1.

$l = 1000\,m$

$T_{winter} = 0.00\,^{\circ}C$

$T_{summer} = 40.0\,^{\circ}C$

$\alpha_{steel} = 10.5 \times 10^{-6}\,K^{-1}$

$\Delta L = \alpha l_0 \Delta T$

$\Delta L = (10.5 \times 10^{-6}\,K^{-1})(1000\,m)(40.0^{\circ}C - 0.00^{\circ}C)$

$\boxed{\Delta L = 0.42\,m}$

2.

$\alpha_{aluminum} = 24 \times 10^{-6}\,K^{-1}$

$T_0 = 15^{\circ}C$

$l_0 = 62.1\,m$

$T_1 = 200^{\circ}C$

$\Delta L = \alpha l_0 \Delta T$

$\Delta L = (24 \times 10^{-6}\,K^{-1})(62.1\,m)(200^{\circ}C - 15^{\circ}C)$

$\Delta L = 0.276\,m = \boxed{27.6\,cm}$

3.

$\ell_{brass} = 40.1\,cm = 0.401\,m$

$\ell_{aluminum} = 79.3\,cm = 0.793\,m$

$T_o = 0°C$

$d = 0.60\,cm = 0.0060\,m$

$\alpha_{brass} = 2.0 \times 10^{-5}\,K^{-1}$

$\alpha_{aluminum} = 2.4 \times 10^{-5}\,K^{-1}$

$$\Delta L_{brass} + \Delta L_{aluminum} = d$$

$$\alpha_{brass}\,\ell_{brass}\,\Delta T + \alpha_{alum}\,\ell_{alum}\,\Delta T = d$$

$$\Delta T = \frac{d}{\alpha_{brass}\,\ell_{brass} + \alpha_{alum}\,\ell_{alum}}$$

$$\Delta T = \frac{0.0060\,m}{(2.0 \times 10^{-5}\,K^{-1})(0.401\,m) + (2.4 \times 10^{-5}\,K^{-1})(0.793\,m)}$$

$$\Delta T = 221.795°C \approx 220°C$$

4.

$m = 199.0\,g = 0.199\,kg$

$Q = 16.0\,J$

$\Delta T = 10.0^\circ C$

$c = ?$

$$Q = mc\Delta T$$

$$c = \frac{Q}{m\Delta T}$$

$$c = \frac{16.0\,J}{(0.199\,kg)(10.0^\circ C)}$$

$$\boxed{c = 8.04\,J\,kg^{-1}\,^\circ C^{-1}}$$

5.

$m = 905\,g = 0.905\,kg$

$v_0 = 1629\,m/s$

$\Delta T = ?$

$c = 472\,J\,kg^{-1}K^{-1}$

$$KE = Q$$

$$\frac{1}{2}mv^2 = mc\Delta T$$

$$\Delta T = \frac{v^2}{2c}$$

$$\Delta T = \frac{(1629\,m/s)^2}{2(472\,J\,kg^{-1}K^{-1})}$$

$$\Delta T = 2811.06^\circ C \approx \boxed{2810^\circ C}$$

6.

$T_{melt} = 20°C$

$L_f = 3.9 \times 10^4 \, J \, kg^{-1}$

$T_{boil} = 150°C$

$L_v = 7.8 \times 10^4 \, J \, kg^{-1}$

$c_{solid} = 600 \, J \, kg^{-1} K^{-1}$

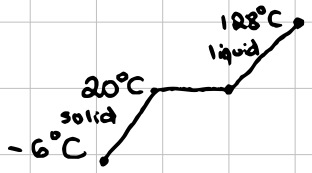
$c_{liquid} = 1000 \, J \, kg^{-1} K^{-1}$

$c_{gas} = 400 \, J \, kg^{-1} K^{-1}$

$m = 3.80 kg$

$T_0 = -6°C$

$T_1 = 128°C$



$Q_0 + Q_1 + Q_2 = Q_{Total}$

$m(c_{solid} \Delta T_{0,1} + L_f + c_{liquid} \Delta T_{1,2}) = Q_{total}$

$Q_{total} = (3.80 kg)[(600 J kg^{-1} K^{-1})(20°C - (-6°C)) + 3.9 \times 10^4 J kg^{-1}$
$+ (1000 J kg^{-1} K^{-1})(128°C - 20°C)]$

$Q_{total} = 617880 J = 6.179 \times 10^5 J$

$= 617.88 kJ \approx 620 kJ$

7.

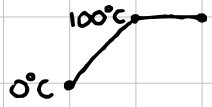
$m = 2.0\,g$

$T_o = 0.00^\circ C$

$c = 1.0\ cal\ g^{-1}K^{-1}$

$L_f = 80\ cal\ g^{-1}$

$L_v = 539\ cal\ g^{-1}$



$Q_{total} = Q_0 + Q_1$

$Q_{total} = m(c\Delta T_{1,0} + L_v)$

$Q_{total} = (2.0g)[(1.0\ cal\ g^{-1}K^{-1})(100.0^\circ C - 0.0^\circ C) + 539\ cal\ g^{-1}]$

$Q_{total} = 1278\ cal \approx 1300\ cal$

8.

$m_{water} = 330\,g = 0.330\,kg$

$T_{water_0} = 45^\circ C$

$m_{container} = 855\,g = 0.855\,kg$

$T_{container_0} = 10^\circ C$

$c_{water} = 4190\,J\,kg^{-1}K^{-1}$

$c_{aluminum} = 900\,J\,kg^{-1}K^{-1}$

$T_1 = ?$

$$Q_0 + Q_1 = 0$$

$$m_w c_w (T_1 - T_{water_0}) + m_c c_{alum} (T_1 - T_{c_0}) = 0$$

$$T_1 (m_w c_w + m_c c_{alum}) = m_w c_w T_{w_0} + m_c c_a T_{c_0}$$

$$T_1 = \frac{m_w c_w T_{w_0} + m_c c_a T_{c_0}}{m_w c_w + m_c c_{alum}}$$

$$T_1 = \frac{(0.330kg)(4190\,J\,kg^{-1}K^{-1})(45^\circ C) + (0.855kg)(900\,J\,kg^{-1}K^{-1})(10^\circ C)}{(0.330kg)(4190\,J\,kg^{-1}K^{-1}) + (0.855\,kg)(900\,J\,kg^{-1}K^{-1})}$$

$T_1 = 32.4861^\circ C \approx 32.0^\circ C$

9.

$T_{melt} = -10°C$

$m_{frozen} = 200g = 0.200\,kg$

$T_{frozen_0} = -10°C$

$m_{water} = 300g = 0.300\,kg$

$T_{water_0} = 20.0°C$

$T_1 = 5.0°C$

$m_f = 0.200\,kg$

$m_w' = 0.500\,kg$

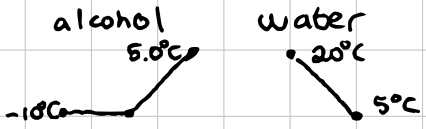
$T_{w_0}' = 20°C$

$T_1' = 10°C$

$Q_0' + Q_1' = Q_2'$

$m_f L_f + m_f c\,\Delta T_{1,f_0}' = m_w' c_w \Delta T_{1,w_0}'$

$$c = \frac{m_w' c_w \Delta T_{1,w_0}' - m_f L_f}{m_f \Delta T_{1,f_0}'}$$



$Q_0 + Q_1 = Q_2$

$m_f L_f + m_f c\,\Delta T_{1,f_0} = m_w c_w \Delta T_{1,w_0}$

$$m_f L_f + m_f \Delta T_{1,f_0}\left[\frac{m_w' c_w \Delta T_{1,w_0}' - m_f L_f}{m_f \Delta T_{1,f_0}'}\right] = m_w c_w \Delta T_{1,w_0}$$

$$L_f\left[m_f - \frac{m_f \Delta T_{1,f_0}}{\Delta T_{1,f_0}'}\right] = c_w\left[m_w \Delta T_{1,w_0} - \frac{m_w' \Delta T_{1,w_0}' \Delta T_{1,f_0}}{\Delta T_{1,f_0}'}\right]$$

$$L_f = c_w\left[m_w \Delta T_{1,w_0} - \frac{m_w' \Delta T_{1,w_0}' \Delta T_{1,f_0}}{\Delta T_{1,f_0}'}\right]\left[\frac{\Delta T_{1,f_0}'}{m_f(\Delta T_{1,f_0}' - \Delta T_{1,f_0})}\right]$$

$$L_f = (4190\,J\,kg^{-1}K^{-1})\left[(0.300kg)(5°C-20°C) - \frac{(0.500kg)(10°C-20°C)(5°C-(-10°C))}{(10°C-(-10°C))}\right]$$

$$\left[\frac{10°C-(-10°C)}{(0.200kg)\left[(10°C-(-10°C))-(5°C-(-10°C))\right]}\right]$$

$L_f = 62850\,J\,kg^{-1} = 6.29\times10^4\,J\,kg^{-1} \approx 6.3\times10^4\,J\,kg^{-1}$

10.

$m_{tea} = 1.8\ kg$

$T_{tea_0} = 80°C$

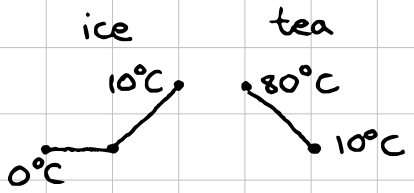
$m_{ice} = ?$

$T_{ice_0} = 0.00°C$

$T_1 = 10°C$

$L_f = 334\ kJ\ kg^{-1} = 334000\ J\ kg^{-1}$

$c_{tea} = 4190\ J\ kg^{-1} K^{-1}$



$$Q_{water,ice} + Q_{1,ice_0} = -Q_{1,tea_0}$$

$$m_{ice} L_f + m_{ice} c_{water} \Delta T_{1,ice_0} = -m_{tea} c_{tea} \Delta T_{1,tea_0}$$

$$m_{ice} = \frac{-m_{tea} c_{tea} \Delta T_{1,tea_0}}{L_f + c_{water}(T_1 - T_{ice_0})}$$

$$m_{ice} = \frac{-(1.8kg)(4190\ J\ kg^{-1} K^{-1})[10°C - 80°C]}{334000 J kg^{-1} + (4190 J kg^{-1} K^{-1})[10°C - 0°C]}$$

$m_{ice} = 1.40\ kg$