Exam 1 review
Professor michalak's practice exam

A true (insulated)
B false but a bit confusing...
C i) ice phase change
ii) warm H_2O cooling → true!
iii) ice warms
iv) warming of melted ice
D False
E True
F False

b) $Q_{system} = 0 = Q_{water} + Q_{ice}$

$$m_{water} c_{water} \Delta T_{water} + m_{ice} c_{ice} \Delta T_{ice} + m_{ice} L_{f_{ice}} + m_{ice} c_{water} \Delta T_{ice \to water} = 0$$

$$m_{ice} = \frac{-m_{water} c_{water} \Delta T_{water}}{c_{ice} \Delta T_{ice} + L_{f_{ice}} + c_{water} \Delta T_{ice \to H_2O}}$$

$$= \frac{-1.0 \; 4190 \; (27-77)}{2100(0--23) + 334 \cdot 10^3 + 4190(27-0)}$$

$$= 0.423 \text{ kg}$$

#2a $1 \to 2$ $W = 0$
$2 \to 3$ $\Delta p = 0$ so $W = p\Delta V = p(V_3 - V_2) = 3p_0(4V_0 - 2V_0) = 6p_0V_0$
$3 \to 4$ $\Delta V = 0$ $W = 0$
$4 \to 1$ $W = p\Delta V = 2p_0(2V_0 - 4V_0) = -4p_0V_0$

b) $1 \to 2$ $Q = \Delta U = nC_v \Delta T = nC_v\left(\frac{P_2V_2}{nR} - \frac{P_1V_1}{nR}\right) = \frac{5}{2}(3p_0 2V_0 - 2p_0 2V_0) = \frac{10}{2} p_0V_0$

$2 \to 3$
$\Delta U = nC_v \Delta T = nC_v\left(\frac{P_3V_3}{nR} - \frac{P_2V_2}{nR}\right) = \frac{5}{2}(3p_0 4V_0 - 3p_0 2V_0) = \frac{30}{2} p_0V_0$

and $Q = \Delta + W \Rightarrow Q = \frac{30}{2} p_0V_0 + 3p_0(4V_0 - 2V_0) = \frac{42}{2} p_0V_0$

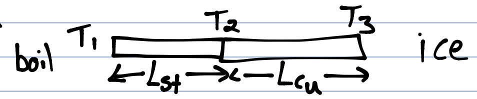
$Q = nC_p \Delta T = n\left(\frac{5}{2} + \frac{2}{2}\right) R \frac{6p_0V_0}{nR} = \frac{42}{2} p_0V_0$

$3 \to 4$ $\frac{-20}{2} p_0V_0$

$4 \to 1$ $\frac{-28}{2} p_0V_0$

c) $W_{tot} = 2p_0V_0$
graphically, it's also $2p_0V_0$ ✓
$\Delta U_{for\,a\,cycle} = 0 \Rightarrow Q_{tot} = W_{tot}$ and $Q_{tot} = \frac{4}{2} p_0V_0$ ✓

#3a



$$P_{st} = P_{cu} \qquad \frac{K_{st} A (T_2 - T_1)}{L_{steel}} = \frac{K_{cu} A (T_3 - T_2)}{L_{cu}} \rightarrow L_{cu} = L_{st} \frac{K_{cu}}{K_{st}} \frac{(T_3 - T_2)}{(T_2 - T_1)}$$

$$L_{cu} = \frac{1.0\text{m } 390 \frac{W}{m \cdot K}}{80 \frac{W}{m \cdot K}} \frac{(0° - 50°)}{(50° - 100°)} = \boxed{4.875 m}$$

A steel hoop snugly encircles the Earth's equator at 20.0 C. What would be the gap created at 25.0 C?

$$\Delta L = L_0 \alpha \Delta T \rightarrow 2\pi \Delta R = 2\pi R_0 \alpha_{st} \Delta T$$

$$\rightarrow \Delta R = R_0 \alpha \Delta T = (6.37 \cdot 10^6 m)(1.2 \cdot 10^{-5} K^{-1})(5.0 K) = \boxed{382 m}$$

A cylinder 1.00 m tall with inside diameter 0.120 m holds propane gas (44.1 g/mol). It is initially filled with gas until the gauge pressure is 1.30e6 Pa at 22.0 C. The temperature remains constant as it is partially emptied, until P_gauge = 3.4e5 Pa. How much propane mass was used?