Ch 3 solutions

28)
a) $(1.0\text{ atm})(3.0L - 1.0L) = 2.0\text{ atm}\cdot L = \boxed{203\text{ J}}$

b) pressure for DB is $-V+4$

$$W = \int dW = \int p\,dV = \int_1^3 (-V+4)\,dV = \left.\frac{-V^2}{2} + 4V\right|_1^3 = 4\text{ atm}\cdot L = \boxed{405\text{ J}}$$

c) pressure $p(V) = V$

$$W = \int p\,dV = \int_1^3 V\,dV = \left.\frac{V^2}{2}\right|_1^3 = 4\text{ atm}\cdot L = \boxed{405\text{ J}}$$

d) $W = \int p\,dV = \int 3\,dV = 3V|_1^3 = 6\text{ atm}\cdot L = \boxed{608\text{ J}}$

35)
a) $U = \frac{3}{2}nRT \Rightarrow$ same U and same $T \Rightarrow$ same n $\boxed{1:1}$

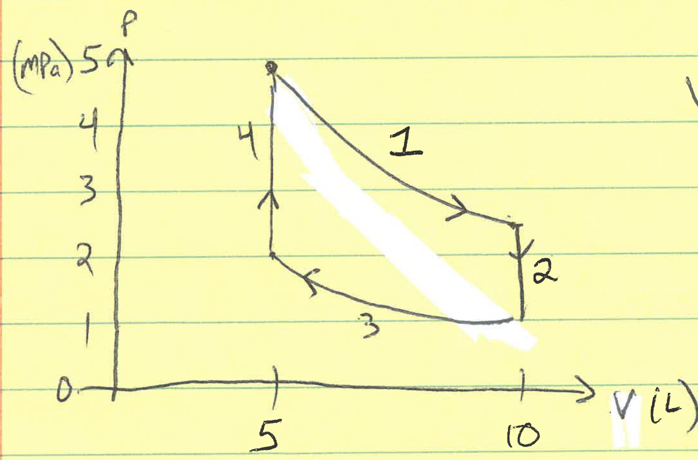
b) same number but 10x different masses $\Rightarrow \boxed{10:1}$

38)
a) since $U \propto T$, and $\Delta T = 0$, then $\boxed{\Delta U = 0}$

b) $\Delta U = Q - W \Rightarrow Q = W = \boxed{250\text{ J}}$

47) see section 3.6 $\Rightarrow$ free expansion requires no work, temperatures are equal

54)



$$W = W_1 + \cancel{W_2}^{\,0} + W_3 + \cancel{W_4} = \int_1 p\,dV + \int_3 p\,dV$$

$$= nRT_1 \ln\frac{V_2}{V_1} + nRT_3 \ln\frac{V_4}{V_3}$$

$T_1 = \frac{P_1V_1}{nR} = 1503.4\text{ K}$

$T_3 = \frac{P_3V_3}{nR} = 601.4\text{ K}$

$V_1 = 5L \quad V_2 = 10L \quad V_3 = 10L \quad V_4 = 5L$

$\rightarrow W = 17328.7 - 6931.5 = 10397\text{ J} = \boxed{10^4\text{ J}}$

58)
a) $W_{AB} = 0 \quad W_{BC} = 5\text{atm}(7L - 3L) = 2026\text{ W} \quad W_{AD} = 2\text{atm}(7L-3L) = 810.4\text{ W}$

$W_{DC} = 0$

b) $\Delta U_{AB} = Q_{AB} - W_{AB} = Q_{AB} = \boxed{3600\,J}$ given in problem statement

$\Delta U_{BC} = Q_{BC} - W_{BC} = 2400\,J - 2026\,J = \boxed{374\,J}$

c) $\Delta U_{AC} = \Delta U_{AB} + \Delta U_{BC} = 3600\,J + 374\,J = \boxed{3974\,J}$

d) $Q_{ADC} = Q_{AD} + Q_{DC} = \Delta U_{AD} + W_{AD} + \Delta U_{DC} + W_{DC} = \Delta U_{AC} + W_{AD} + \cancel{W_{DC}}^{\,0}$

$= 3924 + 810.4 = \boxed{4784.4\,J}$

61) $\Delta U = nC_v\Delta T = (1\,mol)\left(\frac{3}{2}R\right)(8.0°C) = \boxed{99.8\,J}$

65) $\Delta U = Q - W_{by\,gas} \Rightarrow W_{by\,gas} = Q - \Delta U = 400\,J - 10\left(\frac{3}{2}R\right)10 = -847\,J$

$\Rightarrow W_{on\,gas} = -W_{by\,gas} = \boxed{847\,J}$

69) see next page for plot

Fit a line since $PV^{\gamma} = constant$

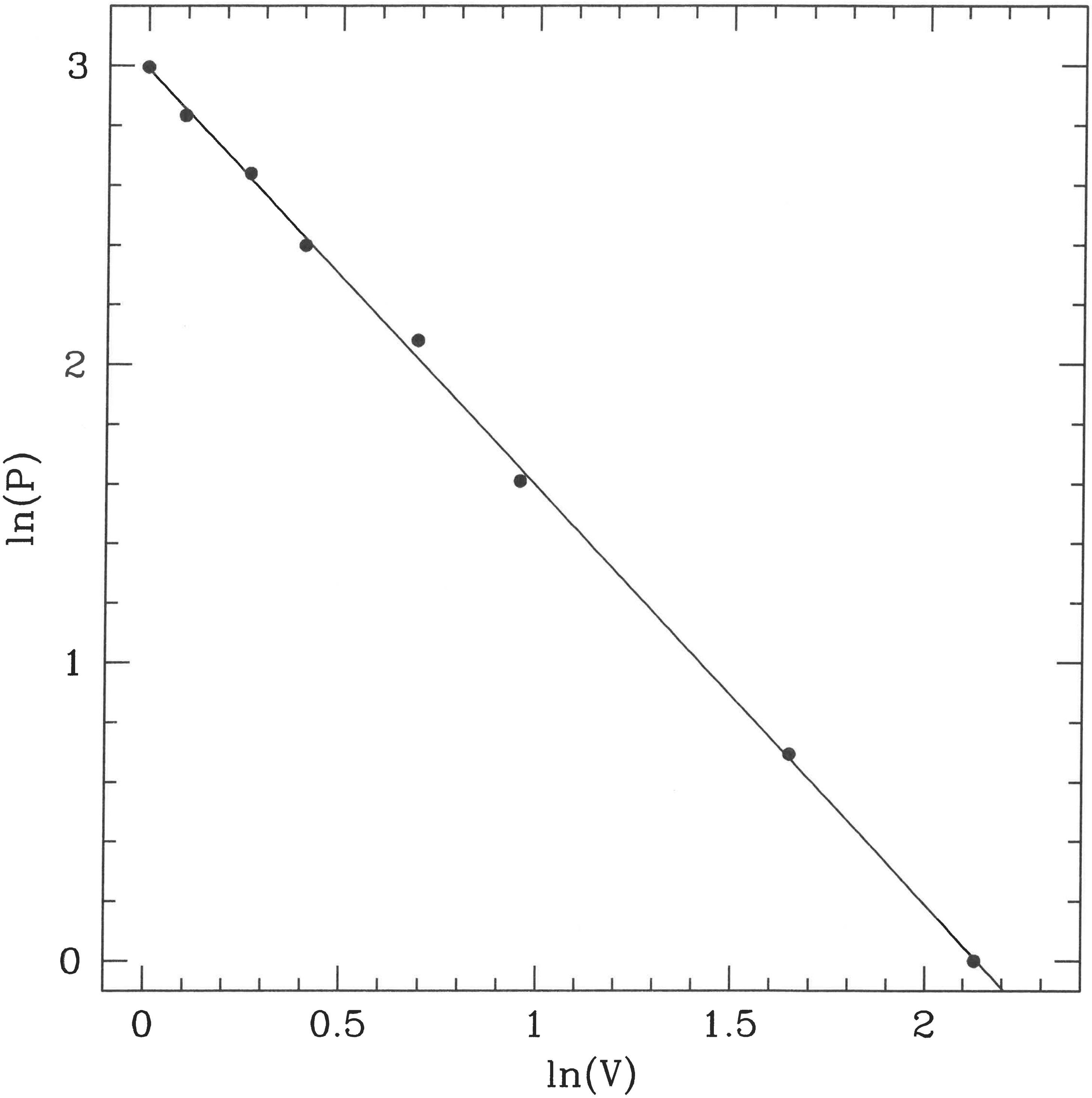
$\Rightarrow \ln P = -\gamma \ln V + constant$

and thus slope $= -\gamma$

plot $\Rightarrow \boxed{\gamma = 1.4}$

72) adiabatic $\Rightarrow T_1 V_1^{\gamma-1} = T_2 V_2^{\gamma-1}$ where $\gamma = 7/5$ for diatomic

$\Rightarrow T_2 = T_1\left(\frac{V_1}{V_2}\right)^{\gamma-1} = (80k)\left(\frac{1}{1/3}\right)^{2/5} = \boxed{124\,k}$


3
2
1
0
ln(P)
0
0.5
1
1.5
2
ln(V)