

Figure 1



(a) Complete **Figure 1** to show the magnetic field pattern around the wire.

(2)

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(b) 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.

4×10^{-2} T ☐

4×10^{-3} T ☐

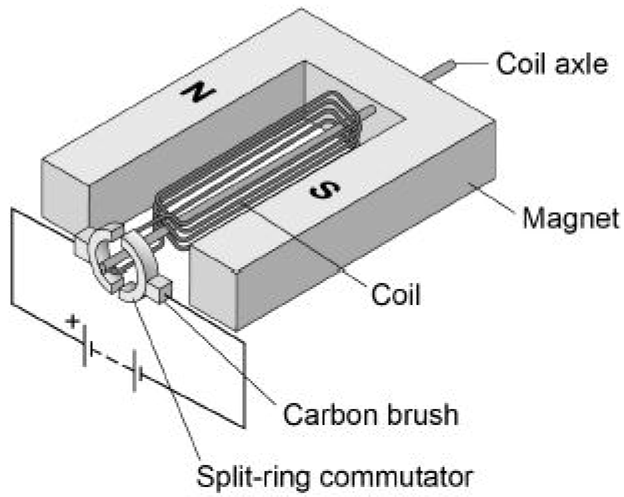
4×10^{-6} T ☐

4×10^{-9} T ☐

(1)

(c) **Figure 2** shows a simple electric motor.

Figure 2



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

Explain why.

____

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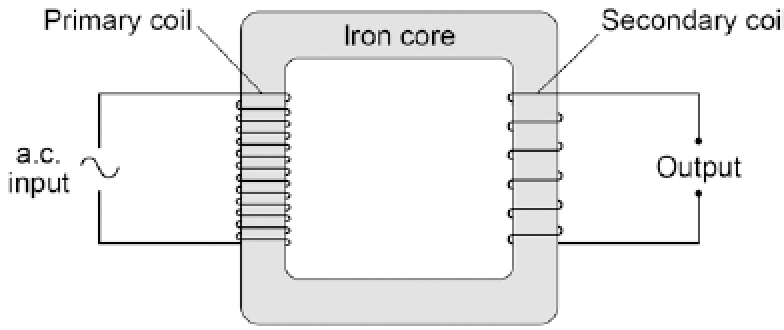
(4)

(Total 7 marks)

10. **Figure 1** shows the construction of a simple transformer.

Figure 1



(a) Why is iron a suitable material for the core of a transformer?

Tick **one** box.

It is a metal. ☐

It will not get hot. ☐

It is easily magnetised. ☐

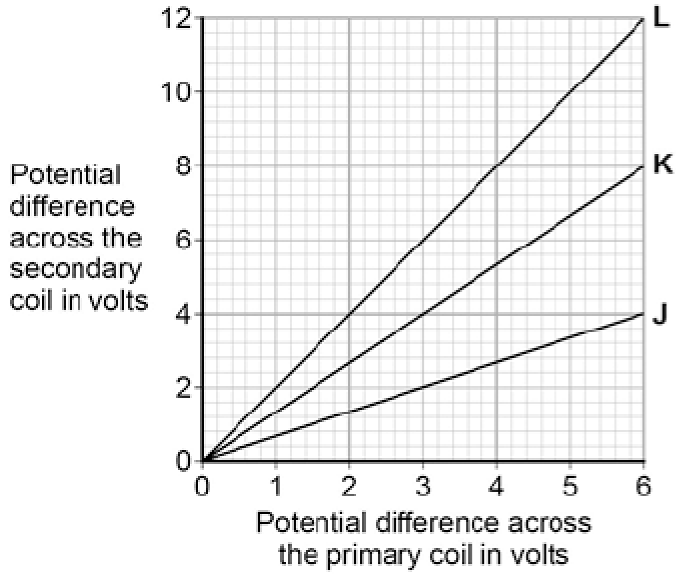
It is an electrical conductor. ☐

(1)

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

Figure 2 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 2



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

___

___

(1)

(c) 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.

___

___

___

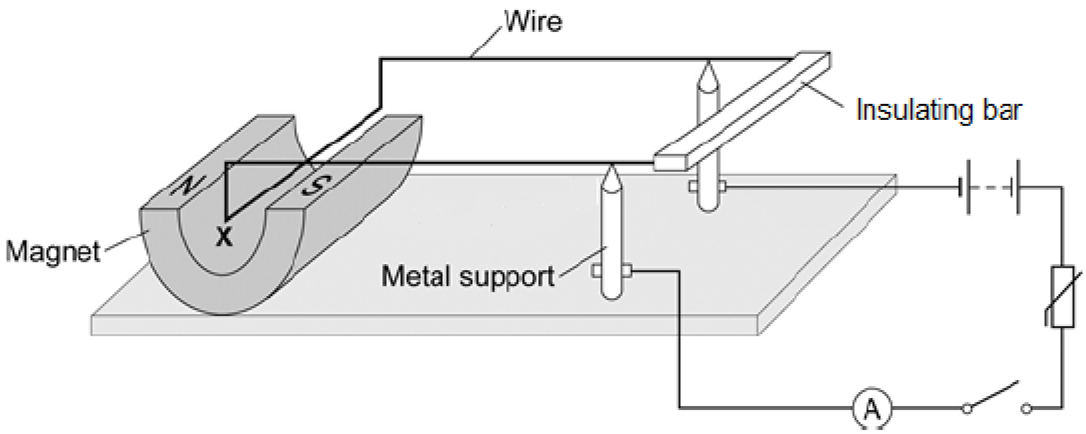
Number of turns on the secondary coil = ___

(3)

(Total 5 marks)

11. **Figure 1** shows a piece of apparatus called a current balance.

Figure 1



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

(a) What is the name of the effect that causes the wire **X** to move downwards?

____

(1)

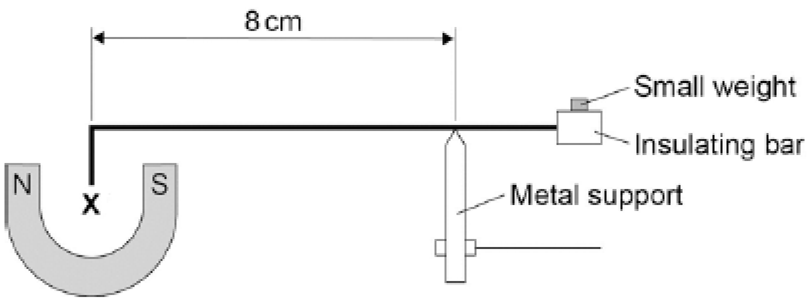
(b) Suggest one change you could make to the apparatus in **Figure 1** that would increase the size of the force that wire **X** experiences.

____

(1)

(c) **Figure 2** shows how a small weight placed on the insulating bar makes the wire **X** go back and balance in its original position.

Figure 2



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.

___

___

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___

___

___

Magnetic flux density = ______________ Unit ______________

(6)

(Total 8 marks)

12. Waves may be either longitudinal or transverse.

(a) Describe the difference between a longitudinal and a transverse wave.

___

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___

___

(2)

(b) 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.

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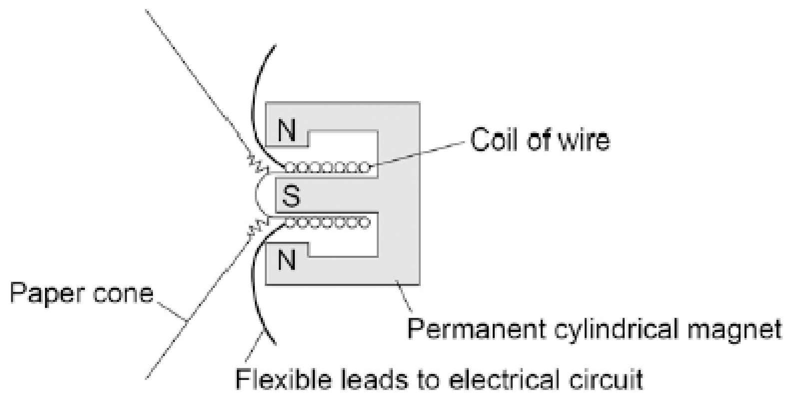
___

(1)

(c) The figure below 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.



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

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(6)

(Total 9 marks)