Solutions

Each answer shows the steps, then the **result**.

2.1

- splits an input voltage into a chosen smaller output voltage, sharing it between resistors in proportion to their resistances

2.2

- $V_{\text{out}} = V_{\text{in}} \cdot R_2/(R_1 + R_2)$

$$V = (6.0\ \text{V}) \times \frac{4.0\ \text{k}\Omega}{2.0\ \text{k}\Omega + 4.0\ \text{k}\Omega} = \mathbf{4.0}\ \text{V}$$

2.3

- a uniform wire: $V \propto L$

$$V = (4.0\ \text{V}) \times \frac{20\ \text{cm}}{80\ \text{cm}} = \mathbf{1.0}\ \text{V}$$

2.4

- it **decreases**

3.1

- $V_{\text{out}} = V_{\text{in}} \cdot R_2/(R_1 + R_2)$

$$V_{\text{out}} = (12\ \text{V}) \times \frac{1.0\ \text{k}\Omega}{3.0\ \text{k}\Omega + 1.0\ \text{k}\Omega} = \mathbf{3.0}\ \text{V}$$

3.2

(a) the wire and R form a potential divider

$$V_{\text{XY}} = \varepsilon \cdot \frac{R_{\text{XY}}}{R + R_{\text{XY}}} \Rightarrow 2.4\ \text{V} = (6.0\ \text{V}) \times \frac{8.0\ \Omega}{R + 8.0\ \Omega}$$

$$R + 8.0\ \Omega = \frac{(6.0\ \text{V})(8.0\ \Omega)}{2.4\ \text{V}} = 20\ \Omega$$

- $R = 20\ \Omega - 8.0\ \Omega = \mathbf{12}\ \Omega$

(b) the wire is **uniform**, so its resistance is **proportional to length**

- the same current flows along it, so by $V = IR$ the p.d. across a length is proportional to that length

3.3

- as temperature rises, the thermistor's resistance **decreases**
- it now takes a **smaller share** of the total voltage
- so the output voltage across the thermistor **decreases**

3.4

- put the **LDR** in series with a fixed resistor and take the output across the **fixed resistor** (so the output rises in the dark)
- as it gets dark the LDR's resistance **rises**, so a larger share of the voltage is across the fixed resistor and the output **rises**
- the output crosses a **threshold** that switches the lamp on (e.g. via a transistor/comparator)