

# THE OP-AMP

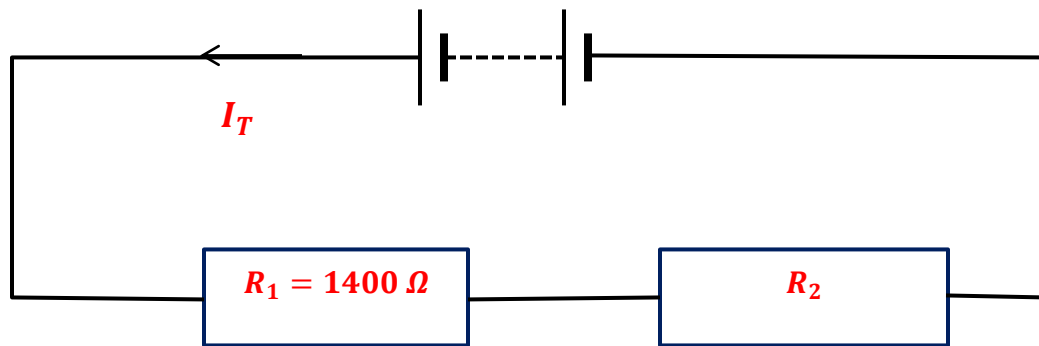
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## QUESTIONS

### SECTION 2: The Potential Divider

#### Q1

The circuit shows two resistors in series. The battery has an e.m.f of  $12\text{ V}$  (i.e.  $V_T = 12\text{ V}$ ). The potential drop (p.d.) across the first resistor ( $V_1$ ) is  $7\text{ V}$ . Study the circuit and calculate  $V_2$ ,  $I_T$  and  $R_2$ . (Assume the internal resistance and that of the connecting wires is negligible)

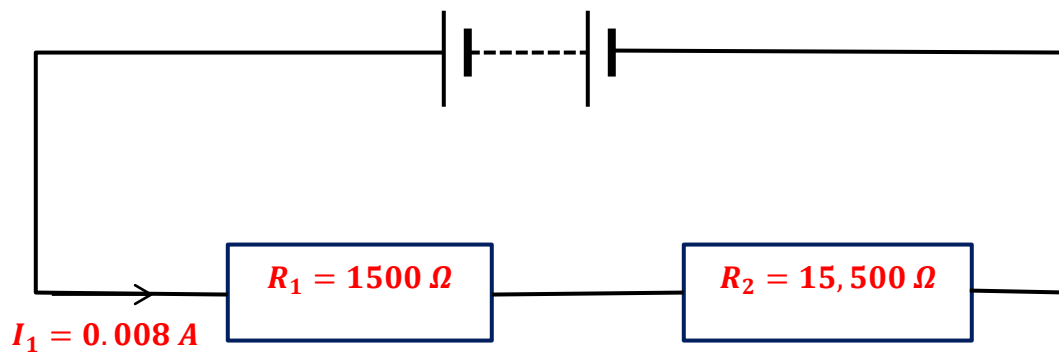


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## Q2

The circuit shows two resistors in series. Their values are as shown in the circuit. The current through the first resistor is  $0.008\text{ A}$ . Determine the total voltage from the battery. (Assume the internal resistance and that of the connecting wires is negligible).



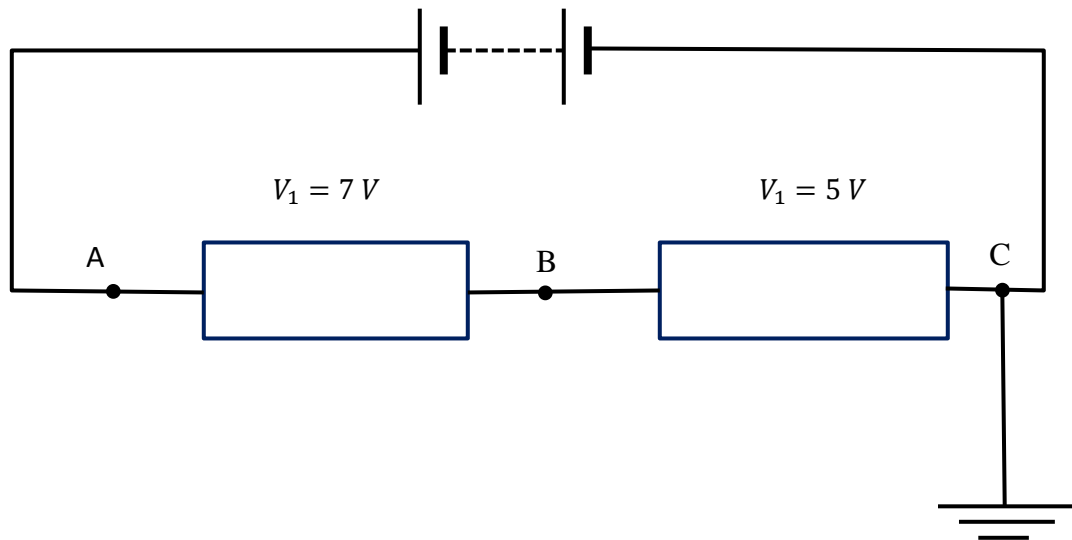
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### Q3

The circuit shows two resistors in series. The battery has an e.m.f of  $12\text{ V}$  (i.e.  $V_T = 12\text{ V}$ ). The potential drop (p.d.) across the two resistors are  $7\text{ V}$  and  $5\text{ V}$  respectively. The circuit is earthed at point C. Determine the potential at point A, B and C. (Assume the internal resistance of battery and that of the connecting wires is negligible)



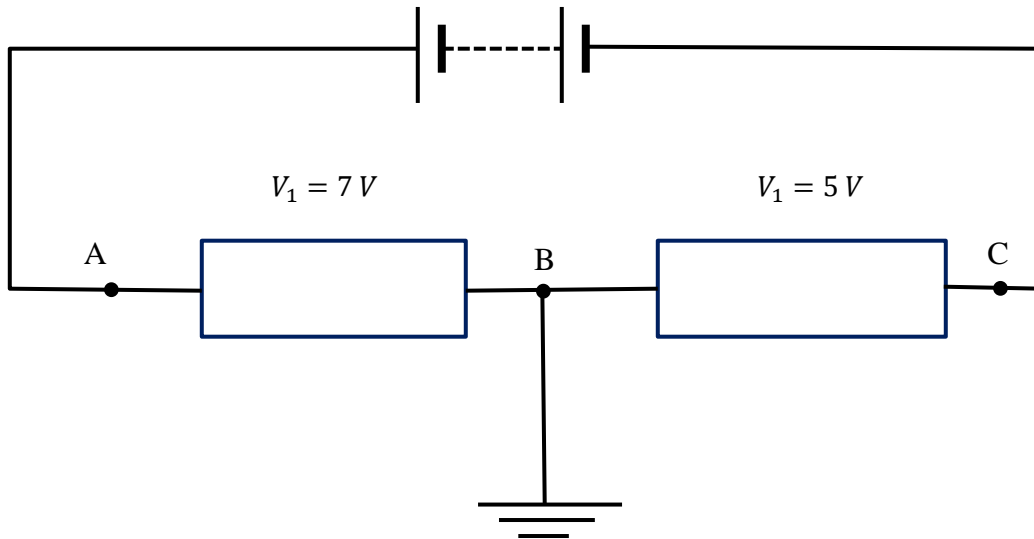
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#### Q4

The circuit shows two resistors in series. The potential drop (p.d.) across the two resistors are  $7\text{ V}$  and  $5\text{ V}$  respectively. The circuit is earthed at point B. Determine the potential at point A, B and C. Hence determine the voltage of the battery. (Assume the internal resistance of battery and that of the connecting wires is negligible).



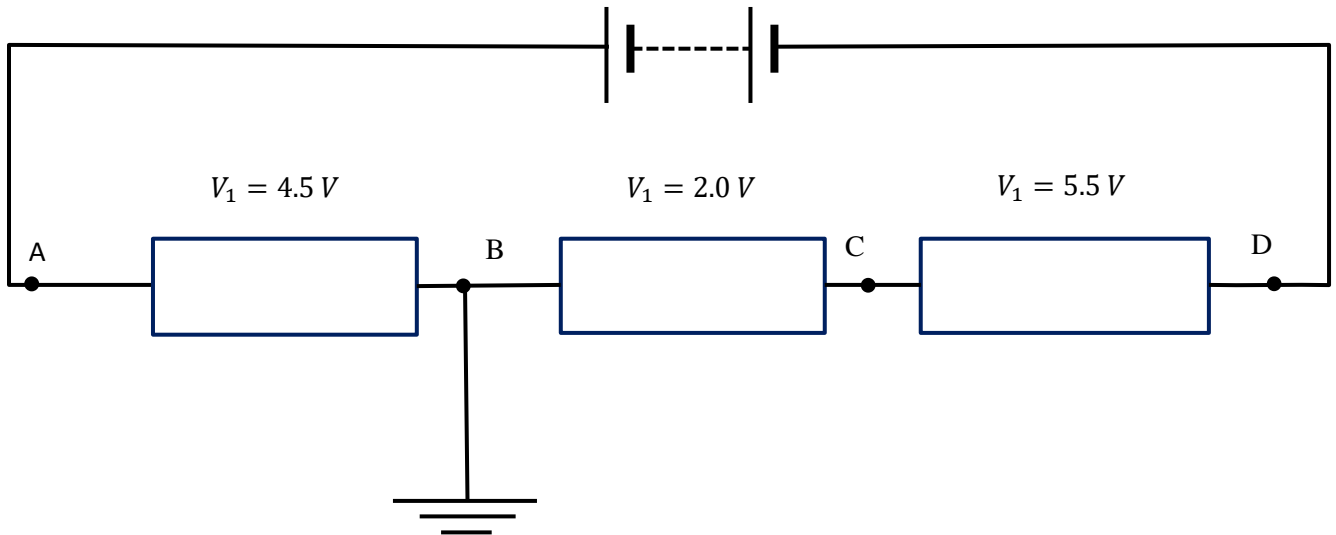
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### Q5

The circuit shows three resistors in series. The potential drop (p.d.) across the resistors are  $4.5\text{ V}$  and  $2\text{ V}$  and  $5.5\text{ V}$  respectively. The circuit is earthed at point B. Determine the potential at point A, B, C and D. Hence determine the voltage of the battery. (Assume the internal resistance of battery and that of the connecting wires is negligible).



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## ANSWERS

### SECTION 2: The Potential Divider

#### ANSWER TO Q1

**Q1**

The diagram shows a series circuit with a DC voltage source  $V_T = 12\text{ V}$  at the top. Below the source are two resistors,  $R_1$  and  $R_2$ , connected in series. The voltage across  $R_1$  is labeled as  $V_1 = 7\text{ V}$ . The resistance of  $R_1$  is given as  $R_1 = 1400\ \Omega$ .

$$V_1 + V_2 = V_T$$
$$7 + V_2 = 12 \Rightarrow V_2 = \underline{\underline{5\text{ V}}}$$
$$I_T = I_1 = \frac{V_1}{R_1} = \frac{7}{1400} = \underline{\underline{0.005\text{ A}}}$$
$$R_2 = \frac{V_2}{I_2} = \frac{5}{0.005} = \underline{\underline{1000\ \Omega}}$$

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## ANSWER TO Q2

**Q2**

$I_1 = 0.008 \text{ A}$

$$V_T = V_1 + V_2 = I_1 R_1 + I_2 R_2$$
$$= (0.008 \times 1500) + (0.008 \times 15500)$$
$$= 12 + 124 = 136 \text{ V}$$

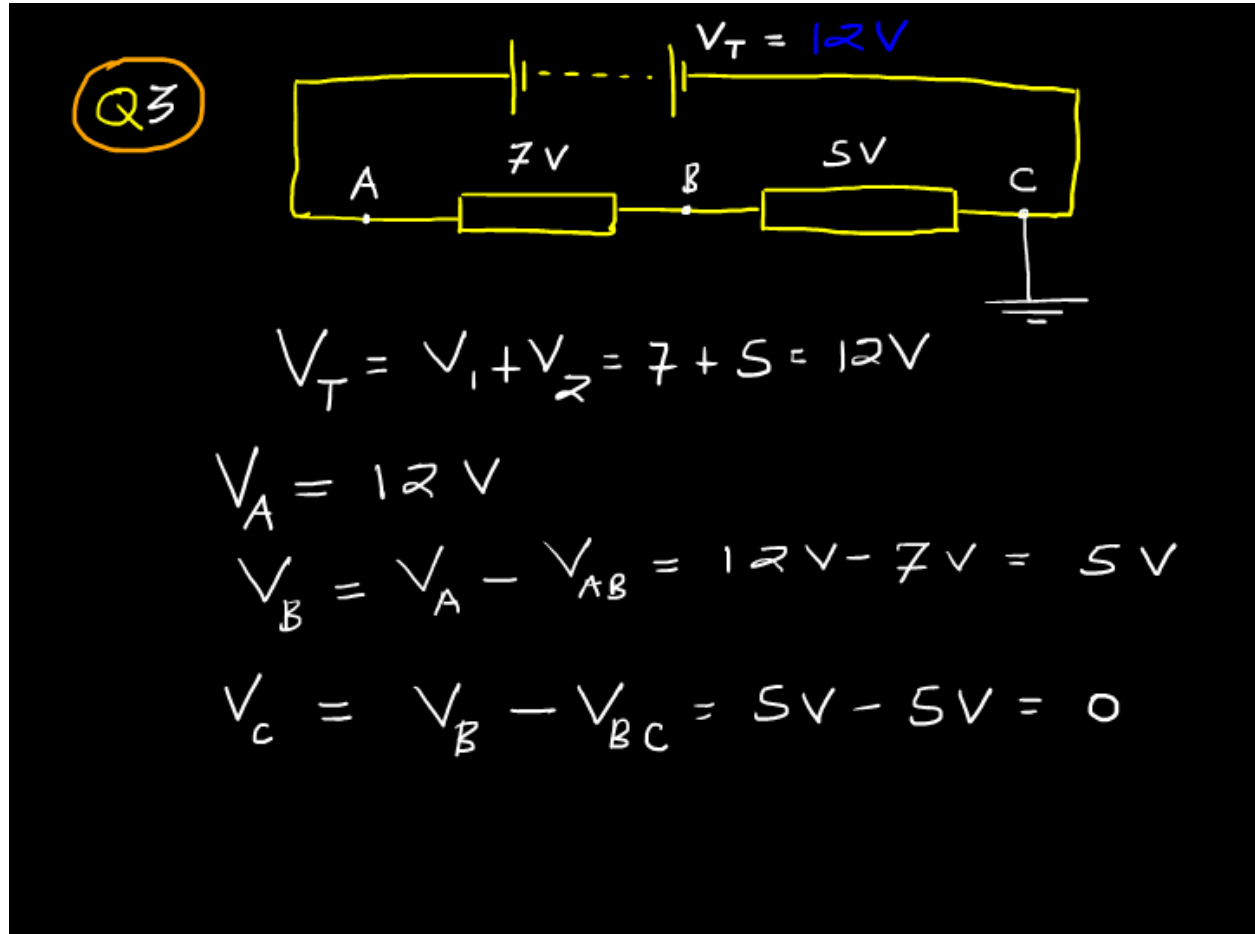
Or  $V_T = I_T R_T$ ,  $I_T = I_1$

$$\therefore V_T = 0.008 \times (1500 + 15500)$$
$$= 0.008 \times 17,000$$
$$= \underline{136 \text{ V}}$$

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### ANSWER TO Q3



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## ANSWER TO Q4

**Q4**

✓  $V_B = 0$  because it is "Earthed"

$V_{AB} = 7V, V_{BC} = 5V$

$V_C = V_B - V_{BC} = 0 - 5 = -5V$  ✓

The -ve terminal of battery is at a potential of 5V below zero, i.e. -5V.

$V_B = V_A - V_{AB}$

$0 = V_A - 7 \Rightarrow V_A = 7V$  ✓

$V_C = V_A - V_T$

$-5 = 7 - V_T \Rightarrow V_T = 7 + 5 = 12V$  ✓

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ANSWER TO Q5

Q5

$V_B = 0$  ✓

$V_B = V_A - V_{AB} \Rightarrow 0 = V_A - 4.5 \Rightarrow V_A = 4.5V$  ✓

$V_C = V_B - V_{BC} = 0 - 2.0 = -2.0V$  ✓

$V_D = V_C - V_{CD} = -2.0 - 5.5 = -7.5V$  ✓

$V_D = V_A - V_T$

$-7.5 = 4.5 - V_T \Rightarrow V_T = 4.5 + 7.5 = 12V$  ✓

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