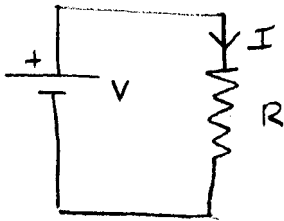


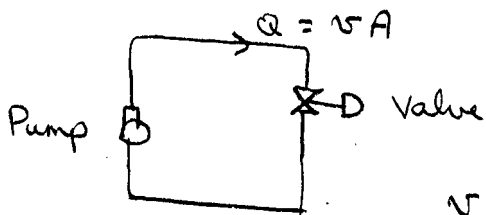
1. [Serway Chapter 27 Question 8, pg 790]  
 In the water analogy of an electric circuit, what corresponds to the power supply, resistor, charge, and potential difference?



$I = \text{flow}$   
 $R = \text{resistance}$   
 $V = \text{potential rise (drop)}$

$$V = RI$$

In hydraulic loops:



$$\Delta P_{\text{pump}} = \frac{fL}{D} \frac{v^2}{2g}$$

$v = \text{velocity}$   
 $A = \text{area}$   
 $L = \text{length}$   
 $D = \text{diameter}$   
 $g = \text{grav. const.}$   
 $\Delta P = \text{pressure diff.}$

$f = \text{friction factor}$   
 $Q = \text{volumetric flow}$

In laminar flow,  $f = \frac{64}{Re} \leftarrow \text{Reynold's \#}$

$$\propto \frac{1}{v}$$

$\therefore \Delta P_{\text{pump}} = k v$   
 $\uparrow$  same factor  $\propto$  to resistance.

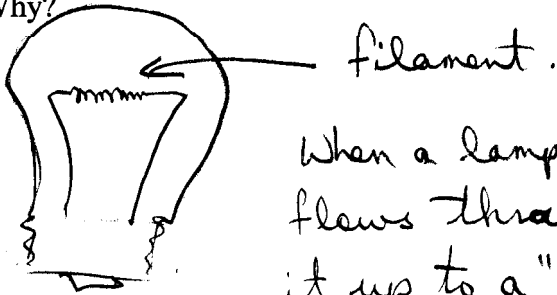
$$\therefore \Delta P \Leftrightarrow V$$

$$k \text{ or } f \Leftrightarrow R$$

$$Q \Leftrightarrow I$$

2. [Serway Chapter 27 Question 18, pg 791]

When incandescent lamps burn out, they usually do so just after they are switched on. Why?



When a lamp is turned on, current flows through the resistor, heating it up to a "white hot" temperature.

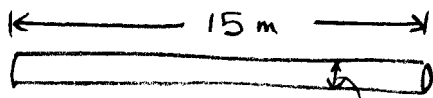
Since  $R = R_0 [1 + \alpha (T - T_0)]$  +  $\alpha > 0$ , the resistance is higher at higher temperatures.

The cycling of temperature as the lamp is switched on + off, on + off, etc., fatigues the metal, making it more susceptible to damage and breakage as time goes on.

The current is highest when the resistance is lowest - i.e. at the lowest temperature - i.e. the instant the lamp is turned on.

Thus a weakened filament (perhaps full of microscopic cracks and in a brittle state) is shocked more as it is turned on than after it is warmed up. Hence that is when it is more likely to break.

3. [Serway Chapter 27 Problem 16, pg 792]  
Eighteen-gauge wire has a diameter of 1.024 mm. Calculate the resistance of 15.0 m of 18-gauge copper wire at 20.0 °C.



$$D = 1.024 \text{ mm}$$

$$T = 20.0^\circ\text{C}$$

$$R = \rho \frac{l}{A} = 1.7 \times 10^{-8} \Omega \cdot \text{m} \times \frac{15}{\left[ \pi \left( \frac{1.024 \times 10^{-3}}{2} \right)^2 \right]} \Omega$$
$$= \underline{\underline{0.31 \Omega}}$$

( $\rho$  from Serway Table 27.1)

4. [Serway Chapter 27 Problem 17, pg 792]

While traveling through Death Valley on a day when the temperature is  $58^\circ\text{C}$ , Bill Hiker finds that a certain voltage applied to a copper wire produces a current of  $1.000\text{ A}$ . Bill then travels to Antarctica and applies the same voltage to the same wire. What current does he register if the temperature is  $-88^\circ\text{C}$ ? Assume no change in the wire's shape and size.

$$V = RI = \frac{\rho l}{A} I$$

Condition 1: Death Valley  $58^\circ\text{C}$   
" 2: Antarctica  $-88^\circ\text{C}$

$$V_1 = \frac{\rho_1 l_1}{A_1} I_1 = V_2 = \frac{\rho_2 l_1}{A_2} I_2$$

We are given  $l_1 = l_2$ ,  $A_1 = A_2$ ,  $V_1 = V_2$

$$\therefore \frac{V_2}{V_1} = 1 = \frac{\rho_2 I_2}{\rho_1 I_1} \Rightarrow I_2 = \frac{\rho_1 I_1}{\rho_2}$$

$$\begin{aligned} \therefore I_2 &= \frac{\cancel{\rho_0} [1 + \alpha(T_1 - T_0)] I_1}{\cancel{\rho_0} [1 + \alpha(T_2 - T_0)]} \\ &= \frac{[1 + 3.9 \times 10^{-3} (58 - 20)] \times 1\text{ A}}{1 + 3.9 \times 10^{-3} (-88 - 20)} \\ &= \frac{1.1482}{0.5788} = \underline{\underline{1.984\text{ A}}} \end{aligned}$$

5. [Serway Chapter 27 Problem 49, pg 794]

Suppose you want to install a heating coil that will convert electric energy to heat at a rate of 300 W for a current of 1.5 A.

(a) Determine the resistance of the coil.

(b) The resistivity of the coil wire is  $1.0 \times 10^{-6} \Omega \cdot m$ , and the diameter is 0.30 mm. Determine its length.

$$a) P = I^2 R \Rightarrow R = \frac{300 \text{ W}}{(1.5 \text{ A})^2} = \underline{\underline{133 \Omega}}$$

$$b) R = \frac{\rho l}{A} \Rightarrow l = \frac{RA}{\rho}$$

$$\therefore l = \frac{133 \Omega \times \pi \left( \frac{0.30 \times 10^{-3} \text{ m}}{2} \right)^2}{1.0 \times 10^{-6} \Omega \cdot m}$$

$$\therefore l = 9.4 \text{ m}$$

6. [Serway Chapter 27 Problem 54, pg 794]

It requires about 10.0 W of power per square foot to heat a room having ceilings 7.5 ft high. At a cost of \$0.08/kWh, how much does it cost per day to use electric heat to a room 10.0 ft x 15.0 ft?

$$\begin{aligned} \$/\text{day-room} &= \frac{\text{W}}{\text{ft}^2} \times \frac{\text{kW}}{\text{W}} \times \frac{\text{ft}^2}{\text{room}} \times \frac{\$}{\text{kWh}} \times \frac{\text{h}}{\text{day}} \\ &= 10 \times .001 \times (10 \times 15) \times \$0.08 \times 24 \\ &= \underline{\underline{\$ 2.88}} / \text{day per room} \end{aligned}$$