HW 4

43) $W = \int p\,dV$

a) $W = p\Delta V + 0$

$= 40 \times 3 = 120(J)$

b) $W = \frac{1}{2}(10+40)\times 3 = 75(J)$

or you can see

$W = \int p\,dV = \int_0^3 (50 - 10)\,dV$

$= (50V - 5V^2)\Big|_0^3 = 75(J)$

c) $W = 0 + p\Delta V = 10 \times 3 = 30J$

45) $Q = W$, $p = a + bV$

$W_{AB} = \int_{V_A}^{V_B} p\,dV = \int_{V_A}^{V_B} (a+bV)\,dV$

$= a(V_B - V_A) + \frac{1}{2}b(V_B^2 - V_A^2)$

the work done by the gas is

$W_{BC} = p_B \Delta V_{BC} = p_B(V_C - V_B)$

the pressure function can be written as

$p = \frac{10}{3}\,Pa + \left(\frac{20}{3}\,Pa/cm^3\right)V$

$p = 10\,Pa$

$V = 1\,cm^3$ and $p = 30\,Pa$ when $V = 6\,cm^3$

49) $\Delta E_{int} = Q - W$

For a closed cycle

$\Delta E_{int} = 0$

$\Delta E_{abc} + \Delta E_{cd} + \Delta E_{da} = 0$

$\Delta E_{abc} = -200\,J$)

For process da:

$\Delta E_{da} = Q_{da} - W_{da} = 80 - 0 = 80\,J$)

$\Delta E_{cd} = -\Delta E_{abc} - \Delta E_{da} = 200 - 80 = 120\,J$

$\Rightarrow W_{cd} = Q_{cd} - \Delta E_{cd} = 180 - 120 = 60\,J$

50) $\Delta E_{int} = Q - W$

a) The process a → b is an expansion ($V_b > V_a$)

$W > 0$ and $W = 5\,J$

$Q_{ab} = \Delta E_{int} + W = 3 + 5 = 8\,(J)$

b) We consider a closed cycle abca

$\Delta E_{int} = Q - W = 0$

$Q_{ab} + Q_{bc} + Q_{ca} = W_{net}$

$Q_{bc} = W_{net} - Q_{ab} - Q_{ca}$

$= 1,5 - 8 - 2,5 = -9,0\,(J)$

$W_{AB} = a(V_B - V_A) + \frac{1}{2} b(V_B^2 - V_A^2)$

$= (\frac{10}{3} Pa)(4m^3 - 1m^3) + \frac{1}{2}(\frac{20}{3})(4)^2 - (1)^2$

$= 60J$

Whereas

$W_{BC} = P_B(V_C - V_B) = 30)(1-4) = -90J$

$\Rightarrow W = W_{AB} + W_{BC} + W_{CA}$

$= 60 - 90 + 0 = -30J$

46) $W_{on} = 200J$

$W_{on} = +W$

a) $W = -W_{on} = -200J$

b) the gas released energy as heat

$Q = -80 = -80.4,19 = -335,2(J)$

c) $\Delta E_{int} = Q - W$

$= -335,2 - (-200) = -135,2(J)$

48)

$\Delta E_{int} = Q - W$

For the ABCA closed cycle

$\Delta E_{int} = 0$

$Q_{AB} + Q_{BC} + Q_{CA} = W$

$\Rightarrow Q_{CA} = W - Q_{AB} - Q_{BC}$

$= 15 - 25 - 0 = -10(J)$