HW3.

11. the formular for volume expansion is

$V_f = V_i \times (1 + \beta \cdot \Delta t)$

we have

$V_i = 50.00\ cm^3$ (Volume at $60°C$)

$\Delta t = 60 - 30 = 30°C$

$\Rightarrow V_f = 50\ cm^3 \cdot (1 + 30 \cdot (29 \cdot 10^{-6})$

$\cancel{\times (30°C - 60)}\ 30°C)$

$= 49,87\ cm^3$

15) For linear expansion of the steel

$D_{steel} = D_{steel,0} + D_{steel,0}\, a_s \Delta t$

$D_{brass} = D_{brass,0} + D_{brass,0}\, a_b \Delta t$

If the ring slides over the rod

$D_{steel} = D_{brass}$

$$\Delta t = \frac{D_{steel,0} - D_{brass,0}}{D_{brass,0}\, a_b - D_{steel,0}\, a_s}$$

$$= \frac{3.0 - 2.992}{2,992 \cdot 19 \cdot 10^{-6} - 3 \cdot 11 \cdot 10^{-6}}$$

$= 335.5°$

$\Rightarrow T = 25 + 335.5 = 360.5°C$

19) $\Delta A = A_0 (2a) \Delta t$

$\Delta V = V_0 \beta \Delta t$

$h = \frac{V}{A} = \frac{V_0 + \Delta V}{A_0 + \Delta A} = \frac{V_0(1+\beta\Delta t)}{A_0(1+2a\Delta t)}$

$= h_0 \frac{(1+\beta\Delta t)}{1+2a\Delta t}$

$\Delta h = h - h_0 = h_0 \left[\frac{(1+\beta\Delta t)}{1+2a\Delta t} - 1 \right]$

$= \frac{1.28}{2} = 0,64 \text{ (m)}$

$\Delta T = 30°C - 20°C = 100°C$

21) $L - L_0 = L_0 a \Delta t$

$x^2 = l^2 - l_0^2 = (l_0 + l_0 a \Delta t)^2 - l_0^2$

where $l = \frac{L}{2}$, $l_0 = \frac{L_0}{2} = L_0$

$x^2 = L_0^2(1+a\Delta t)^2 - L_0^2 \approx 2L_0^2 a \Delta A$

$x = l_0\sqrt{2a\Delta t} = \frac{3.77}{(m)^2}\sqrt{2 \cdot 25 \cdot 10^{-6} \cdot 32}$

$= 754 \cdot 10^{-3} \text{ (m)}$

$= 754 \text{ mm}$

29) $P = \left(\frac{1}{20\%}\right) \frac{cm\Delta T}{t} = \frac{1}{20\%}$

$\frac{(4{,}18\ J/g\,°C)(200.10^3\ cm^3)(1\ g/cm^3)(40\,°C)}{(1h)(3600s)}$

$= 2{,}3.10^4\ W$

the area needed is then A

$A = \frac{2{,}3.10^4\ W}{700\ W/m^2} = 33\ m^2$

30) $R = \frac{Q_{cooling}}{t_{cooling}} = \frac{cm\Delta T}{t_{cooling}}$

$R = 900\ (J/min)$

a) $Q_{freezing} = (900 \cdot 30) = 27000\ J$

$Q_{freezing} = L_F m \Rightarrow L_F = 67{,}5\ (kJ/kg)$

b) $Q_{Frozen} = cm\Delta T \Rightarrow c = \frac{Q_{Frozen}}{m\Delta T} = \frac{12.10}{n.10}$

32) $Q = cm\Delta T \qquad = 2250\ (J/kg.K)$

in the case here

$c = c(T)$

$dQ = mc\,dT$

$Q_{total} = \int_{T_1}^{T_f} cm\,dT = m\int_{T_1}^{T_f} c\,dT = m\int_{T_1}^{T_f}(0{,}20 + 0{,}14T$

$0{,}023T^2)$

35) $Q_1 = \lambda_F m_I + m_I c_w (T_f - 0°C)$

$|Q_c| = m_w c_w (T_i - T_f)$

Setting $Q_1 = |Q_c|$

$$T_f = \frac{m_w c_w T_1 - \lambda_F m_I}{(m_I + m_c) c_w}$$

$$= \frac{(130)(4190)(80) - (333 \cdot 10^3)(12)}{(12 + 130)(4190)}$$

$= 66.5°C$

$|\Delta T| = 80°C - 66{,}5°C = 13{,}5°C$

$= 66.5°C$

$|\Delta T| = 80°C - 66{,}5°C = 13{,}5°C$

36) a) the heat transferered to water

$Q_w = m_w c_w \Delta T + L_v m_s$

$Q_w = 0{,}22 kg \cdot 4187 \cdot (100-20) + 2256$

$= 85 kJ = (20{,}3 kcal)$

b) the heat transfers to bowl

$Q_b = m_b c_b \Delta T = 1{,}1 kcal$

c) the original temperature of the cylinder

$Q_w + Q_b = m_c c_c (T_i - T_f)$

$$T_i = \frac{Q_w + Q_b}{m_c c_c} + T_f = 873°C$$

37) $Q_1 = L_F m_I + c_w m_I (T_f - 0°C)$

While $Q_w = c_w m_w (T_f - T_1)$

$Q_w + Q_1 = 0$

$$T_f = \frac{c_w m_w T_1 - L_F m_I}{(m_1 + m_I) c_w}$$

a) $T_f = 5{,}3°C$ we have $m_f = 0$

$T_f = 0°C$ we would get $T_f < 0$

38. $|Q| = (4190)(0{,}530)(40)$

$= 88828\ J$

Since $\frac{d|Q|}{dt}$ assumed constant then we have

$$P = \frac{88828\ J}{40\ min} = \frac{88828\ J}{2400s} = 37\ W$$

3a) to ...

39) to accoplish the phase change at 78°C

$Q = L_v m = (879)(0,510) = 448,29 kJ$

$Q = C m (\Delta T) = (2,43)(0,510)(192)(237,95)$

$= 114°C$

$Q = L_f m = (109)(0.510) = 55,59\ KJ$

to ul of heat removed

$(448,29 + 237,95 + 55,59) = 742\ KJ$

40) let $m_w = 14K$, $m_c = 3,6K$ $T_f = 18°C$

$m_n = 1,8$, $T_r = 150°C$, $T_r = 16°C$

the specif heat cm

$(m_w C_w + m_c C_m)(T_f - T_r) + m_n C_m (T_f - T_m) = 0$

we salve for Cm

$$C_m = \frac{C_w m_w (T_r - T_f)}{m_c (T_f - T_r) + m_n (T_f - T_m)}$$

$$= \frac{(4)(4,48)(16 - 18)}{(3,6)(18 - 16) + (1,8)(18 - 150)}$$

$= 0,41\ KJ/K°C = 0,41\ KJ/kg \cdot K$