Ch 1 solutions

48) $T_C = \frac{5}{9}(-T_C - 32) \Rightarrow T_C + \frac{5}{9}T_C = -\frac{5}{9}32$

$\Rightarrow T_C = -\frac{5}{9}32 \Big/ \frac{14}{9} = \boxed{-11.4\ °C}$

52) $\Delta L = \alpha L \Delta T = (12 \cdot 10^{-6} \text{ per } °C)(10.0 m)(35.0 °C) = \boxed{0.0042 m}$

56) a) $\Delta V = \beta V \Delta T = (1100 \cdot 10^{-6} \text{ per } °C)(500 mL)(17.0 °C) = \boxed{9.35 mL}$

b) $\Delta V = \beta V \Delta T = (210 \cdot 10^{-6} \text{ per } °C)(500 mL)(17.0 °C) = 1.785 mL$
which is $\boxed{7.565 mL}$ less

66) $mc\Delta T_{Cu} = mc\Delta T_{H_2O} \Rightarrow \frac{m_{Cu}}{m_{H_2O}} = \frac{c_{H_2O}}{c_{Cu}} = \frac{4186}{387} = \boxed{10.8}$

68) $Q = mc_{human}\Delta T = (80.0 kg)(3500 \frac{J}{kg \cdot °C})(3 °C) = 8.40 \cdot 10^5 J$

$P_{cooling} = \frac{Q}{\Delta t} = 8.40 \cdot 10^5 J / 30 min = 4.67 \cdot 10^2 W$

$P_{total} = P_{cooling} + P_{body} = 467 W + 150 W = \boxed{617 W}$

77) $m_{pool} c \Delta T = m_{evaporate} L_V \Rightarrow \frac{m_{evaporate}}{m_{pool}} = \frac{c\Delta T}{L_V}$

$\Rightarrow m_{evaporate}/m_{pool} = (4186 \frac{J}{kg °C})(1.50 °C) \Big/ 2430 \ kJ/k = \boxed{0.00258}$

where I used L_V at 37 °C (see Table 1.4 notes)

80) Heat gained in evaporation equals heat lost by coffee and the glass $\Longrightarrow$

$$m_{evap} L_v = m_w C_w \Delta T_w + m_g C_g \Delta T_g$$

$$\Rightarrow m_{evap} = \frac{m_w C_w \Delta T + m_g C_g \Delta T}{L_v} = \frac{0.35 \cdot 4186 \cdot 50 + (0.1)(840)50}{234 \cdot 10^3}$$

$$= \boxed{0.033\ kg}$$

95) a) $P = \frac{kA\Delta T}{d} = \frac{0.023 \quad 1.40 \cdot 37.0}{0.03} = \boxed{39.2\ W}$

b) over 24 hours, heat lost is $P \cdot 24 \cdot 3600 = 3.43 \cdot 10^6\ J$
which is $\boxed{819.2\ kcal}$ $(1\ kal = 4186\ J)$

96) $d = kA\Delta T/P = \frac{0.2 \quad 2.0 \quad 38.0}{150} = \boxed{0.101\ m}$
where k is fatty tissue from table 1.5

104) $\Delta L_s = \Delta L_{Al}$ and $\Delta T_s = \Delta L_{Al}$ and $L_s - L_{Al} = 0.5m$

$\Rightarrow \alpha_s L_s \cancel{\Delta T} = \alpha_{AL} L_{Al} \cancel{\Delta T} \Rightarrow \alpha_s (L_{Al} + 0.5m) = \alpha_{Al} L_{Al}$

$\Rightarrow \frac{0.50\ \alpha_s}{\alpha_{Al} - \alpha_s} = L_{Al} = \frac{0.5 \quad 12 \cdot 10^{-6}}{25 \cdot 10^{-6} - 12 \cdot 10^{-6}} = \boxed{0.462\ m}$

$\Rightarrow L_s = L_{Al} + 0.5\ m = \boxed{0.962\ m}$