3.2 Electricity and Magnetism: Test Pack

Calculator allowed · about 55 minutes

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Name the tiny negatively charged particles that flow in a metal wire to make an electric current.

(1)

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2 A pupil tests whether adding more cells affects the brightness of a bulb. They connect 1, 2 and then 3 identical 1.5 V cells in series to the same bulb and measure the current each time. Their results are: with 1 cell: 0.08 A; with 2 cells: 0.16 A; with 3 cells: 0.24 A.

(a) State the pattern shown by the results. **(2)**

(b) Give one variable the pupil should keep the same to make the test fair and explain why. **(2)**

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3 A pupil tests a series circuit and finds a small change in the measured current when an extra identical resistor is added in series. Explain one possible experimental error or limitation that could cause the change in current to be larger or smaller than expected, and give one way to reduce this error.

(2)

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4 A small magnetic compass is placed near a current-carrying wire. The compass needle is observed to turn.

(a) State what the compass needle turning shows about the wire. **(1)**

(b) Describe one safety measure when demonstrating electricity and magnetism with pupils. **(2)**

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5 Give the direction of the magnetic field around a straight current-carrying wire using the right-hand rule. If the current flows up the page, which way do the field lines circle the wire when viewed from above: clockwise or anticlockwise?

(2)

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6 A pupil investigates how the current through a filament lamp changes with potential difference. The table of average results is: V (V): 0.5, 1.0, 1.5, 2.0. I (A): 0.10, 0.18, 0.24, 0.28.

(a) Plot these results on graph paper and draw a smooth curve. **(1)**

(b) Use the data to explain whether the filament lamp behaves like an ohmic resistor over this range. **(3)**

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7 A pupil builds an experiment to investigate how the number of coils on a wire wrapped around an iron nail changes the strength of an electromagnet. Suggest the independent variable, two control variables, and the dependent variable the pupil should use.

(4)

8 Stretch question: A wire of resistance 5.0 ohm is placed in a circuit with a 9.0 V supply. The wire warms up and its resistance increases to 6.0 ohm. Calculate the current before and after heating and state the percentage decrease in current. Show working and give answers to two significant figures where appropriate.

(4)

9 Complete the sentence. In a series circuit the total potential difference of the battery is _____ across the components, while in a parallel circuit each branch has _____ potential difference as the battery.

(3)

10 State the name of the device that protects a domestic electrical circuit by breaking the circuit if too much current flows. Give one reason why it is important.

(2)

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11 A pupil measures potential difference across a lamp and the current through it. The readings are: p.d. = 6.0 V, current = 0.50 A. Calculate the power used by the lamp. Show working and unit.

(4)

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12 Four standard circuit symbols are described below (no diagram needed, use the descriptions):
Symbol W: a long straight line and a short straight line, parallel to each other with a gap between them.
Symbol X: a plain rectangle (box).
Symbol Y: a circle with the letter A inside it.
Symbol Z: a circle with a cross (X shape) inside it.

(a) Which symbol (W, X, Y or Z) represents a cell? **(1)**

- ☐ W
- ☐ X
- ☐ Y
- ☐ Z

(b) Which symbol represents a resistor? **(1)**

- ☐ W
- ☐ X
- ☐ Y
- ☐ Z

(c) Which symbol represents an ammeter? **(1)**

- ☐ W
- ☐ X
- ☐ Y
- ☐ Z

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13 A balloon is rubbed on a woollen jumper. The balloon becomes charged and can then stick to a wall.

(a) Explain, in terms of electrons, why the balloon becomes charged when it is rubbed on the jumper. **(2)**

(b) Explain why the charged balloon sticks to the wall. **(2)**

14 (Practical investigation) A student uses a plotting compass to investigate the magnetic field pattern around a bar magnet.

(a) Describe the method the student should use to plot the magnetic field pattern with a plotting compass. **(3)**

(b) State the direction of magnetic field lines outside a bar magnet. **(1)**

(c) The student notices the field lines are closest together near the poles of the magnet. What does this tell you about the magnetic field strength there? **(2)**

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Mark scheme · 3.2 Electricity and Magnetism: Test Pack

Question 1

electrons cao — **B1**

Answer: **Electrons**

Question 2

(a) recognise proportional increase in current as number of cells increases — **M1**

(a) state that current increases roughly in direct proportion to the number of cells (0.08, 0.16, 0.24) — **A1**

(a) Answer: **The current increases proportionally with the number of cells: 0.08 A, 0.16 A, 0.24 A.**

(b) name a sensible control variable, e.g. the same bulb or same resistor — **M1**

(b) explain that keeping the bulb the same keeps its resistance constant so changes in current are due to number of cells only — **A1**

(b) Answer: **Keep the same bulb (same resistor) so the resistance does not change; this ensures changes in current are caused only by the number of cells.**

Question 3

identify a plausible error or limitation such as poor connections adding extra resistance, battery voltage varying due to internal resistance, or instruments not zeroed — **M1**

give a way to reduce it such as checking and tightening connections, using fresh batteries or a regulated power supply, and using better meters or repeating and averaging — **A1**

Answer: **Poor connections or internal resistance of the battery could change the current; reduce this by checking and tightening connections, use a fresh or regulated power supply, and repeat measurements to average out anomalies.**

Question 4

(a) that a magnetic field is produced around the wire when current flows — **B1**

(a) Answer: **That a magnetic field is produced around the wire when current flows.**

(b) state a safety measure such as using low voltages, ensuring wires are insulated and connections tight, or keeping coil cool — **M1**

(b) explain why it is needed, e.g. low voltages reduce risk of shocks and insulated wires prevent exposed conductors causing short circuits — **A1**

(b) Answer: **Use low voltages and check that wires and connections are well insulated and secure; this reduces the risk of electric shock and short circuits.**

Question 5

anticlockwise (counterclockwise) cao — **B1**

reference to right-hand rule or curling fingers of right hand — **B1**

Answer: **Anticlockwise; curling the fingers of the right hand around the wire with the thumb pointing up shows anticlockwise field lines.**

Question 6

(a) one mark for correct plotting of points or indication that points plotted suitably on V (x) and I (y) axes — **M1**

(a) Answer: **Points plotted and smooth curve drawn (on student graph).**

(b) note that V/I is not constant as voltage increases — **M1**

(b) calculate examples: at 0.5 V, V/I = 0.5/0.10 = 5.0 ohm; at 2.0 V, V/I = 2.0/0.28 = 7.14 ohm — **M1**

(b) conclude filament is not ohmic over this range because resistance increases with voltage (curve not straight) — **A1**

(b) Answer: **No. V/I increases from about 5.0 ohm at 0.5 V to about 7.14 ohm at 2.0 V, so the resistance changes and the lamp is not ohmic over this range.**

Question 7

independent variable: number of coils — **M1**

control variable 1: current through the wire or battery voltage — **B1**

control variable 2: same nail or length of wire or same wire thickness (any one reasonable) — **B1**

dependent variable: strength of electromagnet measured by number of paperclips picked up or force or mass held — **A1**

Answer: **Independent: number of coils. Controls: current or battery voltage; same nail (or same wire length/thickness). Dependent: strength measured by number of paperclips picked up.**

Question 8

calculate initial current I1 = 9.0 / 5.0 = 1.8 A — **M1**

calculate final current I2 = 9.0 / 6.0 = 1.5 A — **M1**

calculate decrease = 1.8 - 1.5 = 0.3 A and percentage decrease = (0.3 / 1.8) x 100 — **M1**

percentage decrease = 16.7% or 16.7% to 3 s.f. (accept 17% to 2 s.f.) — **A1**

Answer: **Initial current = 1.8 A; Final current = 1.5 A; Percentage decrease = 16.7%**

Question 9

shared or split — **B1**

the same or equal to the battery — **B1**

both blanks completed to show series splits and parallel equal pd — **B1**

Answer: **shared (split) across components; the same as the battery**

Question 10

circuit breaker or fuse — **B1**

protects against fire or prevents damage to appliances or prevents electric shock (any one) — **B1**

Answer: **Fuse (or circuit breaker); it stops excessive current to prevent fires or damage to appliances.**

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Question 11

use of P = V x I with substitution P = 6.0 x 0.50	**M1**
3.0 W cao	**A1**
unit W shown	**B1**
answer given to 2 significant figures or exact 3.0 W	**B1**

Answer: **3.0 W**

Question 12

(a) W	**B1**

(a) Answer: **W**

(b) X	**B1**

(b) Answer: **X**

(c) Y	**B1**

(c) Answer: **Y**

Question 13

(a) electrons are transferred from the jumper to the balloon (by friction)	**B1**
(a) the balloon gains extra electrons so becomes negatively charged	**B1**

(a) Answer: **Electrons transfer from the jumper to the balloon by friction, so the balloon gains negative charge.**

(b) the balloon's charge induces an opposite charge on the surface of the wall	**B1**
(b) opposite charges attract, holding the balloon in place	**B1**

(b) Answer: **The balloon's charge induces an opposite charge on the wall's surface, and opposite charges attract.**

Question 14

(a) place the plotting compass at a chosen point close to the magnet and mark the direction it points with a dot or arrow	**B1**
(a) move the compass so its tail sits on the mark just made, and mark the new direction it points	**B1**
(a) repeat this until a full line reaches the other pole; repeat the whole process from several different starting points around the magnet	**B1**

(a) Answer: **Mark successive compass directions point-to-point from several starting positions to trace complete field lines around the magnet.**

(b) from the north pole to the south pole	**B1**

(b) Answer: **From north pole to south pole.**

(c) field lines closer together represent a stronger magnetic field	**B1**
(c) so the magnetic field is strongest near the poles	**B1**

(c) Answer: **The magnetic field is strongest near the poles, because field line spacing shows field strength (closer lines = stronger field).**

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