3.7 Magnetism and Electromagnetism: 30-minute Pack

AQA 8463 · Calculator allowed · about 30 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 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 1 is 1 mark)

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2 A student wants to plot the magnetic field pattern around a bar magnet using a plotting compass and a pencil.

(a) Describe how the student could use the plotting compass to plot a magnetic field line around the bar magnet. **(3)**

(b) State the direction of a magnetic field line at any point. **(1)**

(c) The field lines drawn are closer together near the poles of the magnet than they are further away. State what this shows about the magnetic field near the poles. **(1)**

(Total for Question 2 is 5 marks)

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3 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 3 is 2 marks)

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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)**

(b) State two ways 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 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 6 is 3 marks)

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7 The coil of an electromagnet has a resistance of 3.2 ohms. A current of 2.5 A flows through the coil. Use the Physics Equations Sheet. Use the equation: power = current^2 x resistance ($P = I^2 R$)

(a) Calculate the power dissipated as heat in the coil. **(2)**

(b) Suggest one reason why this heating effect could be a problem for an electromagnet that is used continuously. **(1)**

(Total for Question 7 is 3 marks)

8 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)**

(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 8 is 4 marks)

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Mark scheme · 3.7 Magnetism and Electromagnetism: 30-minute Pack

Question 1

(a) it points away (compass north is repelled by magnet north) or points towards magnet south if described, oe **B1**

(a) Answer: It points away from the magnet north pole (the compass north is repelled by the magnet north).

Question 2

(a) place the plotting compass close to one pole of the magnet and mark the position of each end of the compass needle with a pencil dot, oe **B1**

(a) move the compass so that its previous end sits on the last dot, mark the new needle position, and repeat this several times moving away from the magnet, oe **B1**

(a) join the dots to draw a smooth field line and add an arrow to show its direction; repeat starting from different points around the magnet to build up the full field pattern, oe **B1**

(a) Answer: Place the compass near a pole and mark both ends of the needle; move the compass so it starts where the last dot was and mark the new needle position; repeat this to build a chain of dots, then join them into a smooth line with an arrow showing direction, and repeat from several starting points.

(b) the direction that the north pole of a compass placed at that point would point, oe (from north to south outside the magnet) **B1**

(b) Answer: The direction a compass needle's north pole would point if placed at that point (field lines go from north to south outside the magnet).

(c) the magnetic field is stronger near the poles; field strength decreases with distance from the magnet, oe **B1**

(c) Answer: The magnetic field is stronger where the field lines are closer together, i.e. near the poles.

Question 3

(a) soft iron is easily magnetised and demagnetised (low retentivity) oe **B1**

(a) Answer: It is easily magnetised and demagnetised.

(b) steel retains magnetism so it does not lose magnetism quickly, making it less controllable as an electromagnet **B1**

(b) Answer: Steel retains magnetism so it does not demagnetise easily, making control difficult.

Question 4

(a) substitutes: Q = 0.20 x 10 **M1**

(a) 2.0 C cao **A1**

(a) Answer: 2.0 C

(b) increase the number of turns on the coil (more turns than 80) or increase the current (higher current than 0.20 A) oe **B1**

(b) either answer earns a mark; accept increasing current by using a higher supply voltage if safe is stated **B1**

(b) Answer: Increase the number of turns on the coil or increase the current.

Question 5

(a) predicts more paper clips at 0.30 A **B1**

(a) reason: stronger current makes a stronger magnetic field so it picks up more clips, oe **B1**

(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) directly proportional: doubling turns doubles clips (linear relationship) **B1**

(a) Answer: The number of paper clips picked up is directly proportional to the number of turns; doubling turns doubles the clips.

(b) uses proportionality: 20 turns -> 4, so 100 turns is 5 times 20, so 5 x 4 **M1**

(b) 20 clips cao **A1**

(b) Answer: 20 clips

Question 7

(a) $P = 2.5^2 \times 3.2$, oe **M1**

(a) 20 W, cao **A1**

(a) Answer: 20 W

(b) the coil could overheat, which could damage the wire's insulation, or energy is wasted as heat rather than doing useful work, reducing efficiency, oe **B1**

(b) Answer: The coil may overheat and its insulation could be damaged, and energy is wasted as heat instead of doing useful work.

Question 8

(a) substitutes: R = 1.5 / 0.50 **M1**

(a) 3.0 ohm cao **A1**

(a) Answer: 3.0 ohm

(b) states that adding the second identical coil doubles the total resistance (total 6.0 ohm) **M1**

(b) uses V = I x R to show I = 1.5 / 6.0 = 0.25 A or explains that larger resistance causes smaller current cao **A1**

(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.

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