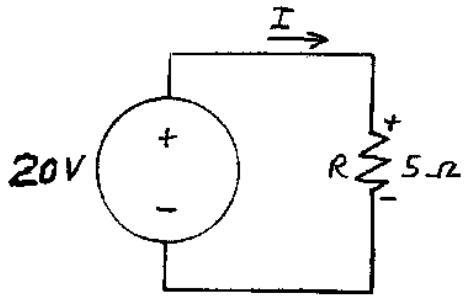
2.2



For this circuit:

a) Find power, P, absorbed by resistor.

$$P = \frac{V^2}{R}$$

$$= \frac{(20V)^2}{5\Omega}$$

$$= \underline{80 \text{ Watts}}$$

b) Find a value of R such that the absorbed power doubles.

$P = 160W \quad V = 20V$

$$P = \frac{V^2}{R}$$

$$R = \frac{V^2}{P}$$

$$= \frac{(20V)^2}{160W}$$

$$= \underline{2.50\Omega}$$

c) Find a value for the source voltage to restore P to 80W.

$P = 80W \quad R = 2.50\Omega$

$$P = \frac{V^2}{R}$$

$$V^2 = PR$$

$$V = \sqrt{PR}$$

$$= \sqrt{(80W)(2.50\Omega)}$$

$$= \underline{14.1V}$$

2.3 The dc resistance of a conductor is:

$$R = \frac{\rho \ell}{A} = \frac{\ell}{\sigma A}$$

ρ = electrical resistivity (Ωm)
ℓ = length of conductor (m)
A = cross-sectional area (m^2)
σ = electrical conductivity ($\frac{S}{m}$)

a) Find the resistance and voltage of a copper bus bar 1 by 5 cm in cross section and 30 cm long when carrying a current of 250 A.

Compute cross section area.

$$A = (1cm)(5cm)$$
$$= 5\,cm^2$$
$$= \underline{0.0005\,m^2}$$

Compute resistance. For copper $\sigma = 5.8 \times 10^7\ S/m$

$$R = \frac{\ell}{\sigma A}$$
$$= \frac{(30cm)(\frac{1m}{100cm})}{(5.8 \times 10^7 \frac{S}{m})(0.0005 m^2)}$$
$$= \underline{1.03 \times 10^{-5}\,\Omega}$$

Compute voltage.

$$V = IR$$
$$V = (250A)(1.03 \times 10^{-5}\,\Omega)$$
$$= \underline{2.58 \times 10^{-3}\,V}$$

b) An aluminum conductor 50 Km long has a circular cross section with a diameter of 1cm.
Find power absorbed by wire when carrying 100 A.

Compute cross section area.

$$A = \pi r^2$$
$$= (\pi)(0.5cm)^2$$
$$= 7.85 \times 10^{-1} cm^2$$
$$= \underline{7.85 \times 10^{-5} m^2}$$

2.3b cont.) Compute resistance For aluminum $\sigma = 3.5 \times 10^7 \frac{S}{m}$

$$R = \frac{\ell}{\sigma A}$$

$$= \frac{(50\,Km)\left(\frac{1000\,m}{Km}\right)}{\left(3.5 \times 10^7 \frac{S}{m}\right)(7.85 \times 10^{-5}\,m^2)}$$

$$= \underline{\underline{18.2\,\Omega}}$$

Compute power absorbed

$$P = I^2 R$$

$$P = (100A)^2 (18.2\,\Omega)$$

$$= \underline{\underline{1.82 \times 10^5\,W}}$$

c) Let us assume that one of Edison's light bulbs was a 30W model connected to a 36 V battery. The carbon filiment had a diameter of 0.9mm. Find the length of the filiment in inches assuming the resistity of carbon to be twice its room temperature value when in use.

Compute resistance.

$$P = \frac{V^2}{R}$$

$$R = \frac{V^2}{P}$$

$$= \frac{(36V)^2}{30W}$$

$$= \underline{\underline{43.2\,\Omega}}$$

Compute cross section area. $R = 0.2\,mm = 2 \times 10^{-4}\,m$

$$A = \pi R^2$$

$$= (\pi)(2 \times 10^{-4}\,m)^2$$

$$= \underline{\underline{1.26 \times 10^{-7}\,m^2}}$$

Compute length of filiment carbon's $\sigma = 2.9 \times 10^4 \frac{S}{m}$

$$R = \frac{\ell}{\sigma A}$$

$$\ell = R \sigma A$$

$$= (86.4\,\Omega)\left(2.9 \times 10^4 \frac{S}{m}\right)(1.26 \times 10^{-7}\,m^2)$$

$$= (0.316\,m)\left(\frac{39.37\,in}{1\,m}\right)$$

$$= \underline{\underline{12.4\ inches}}$$