Physics chapter 27

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Sec:- CSE 1C

Example 27.1:-

The ..... $8.92\ g/cm^3$

Solution:-

$$V = \frac{m}{\rho} = \frac{63.59}{8.92\ g/cm^3} = 7.12\ cm^3$$

$$n = \frac{6.02 \times 10^{23}\ electron}{7.12\ cm^3} \left(\frac{1.00 \times 10^6\ cm^3}{1\ m^3} \right.$$

$$= 8.46 \times 10^{28}\ electron/m^3$$

$$v_d = \frac{I_{avg}}{nqA} = \frac{I}{nqA}$$

$$v_d = \frac{I}{nqA} = \frac{10.0\ A}{(8.46 \times 10^{28}\ m^{-3})(1.60 \times 10^{-19}\ C)(3.31 \times 10^{-6}\ m^2)}$$

$$= 2.23 \times 10^{-4}\ m/s$$

Example 27.2:-

The ..... of this wire

Solution:- (A):-

$$\frac{R}{L} = \frac{\rho}{A} = \frac{\rho}{\pi r^2} = \frac{1.5 \times 10^{-6}\ \Omega \cdot m}{\pi (0.321 \times 10^{-3}\ m)^2}$$

$$= 4.6\ \Omega/m$$

(B)

$$I = \frac{\Delta V}{R} = \frac{\Delta V}{(4.6\ \Omega/m)\ell} = \frac{10\ V}{(4.6\ \Omega/m)(1\ m)} = 2.2\ A$$

example 27.3:-
coaxial..... two conductors!-

Solution:-

$$dR = \frac{\rho}{2\pi r L}\, dr$$

$$R = \int dR = \frac{\rho}{2\pi L}\int_a^b \frac{dr}{r} = \frac{\rho}{2\pi L}\ln(b/a)$$

$$R = \frac{1.0\times10^{15}\,\Omega\cdot m}{2\pi(0.150\,m)}\ln\left(\frac{1.75\,cm}{0.50\,cm}\right) = \boxed{1.33\times10^{13}\,\Omega}$$

example 27.4:-
An ..... heater.

Solution:-

$$I = \frac{\Delta V}{R} = \frac{120\,V}{8.00\,\Omega} = \boxed{15.0\,A}$$

$$P = I^2R = (15.0)^2(8.00\,\Omega) = 1.8\times10^3\,W$$

$$= 1.80\,kW$$

example 27.5:-
An ..... 110V.

Solution:- (A)

$$P = \frac{(\Delta V)^2}{R} = \frac{Q}{\Delta t}$$

$$\frac{(\Delta V)^2}{R} = \frac{mc\Delta T}{\Delta t} \rightarrow R = \frac{(\Delta V)^2\Delta t}{mc\Delta T}$$

$$R = \frac{(110\,V)^2(600\,s)}{(1.50\,kg)(4186\,J/kg\cdot{}^\circ C)(50.0^\circ C - 20.0^\circ C)}$$

$$\boxed{R = 28.9\,\Omega}$$

(B) 1. Estimate the cost of heating the water.

$$P\Delta t = \frac{(\Delta V)^2}{R}\Delta t = \frac{(110V)^2}{28.9\Omega}(10.0min)\left(\frac{1h}{60.0min}\right)$$

$$= 69.8Wh = 0.0698kWh$$

$$Cost = (0.0698kWh)(\$0.1/kWh)$$

$$= 0.007\$ = \boxed{0.7¢}$$