

Key

Physics 103 Quiz # 6, Thursday (2/28/2013)

Show all work in order to obtain points for problems

Name: _____

1. (2 pts) A swimming pool heater has to be able to raise the temperature of the 40 000 gallons of water in the pool by 10.0 C°. How many kilowatt-hours of energy are required? (One gallon of water has a mass of approximately 3.8 kg and the specific heat of water is 4 186 J/kg·°C.)

- a. 1 960 kWh
- b. 1 770 kWh
- c. 330 kWh
- d. 216 kWh

$$Q = mc\Delta T$$

$$= (3.8 \times 40000 \text{ kg}) 4186 \text{ J/kg} \cdot 10$$

$$= 6.36 \times 10^9 \text{ J}$$

$$1 \text{ kWh} = 10^3 \times 3600 = 3.6 \times 10^6 \text{ J} = 1 \text{ kWh}$$

$$= 1770 \text{ kWh}$$

2. (3 pts) The filament temperature of a light bulb is 2 000 K when the bulb delivers 40 W of power. If its emissivity remains constant, what power is delivered when the filament temperature is 2 500 K?

- a. 105 W
- b. 62 W
- c. 98 W
- d. 50 W

$$P_1 = e\sigma AT_1^4$$

$$P_2 = e\sigma AT_2^4$$

$$\frac{P_2}{P_1} = \frac{T_2^4}{T_1^4}$$

$$P = e\sigma AT^4$$

$$\sigma = 5.7 \times 10^{-8} \text{ W/m}^2\text{K}^4$$

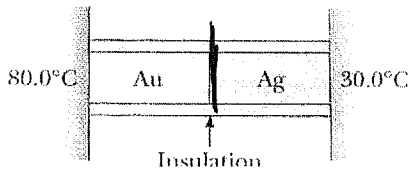
$$T_2 = P_1 \left(\frac{T_2}{T_1} \right)^4$$

$$= 40 \times \left(\frac{2500}{2000} \right)^4$$

$$= 98 \text{ W}$$

3. (5 pts)

A bar of gold (Au) is in thermal contact with a bar of silver (Ag) of the same length and area (Fig. P11.61). One end of the compound bar is maintained at 80.0°C, and the opposite end is at 30.0°C. Find the temperature at the junction when the energy flow reaches a steady state.



$$k = 314 \text{ Au}$$

$$k = 417 \text{ Ag}$$

$$P_1 = P_2$$

$$k_{Au} A \left(\frac{80 - T_m}{L} \right) = k_{Ag} A \left(\frac{T_m - 30}{L} \right)$$

$$k_{Au} (80 - T_m) = k_{Ag} (T_m - 30)$$

$$k_{Au} 80 + k_{Ag} 30 = T_m (k_{Au} + k_{Ag})$$

$$T_m = \frac{k_{Au} (80) + k_{Ag} (30)}{k_{Au} + k_{Ag}}$$

$$= 51.20 \text{ C}$$