FOUNDATION

P7F Magnetism and Electromagnetism: Foundation Tier Practice

Total Marks

AQA 8463 · Calculator allowed · about 75 minutes

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Magnets have two ends called poles.

(a) State the names given to the two poles of a bar magnet. **(1)**

(Total for Question 1 is 1 mark)

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2 A student holds two small bar magnets near each other and observes their behaviour.

(a) Give the observation when the north pole of one magnet is brought near the north pole of the other magnet. **(1)**

(b) Give the observation when the north pole of one magnet is brought near the south pole of the other magnet. **(1)**

(Total for Question 2 is 2 marks)

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3 Iron filings are sprinkled around a bar magnet and the pattern is observed.

(a) Describe the shape of the magnetic field lines around a bar magnet. **(1)**

(b) State where the magnetic field is strongest around a bar magnet. **(1)**

(c) Explain why the iron filings form lines rather than a uniform cloud. **(1)**

(Total for Question 3 is 3 marks)

4 An electromagnet is made by wrapping 80 turns of insulated wire around an iron core and connecting it to a 2.0 V supply. The current in the coil is 0.20 A.

(a) Calculate the total charge that flows through the coil in 10 seconds. Use Q = I x t. **(2)**

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(b) State one way the strength of this electromagnet could be increased, using information from the data given. **(2)**

(Total for Question 4 is 4 marks)

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5 An electromagnet is used to pick up paper clips. A student counts the number of paper clips picked up by the electromagnet when the current is 0.10 A and when it is 0.30 A.

(a) Predict whether the electromagnet will pick up more paper clips at 0.30 A than at 0.10 A and give a brief reason. **(2)**

(Total for Question 5 is 2 marks)

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6 A compass is placed near a bar magnet.

(a) State which way the north end of the compass needle points when it is placed near the north pole of the bar magnet. **(1)**

(Total for Question 6 is 1 mark)

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7 A simple demonstration shows a coil of wire near a magnet. When the magnet is moved into the coil, a current is detected for a short time.

(a) Explain why a current is detected when the magnet is moved into the coil but not when the magnet is held still inside the coil. **(4)**

(Total for Question 7 is 4 marks)

8 A generator rotates a coil in a magnetic field. The teacher says that increasing the number of turns in the coil increases the output.

(a) State what effect increasing the number of turns has on the induced voltage. **(1)**

(b) Give a simple reason for this effect. **(1)**

(Total for Question 8 is 2 marks)

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9 A simple practical tests an electromagnet. The student records how many paper clips are picked up when different numbers of turns are used. The results are: 20 turns picks up 4 clips, 40 turns picks up 8 clips, 60 turns picks up 12 clips.

(a) Describe the relationship between number of turns and number of paper clips picked up. **(1)**

(b) Use the data to predict how many paper clips would be picked up with 100 turns. **(2)**

(Total for Question 9 is 3 marks)

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10 A student makes an electromagnet and measures current and voltage across the coil. The coil has current 0.50 A when connected to 1.5 V. When a second identical coil is added in series the supply remains 1.5 V and the current falls to 0.25 A.

(a) Calculate the resistance of one coil. Use R = V / I. **(2)**

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(b) Explain why the current falls to 0.25 A when a second identical coil is added in series to the same 1.5 V supply. **(2)**

(Total for Question 10 is 4 marks)

11 A soft iron core and a steel core are compared as cores for an electromagnet.

(a) Give one property of soft iron that makes it a good core for an electromagnet. **(1)**

(b) Give one reason why steel is less suitable as an electromagnet core. **(1)**

(Total for Question 11 is 2 marks)

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12 A doorbell uses an electromagnet to pull a metal striker. The student investigates why the striker might not move when the button is pressed.

(a) Suggest two possible reasons, linked to electricity or magnetism, why the striker does not move when the button is pressed. **(3)**

(Total for Question 12 is 3 marks)

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13 A teacher describes a magnetic field around a straight current-carrying wire and draws concentric circles around the wire.

(a) State the shape of the magnetic field around a straight current-carrying wire. **(1)**

(b) Give one simple safety point when demonstrating current in a wire for this experiment. **(1)**

(Total for Question 13 is 2 marks)

14 Explain how a relay switch in a car can use a small control current to switch a much larger current to the starter motor. In your answer include how the components work together and why a relay is useful.

(Total for Question 14 is 6 marks)

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15 A student investigates electromagnetic induction using a coil connected to a voltmeter and a bar magnet moved in and out of the coil. The peak voltmeter readings measured are: magnet moved quickly in gives 1.2 V, moved slowly in gives 0.4 V. The coil has 50 turns.

(a) Calculate the ratio of induced voltage for quick movement compared to slow movement. **(2)**

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(b) Explain why the reading is larger when the magnet is moved quickly. Mention the coil turns in your explanation. **(4)**

(Total for Question 15 is 6 marks)

16 A student is asked to design a safer classroom demonstration of an electromagnet picking up metal objects. The original demo used a mains supply. The student suggests using a 6.0 V battery instead.

(a) Evaluate the suggestion to use a 6.0 V battery instead of mains, giving two advantages and one potential drawback. **(5)**

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(Total for Question 16 is 5 marks)

Mark scheme · P7F Magnetism and Electromagnetism: Foundation Tier Practice

Question 1

- (a) **B1** north and south (poles) cao
- **(a) Answer: North and south**

Question 2

- (a) **B1** they repel / push apart (north repels north) oe cao
- **(a) Answer: They repel**
- (b) **B1** they attract / pull together (north attracts south) oe cao
- **(b) Answer: They attract**

Question 3

- (a) **B1** lines curve from north to south around the magnet, forming loop shapes
- **(a) Answer: Field lines curve from the north pole to the south pole in loops around the magnet.**
- (b) **B1** near the poles cao
- **(b) Answer: Near the poles**
- (c) **B1** filings become tiny induced magnets and align along the field direction, showing the field lines
- **(c) Answer: The filings become tiny induced magnets and align along the magnetic field, showing lines rather than a uniform cloud.**

Question 4

- (a) **M1** substitutes: Q = 0.20 x 10
- (a) **A1** 2.0 C cao
- **(a) Answer: 2.0 C**
- (b) **B1** increase the number of turns on the coil (more turns than 80) or increase the current (higher current than 0.20 A) oe
- (b) **B1** either answer earns a mark; accept increasing current by using a higher supply voltage if safe is stated
- **(b) Answer: Increase the number of turns on the coil or increase the current.**

Question 5

- (a) **B1** predicts more paper clips at 0.30 A
- (a) **B1** reason: stronger current makes a stronger magnetic field so it picks up more clips, oe
- **(a) Answer: Yes. At 0.30 A it will pick up more clips because the larger current makes a stronger magnetic field.**

Question 6

- (a) **B1** it points away (compass north is repelled by magnet north) or points towards magnet south if described, oe
- **(a) Answer: It points away from the magnet north pole (the compass north is repelled by the magnet north).**

Question 7

- (a) **M1** states that moving the magnet changes the magnetic field through the coil
- (a) **M1** links change in magnetic field to induced current (electromagnetic induction)
- (a) **A1** states that when the magnet is held still there is no change in magnetic field so no current is induced cao
- (a) **B1** gives reason that only a changing magnetic field induces a current, oe
- **(a) Answer: Moving the magnet changes the magnetic field through the coil and this change induces a current (electromagnetic induction). When the magnet is held still the magnetic field is not changing so no current is induced.**

Question 8

- (a) **B1** increase in induced voltage
- **(a) Answer: It increases the induced voltage.**
- (b) **B1** more turns mean more loops cut by the changing field so more emf is induced, oe
- **(b) Answer: More turns mean more loops cutting the changing magnetic field so a larger emf is induced.**

Question 9

- (a) **B1** directly proportional: doubling turns doubles clips (linear relationship)
- **(a) Answer: The number of paper clips picked up is directly proportional to the number of turns; doubling turns doubles the clips.**
- (b) **M1** uses proportionality: 20 turns -> 4, so 100 turns is 5 times 20, so 5 x 4
- (b) **A1** 20 clips cao
- **(b) Answer: 20 clips**

Question 10

- (a) **M1** substitutes: R = 1.5 / 0.50
- (a) **A1** 3.0 ohm cao
- **(a) Answer: 3.0 ohm**
- (b) **M1** states that adding the second identical coil doubles the total resistance (total 6.0 ohm)
- (b) **A1** uses V = I x R to show I = 1.5 / 6.0 = 0.25 A or explains that larger resistance causes smaller current cao
- **(b) Answer: Adding the second coil doubles the total resistance to 6.0 ohm, so I = 1.5 V / 6.0 ohm = 0.25 A; the larger resistance reduces the current.**

Question 11

- (a) **B1** soft iron is easily magnetised and demagnetised (low retentivity) oe
- **(a) Answer: It is easily magnetised and demagnetised.**
- (b) **B1** steel retains magnetism so it does not lose magnetism quickly, making it less controllable as an electromagnet
- **(b) Answer: Steel retains magnetism so it does not demagnetise easily, making control difficult.**

Question 12

- (a) **B1** no electrical contact or broken wire so no current flows
- (a) **B1** supply voltage too low or battery flat so current too small
- (a) **B1** electromagnet coil damaged or too few turns/loose core so magnetic field too weak
- **(a) Answer: Any two of: broken electrical contact/broken wire; battery flat or supply voltage too low; damaged coil or too few turns/weak electromagnet.**

Question 13

- (a) **B1** concentric circles around the wire cao
- **(a) Answer: Concentric circles around the wire.**
- (b) **B1** avoid high currents or use low voltage only; do not touch hot wires; switch off before changing connections, oe
- **(b) Answer: Use a low voltage/small current and switch off before changing connections.**

Question 14

- **Level 3** (5-6): Detailed explanation of how a relay works, linking the small control current to magnetism in the coil, movement of an armature or switch, and switching of a larger circuit; clear reason why this is useful, including safety or reduced wiring.
- **Level 2** (3-4): Partial explanation linking coil and magnetism to movement of contacts; mentions that a small current controls a larger one and gives one plausible reason why this is useful.
- **Level 1** (1-2): Simple statements: coil makes magnet when current flows; this can close a switch; limited or no explanation of why it is useful.
- **Indicative content:**
  - A current in the control coil produces a magnetic field that magnetises the core and attracts an armature or moves a switch contact.
  - Movement of the armature closes a separate set of contacts in the high-current circuit to the starter motor, allowing the larger current to flow.
  - The coil circuit carries a small current and the contact circuit carries the larger starter current, so the control circuit wiring and switch do not need to be heavy duty.
  - A relay protects the driver and low-current switch from high currents and allows safer and more convenient control over high-power devices.
  - Mention could include reduced voltage drop, isolation between circuits, or preventing heavy current through the ignition switch.

Question 15

- (a) **M1** substitutes ratio 1.2 / 0.4
- (a) **A1** 3.0 cao
- **(a) Answer: 3.0**
- (b) **M1** states that quicker movement causes a larger rate of change of magnetic field
- (b) **M1** links larger rate of change to larger induced emf/voltage
- (b) **A1** mentions coil turns: more turns (50) mean more emf for given change, so a larger reading results
- (b) **A1** conclusion: therefore moving quickly gives a larger induced voltage, as seen 1.2 V vs 0.4 V cao
- **(b) Answer: Moving the magnet quickly gives a larger rate of change of magnetic field through the 50-turn coil, which induces a larger emf. More turns mean each loop contributes to the emf, so with 50 turns the quick movement gives 1.2 V while slow movement gives 0.4 V.**

Question 16

- (a) **B1** advantage: battery is safer than mains (lower voltage and no dangerous AC) or reduces risk of electric shock
- (a) **B1** advantage: battery is portable and easy to isolate quickly, making the demo more convenient
- (a) **M1** draws a reasoned drawback: battery may provide lower current so electromagnet may be weaker
- (a) **A1** explains drawback with consequence: fewer clips picked up or need many batteries / short battery life
- (a) **B1** additional point such as checking battery capacity or including a resistor to limit current for safety
- **(a) Answer: Using a 6.0 V battery is safer (lower risk of shock) and more portable, but it may give a lower current so the electromagnet could be weaker or the battery may run flat quickly; you may need multiple batteries or a suitable resistor and to check battery capacity.**