3.22 Magnetism and the Motor Effect: Test Pack

AQA 8464 · Calculator allowed · about 25 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Iron and steel are both magnetic materials, but they behave differently when used to make magnets.

(a) State what is meant by a magnetically hard material. **(1)**

(b) State what is meant by a magnetically soft material. **(1)**

(c) State which of these materials, iron or steel, would be more suitable for making the core of an electromagnet, and give a reason for your answer. **(1)**

(Total for Question 1 is 3 marks)

2 Higher Tier only. A straight wire carries a current of 3.0 A. A 0.15 m length of the wire lies at right angles inside a uniform magnetic field of flux density 0.40 T. Use the Physics Equations Sheet. Use the equation: force on a conductor (at right angles to a magnetic field) carrying a current = magnetic flux density * current * length (F = B * I * L). Calculate the force on this length of wire.

(Total for Question 2 is 3 marks)

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3 Higher Tier only. A student wants to increase the speed of rotation of a simple d.c. motor.

(a) State one change the student could make to the motor to increase its speed of rotation, and explain why this change has this effect. **(2)**

(b) State a different change the student could make to increase the speed of rotation, and explain why this change has this effect. **(2)**

(Total for Question 3 is 4 marks)

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4 Magnets produce a magnetic field around them.

(a) Define a magnetic field. **(1)**

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

(c) Two bar magnets are placed in a line with a small gap between them, north pole facing north pole. Describe what happens to the magnetic field lines in the gap between the two north poles, and explain what this shows about the force between the poles. **(2)**

(d) State two examples of materials that are not magnetic. **(2)**

(Total for Question 4 is 6 marks)

5 Higher Tier only. A straight current-carrying wire can be placed at different angles to a uniform magnetic field.

(a) State the direction of the current relative to the magnetic field lines for which the force on the wire is at its maximum. **(1)**

(b) State the direction of the current relative to the magnetic field lines for which the force on the wire is zero. **(1)**

(c) A wire is placed at an angle between these two orientations (neither parallel nor perpendicular to the field). Explain why the force on the wire in this case is smaller than the maximum possible force, but greater than zero. **(2)**

(Total for Question 5 is 4 marks)

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Mark scheme · 3.22 Magnetism and the Motor Effect: Test Pack

Question 1

(a) a magnetically hard material keeps (retains) its magnetism once magnetised, and is not easily demagnetised, oe **B1**

(a) Answer: A magnetically hard material keeps its magnetism after the magnetising field is removed.

(b) a magnetically soft material is magnetised and demagnetised easily; it does not stay magnetised, oe **B1**

(b) Answer: A magnetically soft material is magnetised and demagnetised easily and does not stay magnetised.

(c) iron, because it is magnetically soft, so it loses its magnetism as soon as the current is switched off, allowing the electromagnet to be switched on and off, oe **B1**

(c) Answer: Iron - it is magnetically soft, so it loses its magnetism as soon as the current is switched off, allowing the electromagnet to be turned on and off.

Question 2

correct substitution into F = B * I * L: F = 0.40 * 3.0 * 0.15, oe **M1**

F = 0.18, cao **A1**

correct unit, N (newtons) **B1**

Answer: F = 0.18 N

Question 3

(a) increase the current in the coil (e.g. by increasing the p.d./voltage of the supply), oe **B1**

(a) this increases the force on each side of the coil (F = B * I * L, force is directly proportional to current), increasing the turning effect on the coil, so it rotates faster, oe **B1**

(a) Answer: Increase the current in the coil; this increases the force on the coil (F = B * I * L), increasing the turning effect, so the motor rotates faster.

(b) increase the strength of the magnetic field (e.g. use a stronger magnet), oe **B1**

(b) this increases the force on each side of the coil (F = B * I * L, force is directly proportional to magnetic flux density), increasing the turning effect on the coil, so it rotates faster, oe **B1**

(b) Answer: Use a stronger magnet; this increases the force on the coil (F = B * I * L), increasing the turning effect, so the motor rotates faster.

Question 4

(a) a region (of space) around a magnet, or a current-carrying conductor, in which a force is exerted on other magnets or on magnetic materials, oe **B1**

(a) Answer: The region around a magnet (or current-carrying conductor) in which a force acts on other magnets or on magnetic materials.

(b) from the north (seeking) pole to the south (seeking) pole, oe (accept: the direction a free north pole would move at that point) **B1**

(b) Answer: From the north pole to the south pole, outside the magnet.

(c) the field lines curve away from each other and do not cross in the gap; a neutral point (a region with no resultant magnetic field) forms there, oe **M1**

(c) this shows that the two poles are repelling each other, since like poles repel, oe **A1**

(c) Answer: The field lines bend away from each other and do not meet between the two poles; a neutral point (no resultant field) forms there. This shows the two north poles repel, since like poles repel.

(d) one correct non-magnetic material, e.g. wood, plastic, aluminium, copper, glass **B1**

(d) a second, different correct non-magnetic material from the list above **B1**

(d) Answer: Any two of: wood, plastic, aluminium, copper, glass (or other non-magnetic materials).

Question 5

(a) the current is at right angles (perpendicular) to the magnetic field lines, oe **B1**

(a) Answer: The current is at right angles to the magnetic field lines.

(b) the current is parallel to (in the same or opposite direction as) the magnetic field lines, oe **B1**

(b) Answer: The current is parallel to the magnetic field lines.

(c) only the component of the current (or of the wire's length) that is at right angles to the field contributes to the force, oe **M1**

(c) at this intermediate angle, this perpendicular component is smaller than the full current/length (as at 90 degrees) but is not zero (as at 0 degrees), so the force lies between zero and the maximum, oe **A1**

(c) Answer: Only the part of the current/wire acting at right angles to the field produces a force. At an intermediate angle this component is less than the full value (so less than the maximum force) but still greater than zero.

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