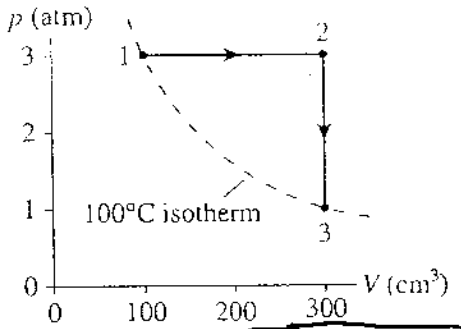
Quiz 2 – PH242 **Name**_____ ☐ **Pledged**

An ideal monatomic gas follows the process $1 \rightarrow 2 \rightarrow 3$

(a) How much heat is needed for process $1 \rightarrow 2$

(b) how much heat is needed for process ~~1-2~~ 2-3

$$\Delta U = Q - W \qquad PV = nRT \qquad \Delta U = \tfrac{3}{2}nR\Delta T$$
$$W_{isovolumic} = 0 \qquad W_{isothermal} = PV\ln(\tfrac{V_f}{V_0}) = nRT\ln(\tfrac{V_f}{V_0})$$
$$W_{isobaric} = P(V_f - V_0) = P\Delta V$$
$$1atm = 1.01 \times 10^5 Pa \qquad 1m^3 = 1 \times 10^6 cm^3 \qquad R = 8.315 J/(molK)$$



a) $\Delta U_{12} = Q_{12} - W_{12}$

$Q_{12} = \Delta U_{12} + W_{12}$

$W_{12} = P_1 \Delta V = (3Atm)(200cm^3)$

$W_{12} = 600\,Atm\,cm^3 = 60.6\,Pa\,m^3 = \boxed{60.6\ J}$

so $Q_{12} = \Delta U_{12} + 60.6\ J = 3/2\, nR\Delta T + 60.6\ J$

$PV = nRT$ so $P_2V_2 - P_1V_1 = nR\Delta T$

$(3atm)(300cm^3) - (3atm)(100cm^3) = 600\,Atm\,cm^3$

$nR\Delta T = 600\,Atm\,cm^3 = 60.6\ J$ so $3/2\, nR\Delta T = 90.9\ J = \Delta U_{12}$

$Q_{12} = 90.9\ J + 60.6\ J = \boxed{151.5\ J}$

b) $\Delta U_{23} = Q_{23} + W_{23}$ $\quad W_{23} = 0$

$\Delta U_{23} = Q_{23}$ and $\Delta U_{12} + \Delta U_{23} = 0$

so $Q_{23} = -\Delta U_{12} = \boxed{-90.9\ J}$