$\boxed{12.1}$

$T_C = -273.15\ ^\circ C$

$$T_F = \left(\frac{9}{5} T_C + 32.0\right) ^\circ F = \left[\frac{9}{5}(-273.15) + 32.0\right] ^\circ F = \boxed{-459.67\ ^\circ F}$$

$\boxed{12.3}$

$T_{F_1} = 50.0\,°F$
$T_{F_2} = 104\,°F$

a. Since $T_C = \frac{5}{9}(T_F - 32°)$

$$T_{C_1} = \frac{5}{9}(50.0° - 32°) = \boxed{10.0°C}$$

$$T_{C_2} = \frac{5}{9}(104° - 32°) = \boxed{40.0°C}$$

b. Since $T_K = T_C + 273°$

$$T_{K_1} = (10.0° + 273°)\,K = \boxed{283\ K}$$

$$T_{K_2} = (40.0° + 273°)\,K = \boxed{313\ K}$$

$\boxed{12.11}$

$L_o = ?$

$\Delta L = 0.53\,m$

$\Delta T = 32°C - 2°C = 30C°$

Since $\Delta L = \alpha L_o \Delta T \longrightarrow L_o = \dfrac{\Delta L}{\alpha \Delta T}$

From the table of coefficients of thermal expansion in this chapter,

$\alpha_{steel} = 12 \times 10^{-6}\ {}^{1}\!/_{C°}$

$\therefore\ L_o = \dfrac{0.53\,m}{(12 \times 10^{-6}\ {}^{1}\!/_{C°})(30C°)} = 1472.22\,m$

Rounded to two significant figures,

$L_o = \boxed{1500\,m}$

$\boxed{12.25}$

$T_1 = 24°C$
$T_2 = 100°C$
$\Delta V = 1.2 \times 10^{-5} m^3$
$V_0 = ?$

Since the kettle is made of copper, it has a coefficient of volume expansion

$$\beta_{cu} = 51 \times 10^{-6} \frac{1}{C°}$$

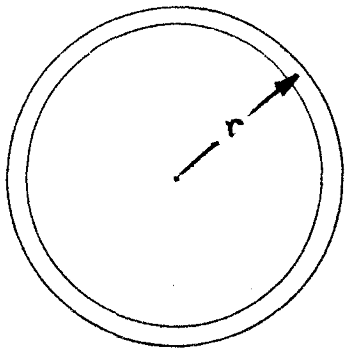
Since $\Delta V = \beta V_0 \Delta T \longrightarrow V_0 = \dfrac{\Delta V}{\beta \Delta T}$

$$\therefore \; V_0 = \frac{1.2 \times 10^{-5} m^3}{(51 \times 10^{-6} \frac{1}{C°})(76 C°)} = 0.0030959752 \; m^3$$

when rounded to two significant figures,

$$V_0 = 0.0031 \; m^3 = \boxed{3.1 \times 10^{-3} m^3}$$

$\boxed{12.27}$



The cavity in an object expands and contracts exactly as the material would that was removed to create the cavity. So,

$$\Delta V = \beta V_0 \Delta T$$

where V_0 is the volume of the cavity. Since this is a spherical cavity,

$$V_0 = \frac{4}{3}\pi r^3 = \frac{4}{3}\pi (2.0\times 10^{-2} m)^3 = 3.351\times 10^{-5} m^3$$

$$\Delta T = T_2 - T_1 = 147°C - 18°C = 129C°$$

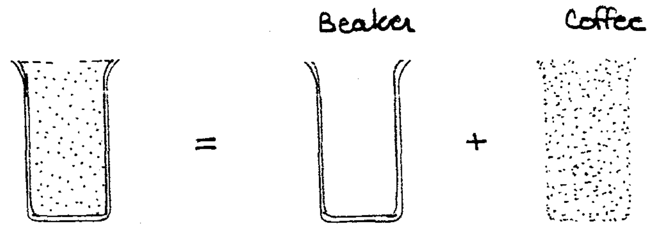
From the tables in chapter 12 that list coefficients of expansion,

$$\beta = 57\times 10^{-6} \frac{1}{C°}$$

$$\therefore \Delta V = (57\times 10^{-6} \frac{1}{C°})(3.351\times 10^{-5} m^3)(129C°) = 2.464\times 10^{-7} m^3$$

Rounded to two significant figures, $\Delta V = \boxed{2.5\times 10^{-7} m^3}$

$\boxed{12.30}$



$V_B = V_c = 0.50 \times 10^{-3}\, m^3$

$\Delta T_B = \Delta T_c = 92\,°C - 18\,°C = 74C°$

$\beta_B = \beta_{Pyrex} = 9.9 \times 10^{-6}\,(C°)^{-1}$
$\beta_c = \beta_{water} = 207 \times 10^{-6}\,(C°)^{-1}$

Since $\Delta V = \beta\, V_o\, \Delta T$

$$\Delta V_c = \beta_c V_c \Delta T_c = (207 \times 10^{-6}/C°)(0.50 \times 10^{-3} m^3)(74C°) = 7.659 \times 10^{-6}\, m^3$$

$$\Delta V_B = \beta_B V_B \Delta T_B = (9.9 \times 10^{-6}/C°)(0.50 \times 10^{-3} m^3)(74C°) = 3.663 \times 10^{-7}\, m^3$$

We see that while the volume of the beaker increases (that would make more room for the coffee), the volume of the coffee increases even more (at that means it will spill). The volume that spills V_{spill} is the difference between ΔV_c and ΔV_B.

$$\therefore V_{spill} = \Delta V_c - \Delta V_B = 7.659 \times 10^{-6} m^3 - 3.663 \times 10^{-7} m^3 = \boxed{7.3 \times 10^{-6}\, m^3}$$

$\boxed{12.45}$

Since the heat gained by the oil equals the heat lost by the metal,

$$\Delta Q_{oil} = -\Delta Q_{metal}$$

Assuming that neither the oil nor the metal change state,

$$m_o c_o \Delta T_o = -m_m c_m \Delta T_m$$

Solving for ΔT_m we have

$$\Delta T_m = \frac{m_o c_o \Delta T_o}{-m_m c_m} = \frac{(710\,kg)(2700\ J/kg\,C^\circ)(47^\circ C - 32^\circ C)}{-(75\,kg)(430\ J/kg\,C^\circ)}$$

$$\Delta T_m = -891.627907\ C^\circ$$

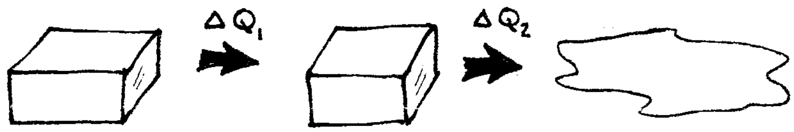
Since $\Delta T_m = T_{m_2} - T_{m_1}$ and $T_{m_2} = 47^\circ C$, we can solve for T_{m_1}:

$$T_{m_1} = T_{m_2} - \Delta T_m = 47^\circ C - (-891.627907\,C^\circ) = 938.627907^\circ C$$

Rounding off the answer to two significant figures,

$$T_{m_1} = \boxed{940^\circ C}$$

$\boxed{12.51}$



$T_1 = 130°C$ $\quad$ $T_2 = 660°C$ $\quad$ $T_3 = 660°C$

$$\Delta Q_{total} = \Delta Q_1 + \Delta Q_2 = mc\Delta T + mL = m(c\Delta T + L)$$

$$\therefore \Delta Q_{total} = 0.45\,kg\left[\left(900\,\frac{J}{kg\,C°}\right)(530\,C°) + 4.0\times10^5\,J/kg\right] = 394{,}650\,J$$

Rounded to two significant figures, $\Delta Q_{total} = \boxed{390{,}000\,J}$

$\boxed{12.53}$

a. Since the 2.00 kg of water is already at the boiling point (100.0°C at atmospheric pressure), the heat required to just vaporize it is

$$\Delta Q = m L_v = (2.00\ \text{kg})(22.6 \times 10^5\ \frac{\text{J}}{\text{kg}}) = 45.2 \times 10^5\ \text{J} \text{ or } \boxed{4.52 \times 10^6\ \text{J}}$$

b. In this case, the water (I assume liquid) must first be raised from 0.0°C to 100.0°C before the vaporization described in part a can occur. Thus, the total heat required is

$$\Delta Q = mc\Delta T + mL_v$$

$$\Delta Q = (2.00\ \text{kg})(4186\ \frac{\text{J}}{\text{kg}})(100.0\ \text{C}^\circ) + 4.52 \times 10^6\ \text{J}$$

$$\Delta Q = .8372 \times 10^6\ \text{J} + 4.52 \times 10^6\ \text{J} = \boxed{5.36 \times 10^6\ \text{J}}$$

$\boxed{12.57}$

$T_1 = -12.0°C$
$h = 4.50 \times 10^{-4}\ m$
$A = 1.25\ m^2$
$\rho_{ice} = 917\ kg/m^3$
$\Delta Q = ?$

In order to melt the ice, two stages of heating are required: ΔQ_1 is the heat needed to raise the temperature of the ice to 0°C and ΔQ_2 is the heat needed to change the ice to water.

Thus, the total heat needed is,

$$\Delta Q = \Delta Q_1 + \Delta Q_2 = m_{ice} c_{ice} \Delta T_{ice} + m_{ice} L_F = m_{ice}(c_{ice} \Delta T_{ice} + L_F) \quad \#1$$

$$\Delta T_{ice} = T_{ice_2} - T_{ice_1} = [0.0°C - (-12.0°C)] = 12.0C°$$

To determine m_{ice}, we use

$$m_{ice} = \rho_{ice} V_{ice} = \rho_{ice} A h = (917\ kg/m^3)(1.25 m^2)(4.50 \times 10^{-4} m) = 0.515812 5\ kg$$

Substituting these values and those from tables 12.2 and 12.4 into eq # 1,

$$\Delta Q = 0.5158125\ kg \left[(2.00 \times 10^3 \frac{J}{kg\, C°})(12.0C°) + 33.5 \times 10^4 \frac{J}{kg} \right]$$

$$\Delta Q = \boxed{185{,}000\ J}$$

$\boxed{12.77}$

$L_o = 370\ m.$
$T_1 = 2.0\ °C$
$T_2 = 21\ °C$
$\alpha_{steel} = 12 \times 10^{-6}\ (C°)^{-1}$

$$\Delta L = \alpha L_o \Delta T = (12 \times 10^{-6}\ 1/C°)(370\ m)(21°C - 2.0°C)$$

$$\Delta L = (12 \times 10^{-6}\ 1/C°)(370\ m)(19\ C°) = \boxed{8.4 \times 10^{-2}\ m}$$