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QUESTION WORKBOOK

Potential dividers

Electricity · Year 12

AQA 3.5.1.5 · CIE 9.3.7, 10.3.1, 10.3.2, 10.3.3, 10.3.4 · OCR A 4.2.3(d), 4.3.3(a), 4.3.3(b), 4.3.3(c)(i)

18 questions · 50 marks

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SECTION A · Warm-up

A1 Explain why two resistors in series share the supply potential difference between them. [2]

A2 A 12 V supply is connected across a 4.0 kΩ resistor in series with an 8.0 kΩ resistor. Calculate the potential difference across the 8.0 kΩ resistor. [2]

A3 State the potential divider equation for the output taken across R_2, and the assumption it relies on. [1]

A4 The output of a potential divider is taken across R_2. State the value the output approaches (a) as R_2 becomes very small and (b) as R_2 becomes very large. [2]

A5 In a two-resistor potential divider the output across R_2 is exactly one quarter of the supply pd. Determine the ratio $R_1 : R_2$. [2]

A6 State how the resistance of a light-dependent resistor changes as the light intensity falling on it increases. [1]

SECTION B · Standard

B1 A 10 V supply is connected across a 2.0 kΩ resistor (R_1) in series with a 3.0 kΩ resistor (R_2). Calculate the output potential difference taken across R_2. [2]

B2 A potential divider has a 4.0 kΩ resistor as R_1 and a 9.0 V supply. Calculate the value of R_2 needed to give an output of 3.0 V across it. [3]

B3 A thermistor is connected in series with a fixed 4.0 kΩ resistor across a 6.0 V supply, with the output taken across the fixed resistor. When warm, the thermistor's resistance is 2.0 kΩ. Calculate the output pd, and state how it changes as the thermistor cools. [4]

B4 Describe how a potentiometer (a potential divider with a sliding contact) can provide a continuously variable output voltage. [3]

B5 A 12 V supply is connected across a uniform resistance track 20 cm long. A sliding contact touches the track 15 cm from the bottom end, and the output is taken between the bottom end and the contact. Calculate the output pd. [2]

B6 A thermistor is connected in series with a fixed 2.0 kΩ resistor across a 12 V supply. The output, taken across the fixed resistor, is measured as 8.0 V. Determine the resistance of the thermistor. [3]

B7 A potential divider consists of a 68 kΩ resistor and a 12 kΩ resistor in series across a 20 V supply. Calculate the current in the divider chain and hence the output pd across the 12 kΩ resistor. [3]

SECTION C · Stretch

C1 A light-dependent resistor (LDR) is placed in series with a fixed 2.0 kΩ resistor across a 6.0 V supply, with the output taken across the fixed resistor. The LDR's resistance is 10 kΩ in the dark and 1.0 kΩ in bright light. Calculate the output in each case. [4]

C2 Explain one advantage of using a potential divider rather than a variable resistor (rheostat) to control the voltage supplied to a component. [3]

C3 An automatic porch light must be off in daylight and on in darkness. An LDR (resistance 300 Ω in bright light, 90 kΩ in darkness) is connected above a fixed 5.0 kΩ resistor across a 5.0 V supply, and the output is taken across the LDR. The lamp switches on when the output exceeds 2.5 V. Deduce whether the circuit behaves as intended. [4]

C4 A potential divider is built from two equal 6.0 kΩ resistors across a 9.0 V supply, so the output across the lower resistor is 4.5 V. A third 6.0 kΩ resistor is now connected in parallel with the lower resistor. Determine the new output pd. [3]

C5 A grower wants a circuit whose output voltage rises as a greenhouse cools, so that a switching circuit can turn a heater on during cold nights. Design a suitable potential divider using an ntc thermistor, explaining fully how it works. State which component the output is taken across and what could be changed to adjust the temperature at which the heater comes on. [6]