Answer on Question 51848, Physics, Other

18. A ray of light travels from air to glass. The incident ray makes an angle 45° while the refracted ray makes an angle of 30° with the normal to the interface. The speed of light in air is $3.0 \cdot 10^8\, m/s$. What is the speed of light in glass?

a) $2.12 \cdot 10^8\, m/s$

b) $4.24 \cdot 10^8\, m/s$

c) $3.73 \cdot 10^8\, m/s$

d) $3.0 \cdot 10^8\, m/s$

Solution:

From the Snell's law we have:

$$\frac{sin\theta_1}{sin\theta_2} = \frac{n_2}{n_1} = \frac{v_1}{v_2},$$

where, $\theta_1 = 45^{\circ}$ is the angle of incidence, $\theta_2 = 30^{\circ}$ is the angle of refraction, v_1 is the speed of light in air, v_2 is the speed of light in glass, n_1 is the refractive index of air, n_2 is the refractive index of glass.

Thus, we can find the speed of light in glass:

$$v_2 = v_1 \frac{sin\theta_2}{sin\theta_1} = 3.0 \cdot 10^8 \frac{m}{s} \cdot \frac{sin30^{\circ}}{sin45^{\circ}} = 3.0 \cdot 10^8 \frac{m}{s} \cdot \frac{0.5}{0.707} = 2.12 \cdot 10^8 \frac{m}{s}.$$

Answer: a) $2.12 \cdot 10^8 \frac{m}{s}$.

19. A $9V$ battery is short-circuited. The potential difference across the battery is found to be $8V$, and the current is $5A$. What is the internal resistance of the battery?

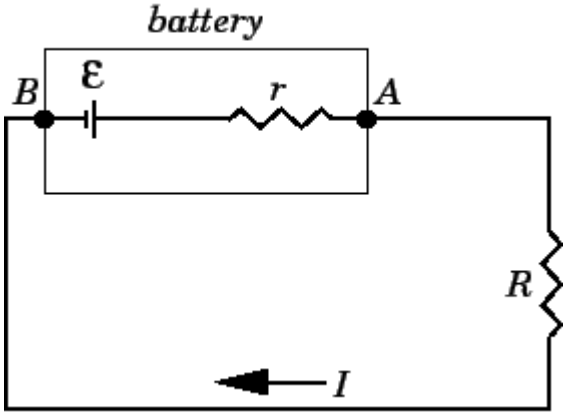
a) 0.1Ω

b) 0.2Ω

c) 0.3Ω

d) 0.4Ω

Solution:



Let us consider the short-circuited battery in the figure. The voltage V of the battery is defined as the difference in electric potential between its positive and negative terminals – the points A and B, respectively. As we move from B to A, the electric potential increases by $+\mathcal{E}$ volts as we cross the electromotive force, but then decreases by Ir volts as we cross the internal resistor. The voltage drop across the resistor follows from Ohm's law, which implies that the drop in voltage across a resistor R, carrying a current I, is IR in the direction in which the current flows. Therefore, the voltage V of the battery is related to its electromotive force $\mathcal{E}$ and internal resistance r as:

$$V = \mathcal{E} - Ir,$$

$$r = \frac{\mathcal{E} - V}{I} = \frac{9V - 8V}{5A} = \frac{1V}{5A} = 0.2\Omega.$$

Answer: b) 0.2Ω.

20. Ohm's law relates potential difference with?

a) power

b) energy

c) current

d) time

Answer: Ohm's law states that the current through a conductor between two points is directly proportional to the potential difference across the two points. So, the answer is c) current.