19: 5, 9, 15

5. $\frac{7200\,\text{Kcal}}{\text{hr}} = \frac{mc\Delta T}{\text{hr}} = m\frac{(4186\,\text{J})}{\text{Kg K}}(35^\circ)$

$\left(\frac{4186\,\text{J}}{1\,\text{Kcal}}\right)\left(\frac{7200\,\text{Kcal}}{\text{hr}}\right) = m\left(\frac{4186\,\text{J}}{\text{Kg K}}\right)(35^\circ)$

$\boxed{m = 206\,\text{Kg}}$

9.

$Q = mc\Delta T = \rho V c \Delta T = \left(\frac{1000\,\text{kg}}{m^3}\right)(16\,L)\left(\frac{4186\,\text{J}}{\text{Kg K}}\right)(70)$

$= \left(\frac{1000\,\text{kg}}{m^3}\right)(16\,L)\left(\frac{1 \times 10^{-3}\,m^3}{1\,L}\right)\left(\frac{4186\,\text{J}}{\text{Kg K}}\right)(70) \boxed{= 4.7 \times 10^6\,\text{J}}$

15. $\frac{750\,\text{J}}{s} = \frac{mc\Delta T}{s} = \frac{\rho V c \Delta T}{s}$ Solve for ΔT for 1 second

$\frac{750\,\text{J}}{s} = \frac{1000\,\text{Kg}}{m^3}(.75\,L)\left(\frac{1 \times 10^{-3}\,m^3}{L}\right)\left(\frac{4186\,\text{J}}{\text{Kg K}}\right)\Delta T/s$

$\Delta T = .24^\circ C/s$

To boil it needed to raise $92^\circ C$ which would take $\boxed{383\,S}$ ~ 6.4 minutes X wrong

oops! Did not see Aluminum

$\frac{750\,\text{J}}{s} = \left(\frac{1000\,\text{Kg}}{m^3}\right)(.75\,L)\left(\frac{1 \times 10^{-3}\,m^3}{L}\right)\left(\frac{4186\,\text{J}}{\text{Kg K}}\right)\Delta T/s$

$+ (.360\,\text{Kg})\left(\frac{900\,\text{J}}{\text{Kg C}}\right)\Delta T/s \Rightarrow \Delta T/s = .216^\circ C$

so 426 S

19 21, 29, 33, 37

21. $Q = mL_f = m\left(\frac{3.33\times10^5 J}{Kg}\right)$ to melt ice

so $Q_{steam} = -m(3.33\times10^5 J/Kg)$

to condense all steam one needs $m\left(\frac{22.6\times10^5 J}{Kg}\right)$ (much larger)

so % condensed $= \frac{m(3.33\times10^5 J/Kg)}{m(22.6\times10^5 J/Kg)} = .147$

Now heat water to 100 °C → equilibrium

$Q = m\left(\frac{4186 J}{Kg\,K}\right)100K = m\frac{4.19\times10^5 J}{Kg}$

% condensed $= \frac{4.19\times10^5 J/Kg}{22.6\times10^5 J/Kg} = .185$

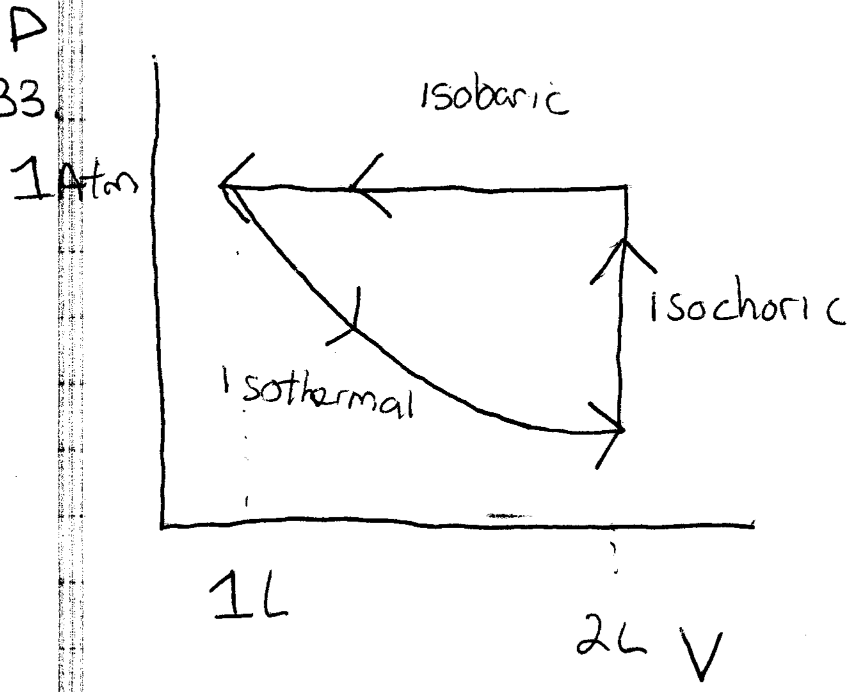
so total is .332 or 33.2% of steam turned into hot water, 100% of ice turned into hot water.

29. $\frac{1}{2}mv^2 = Q = mc\Delta T + mL_f$

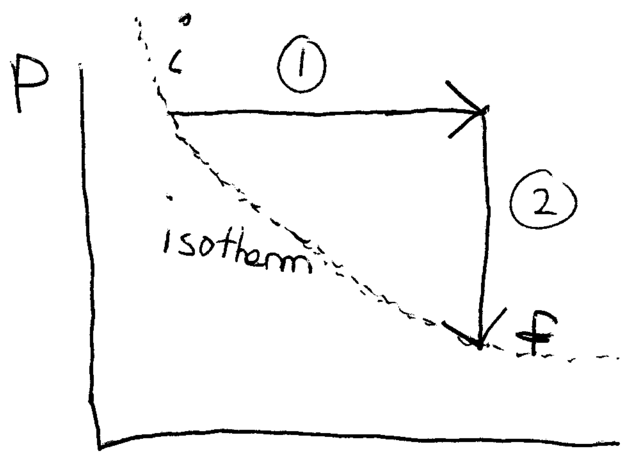
$\frac{1}{2}v^2 = c\Delta T + L_f = \frac{130 J}{Kg\,K}(307) + .25\times10^5 J/Kg$

$V = 360 m/s$

33.



37.



$W_{①} = P_1 \Delta V = (5\,Atm)(310\,mL)$

$W_{②} = 0$

$W_{①} =$

$W_{①} = (5.1 \times 10^5\,Pa)(3.1 \times 10^{-4}\,m^3)$

$= 158\,J$

$Q = ?$ Since i and f are at the same temperature then $\Delta U = 0$

so $\boxed{Q = W}$

(19 #41.) $W_{isothermal} = P_1 V_1 \ln \frac{V_2}{V_1} =$

$= (1.02 \times 10^5 Pa)(2.5 \times 10^{-3} m^3) \ln \left(\frac{1.5 \times 10^{-3} m^3}{2.5 \times 10^{-3} m^3} \right)$

$= -130 J$ (by the gas)

(20-5)

9, 17, 27

$e = \frac{W}{|Q_h|}$ $\quad W/_{Km} = \frac{20 hp}{90 km/hr}$

$|Q_h|/_{Km} = \frac{3.0 \times 10^4 Kcal/gal}{38 Km/gal}$

so $e = \dfrac{\left(\dfrac{(20hp)}{\frac{90Km}{3600s}} \left(\frac{746 J/s}{1hp} \right) \right)}{\left(\dfrac{3 \times 10^4 Kcal/gal}{38 Km/gal} \left(\frac{4186 J}{Kcal} \right) \right)}$ All units cancel! $= .18$

(9.) $e_{MAX} = 1 - \frac{T_L}{T_h} = 1 - \frac{578}{803} = .28$

17. $e_{max} = .29 = 1 - \frac{T_L}{853} \Rightarrow T_L = 606 K$

NOW $.35 = 1 - \frac{606 K}{T_h}$ $\quad T_h = 932 K$

$= 659°C$

20-27. $e_{carnot} = .35 = 1 - T_L/T_h$ so $T_L/T_H = .65$

Now Flip! $CP = (1 - T_L/T_n)^{-1} = 2.86$

35. $Q = mL_f + mc\Delta T \qquad m = 1000\,kg$

$= (1000\,kg)\left(\frac{3.33\times10^5 J}{kg}\right) + (1000\,kg)\left(\frac{2100 J}{kg\,K}\right)(10)$

$= 3.33\times10^8 J + 2.1\times10^7 J$

$\Delta S = \int \frac{dQ}{T} = \frac{mL_f}{T} + {}^{-}mc \ln\frac{T_f}{T_i}$

$= \frac{3.33\times10^8 J}{273 K} + {}^{-}(1000\,kg)\left(\frac{2100 J}{kg\,K}\right)\left(\ln\frac{263}{273}\right)$

$\frac{1.298\times10^6 J}{K} \cong \frac{1.3\times10^6 J}{K}$ which ~~ice~~ water lost (negative!)

Large ice: (const temp) $\frac{3.33\times10^8 J + 2.1\times10^7 J}{263 K}$

$\simeq \frac{1.346\times10^6 J}{K}$ (positive)!

so $\Delta S_{TOT} = +\frac{1.346\times10^6 J}{K} - \frac{1.298\times10^6 J}{K}$ $= 48000 J/K$

20-39) Estimate ice is large!

$\Delta S_{water} + \Delta S_{ice} = ?$

$$Q_{water} = -(2.5\,kg)\left(\frac{3.33 \times 10^5\,J}{kg}\right) = -8.325 \times 10^5\,J$$

$$\Delta S_{water} = \frac{-8.325 \times 10^5\,J}{273\,K} = -3.05 \times 10^3\,J/K$$

$$\Delta S_{ice} = \frac{+8.325 \times 10^5\,J}{258\,K} = +3.23 \times 10^3\,J/K$$

$$\approx +180\,J/K$$

47) definition of Carnot is that it does not increase entropy of total system

2 adiabatic Processes $Q = 0$

so $S = 0$ No change!

For ideal $\frac{Q_L}{Q_H} = \frac{T_L}{T_H}$ so $\frac{Q_H}{T_H} = \frac{Q_L}{T_L}$

2 isothermal Processes No change.

$$\Delta S = \frac{+|Q_H|}{T_H} - \frac{|Q_L|}{T_L} = \frac{|Q_L|}{T_L} - \frac{|Q_L|}{T_L} = 0$$