3.6 Current, Potential Difference, Resistance and Electrical Power: 30-minute Pack

EDEXCEL 4PH1 · Calculator allowed · about 30 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 State the rule for electric current in a series circuit, naming the relevant parts of the circuit.

(Total for Question 1 is 1 mark)

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2 State the rule for potential difference across components connected in parallel, naming the branch context.

(Total for Question 2 is 1 mark)

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3 Two resistors of 10 ohm and 20 ohm are connected in series across a 9 V battery. Calculate (a) the total resistance of the pair and (b) the current from the battery. Show equation, substitution and final answers with units for both parts.

(Total for Question 3 is 3 marks)

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4 A component has 0.40 A flowing through it when 3.0 V is applied. Calculate the resistance of the component using V = IR. Show equation, substitution and final answer with unit.

(Total for Question 4 is 3 marks)

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5 A small motor draws a current of 2.0 A from a 6.0 V supply. Calculate the electrical power delivered to the motor using P = IV. Show equation, substitution and final answer with unit.

(Total for Question 5 is 3 marks)

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6 A heater is a 15 ohm resistor carrying 3.0 A. Calculate the electrical power dissipated in the heater using $P = I^2 R$. Show equation, substitution and final answer with unit.

(Total for Question 6 is 3 marks)

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7 An electric kettle is rated at 2.4 kW and is used for 20 minutes. Calculate (a) the energy used in kWh and (b) the cost if electricity is charged at 28p per kWh. Show all working, units and final answers.

(Total for Question 7 is 4 marks)

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8 A circuit contains a 6 ohm resistor in series with two parallel resistors of 12 ohm and 24 ohm. The combination is connected to a 12 V supply. Calculate the total current drawn from the supply and the current through the 24 ohm resistor. Show equations, substitutions and answers with units.

(Total for Question 8 is 4 marks)

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9 Sketch the I-V characteristic on the axes for a fixed resistor and for a filament lamp, both labelled, and then explain why the filament lamp curve has its particular shape as current and voltage increase in the lamp.

(Total for Question 9 is 6 marks)

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Mark scheme · 3.6 Current, Potential Difference, Resistance and Electrical Power: 30-minute Pack

Question 1

current is the same/same value at all points/components in a series circuit **B1**

Answer: The current is the same through every component and at every point in a series circuit

Question 2

the potential difference across each parallel branch is the same **B1**

Answer: The potential difference across each branch in a parallel circuit is the same

Question 3

for (a) adds series resistances R_total = 10 + 20 **M1**

for (b) uses I = V / R_total with V = 9 V and R_total = 30 ohm **M1**

gives R_total = 30 ohm and I = 0.30 A cao **A1**

Answer: R_total = 30 ohm; I = 0.30 A

Question 4

uses R = V / I and substitutes R = 3.0 / 0.40 **M1**

performs the division **M1**

R = 7.5 ohm cao **A1**

Answer: 7.5 ohm

Question 5

uses P = I V and substitutes P = 2.0 x 6.0 **M1**

performs multiplication **M1**

P = 12 W cao **A1**

Answer: 12 W

Question 6

uses $P = I^2 R$ and substitutes $P = (3.0)^2 \times 15$ **M1**

performs the calculation (9 x 15) **M1**

P = 135 W cao **A1**

Answer: 135 W

Question 7

converts time to hours: 20 minutes = 20/60 = 1/3 hour and forms energy = power x time = 2.4 kW x 1/3 h **M1**

calculates energy = 0.8 kWh **M1**

calculates cost = 0.8 x 28p = 22.4p **M1**

gives energy = 0.8 kWh and cost = 22.4p (or 22p to appropriate rounding) cao **A1**

Answer: Energy = 0.8 kWh; cost = 22.4p

Question 8

finds equivalent of parallel pair: 1/Rp = 1/12 + 1/24 so Rp = 8 ohm or uses $R_p = (12*24)/(12+24)$ **M1**

finds total R_total = 6 + 8 = 14 ohm **M1**

uses I_total = V / R_total = 12 / 14 **M1**

gives I_total = 0.857 A (awrt 0.86 A) and current through 24 ohm as I_{24} = V_branch / 24 = 6.857 / 24 = 0.286 A (awrt 0.29 A) cao **A1**

Answer: Total current = 0.857 A (about 0.86 A); current through 24 ohm = 0.286 A (about 0.29 A)

Question 9

sketches straight line through origin for fixed resistor (I proportional to V) labelled 'fixed resistor' or 'ohmic conductor' **B1**

sketches a curve for filament lamp that is shallower at higher V (non-linear), labelled 'filament lamp' **B1**

states that filament resistance increases as current increases **B1**

explains that current heating raises the filament temperature **B1**

explains that higher temperature causes greater resistance due to increased vibrations of metal ions reducing electron flow **B1**

links the increasing resistance to the curve bending so that I increases less for each increment of V at higher voltages **B1**

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