Physical Constants

$\sigma = 5.6705 \times 10^{-8}\ \mathrm{W \cdot m^{-2} \cdot K^{-4}}$
$R = 8.3145\ \mathrm{J/(K \cdot mol)}$
$N_A = 6.0221 \times 10^{23}$
$k_B = 1.3807 \times 10^{-23}\ \mathrm{J/K}$
$1\ \mathrm{atm} = 1.0133 \times 10^5\ \mathrm{Pa}$

Properties of H_2O

$L_V = 2.26 \times 10^6\ \mathrm{J/kg}$
$c_w = 4186\ \mathrm{J/(kg \cdot K)}$
$L_f = 3.33 \times 10^5\ \mathrm{J/kg}$
$c_i = 2090\ \mathrm{J/(kg \cdot K)}$
$\rho_w = 1000\ \mathrm{kg/m^3}$

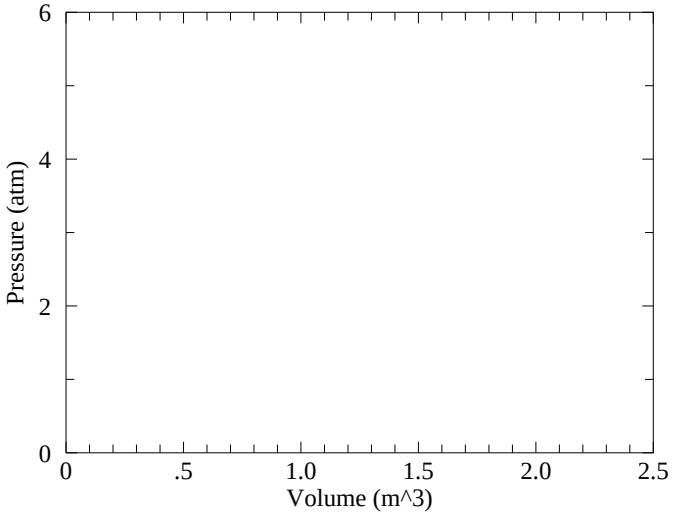
1. Consider the following cycle starting with 1 m^3 of a monoatomic ideal gas at a pressure of 1 atm and a temperature of 300 K.

   (a) The volume is adiabatically compressed until the temperature reaches 600 K.

   (b) The volume is then isothermally expanded until the pressure reaches 1 atm.

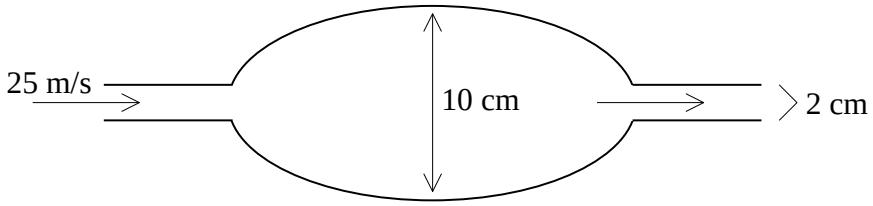
   (c) In a constant-pressure (a.k.a., isobaric) process, the volume is returned to 1 m^3.

   On the below graph, accurately plot and label each leg of this cycle. This will require calculating various pVT values at the end of some cycles. Fill in the below table giving the sign $(+, -, 0)$ of the quantity for each leg of the cycle.



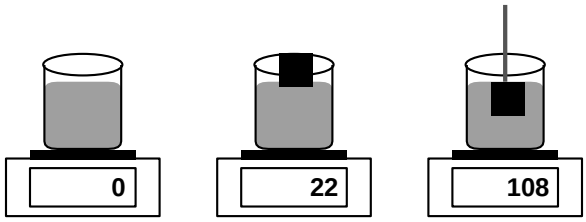
path:	a	b	c
ΔT			
ΔU			
Q			
W			
ΔS			

2. A hose with a normal diameter of 2 cm carries water at atmospheric pressure moving at 25 m/s. At one spot the hose balloons out to a diameter of 10 cm. What is the gauge pressure inside the enlarged region of the hose?



3. You want to cool 250 g of water (initially at room temperature: 22°C) to 5°C. What mass of ice (fresh from the freezer at −10°C) is required to exactly achieve this goal?

4. In an experiment very similar to Lab 8, a beaker of mercury is placed on a balance and then tared (zeroed). A cube of aluminum, 2 cm on a side, is placed on the mercury; it floats. The balance reads 22 g. The cube is then submerged (pushed under) and the balance reads 108 g. (A) What is the density of the aluminum? (B) What is the density of mercury?



5. A Carnot refrigerator is used to freeze 1000 g of water at 0°C by discharging heat into a room that acts as a heat reservoir at a temperature of 27°C. What is the total amount of heat discharged into the room during this process?