Daily Tutorial Sheet-11	Numerical Value Type

126.(223.53)

$C_p = C_v + R = (3/2)R + R = \frac{5}{2}R$

At constant pressure

Heat given to 1 mole gas $= C_p.\Delta T$

Or $\Delta H = q_p = 1 \times (5/2)R \times (373 - 298)$

Or $\Delta H = q_p = 1 \times (5/2) \times 1.987 \times 75$

$\Delta H = q_p = 372.56\,\text{cal}$

Also, work done in process (irreversible)

$\Delta U = q + w = 372.56 - 149.03 = 223.53\,\text{cal}$

$= -nR(T_2 - T_1) = -1 \times 1.987 \times (373 - 298) = -149.03\,\text{cal}$

127.(32) $w = -8J;\ q = 40J$

From I law $\Delta U = q + w = 40 - 8 = 32$ joule

128.(290.81K)

Work is done against external pressure and thus process is irreversible

$w = -P\Delta V$

$\Delta V = (5 - 3) = 2dm^3 = 2 \times 10^{-3} m^3$

$P = 3\,\text{atm} = 3 \times 1.013 \times 10^5\,N\,m^{-2}$

$w = -3 \times 1.013 \times 10^5 \times 2 \times 10^{-3} = -607.8J$

Since, the work is used in heating water and thus

$-w = q = n \times C \times \Delta T$

Or $607.8 = 10 \times 4.184 \times 18 \times \Delta T$

$\Delta T = 0.81$

Final temperature $= 290 + 0.81 = 290.81K$

129.(190.7)

$dU = -P_{ext.} \cdot dV$

$nC_v(T_2 - T_1) = -P_{ext.}[V_2 - V_1] = -P_2\left[\frac{nRT_2}{P_2} - \frac{nRT_1}{P_1}\right]$

$C_v(T_2 - T_1) = -P_2 \times R\left[\frac{T_2}{P_2} - \frac{T_1}{P_1}\right]$

$1.5 \times (T_2 - 298) = -1.013 \times 10^5 \times R\left[\frac{T_2}{1.013 \times 10^5} - \frac{298}{1.013 \times 10^6}\right]$

$T_2 = 190.7K$

130.(2.98)

Entropy change of fusion, $\Delta S_f = \Delta H_f / T$

$\Delta H_f = 6 \times 10^3 J;\ T = 273K$

$\Delta S_f = \frac{(6 \times 10^3)}{273} = 21.98\,JK^{-1}\,mol^{-1}$

131.(172.28)

$$w = P(V_g - V_e) = PV_g = nRT = \frac{10^3}{18} \times 8.314 \times 373 = 172284.56\,J = 172.28\,kJ$$

132.(50) $Q_p = C_p \cdot \Delta T \quad \therefore \quad C_p = \frac{70}{5} = 14\,cal°C^{-1}$

$C_p - C_v = nR$

$C_v = 14 - 2 \times 2 = 10\,cal\,K^{-1}$

$Q_v = C_v \Delta T = 10 \times 5 = 50\,cal$

133.(0) For isothermal process $\Delta U = 0$

134.(9.2) $\Delta S = 2.303 nR \log \frac{V_2}{V_1} = 2.303 \times 2 \times 2 \log \frac{20}{2} = 9.2\,cal\,K^{-1}\,mol^{-1}$

135.(2.4) $q = n \cdot C_P \Delta T$

$1000 = \frac{100}{18} \times 75 \times \Delta T$

$\Delta T = 2.4K$

136. $\Delta S_{surr} = \frac{q_{surr}}{T} = -\frac{q_{sys}}{T} = \frac{W_{sys}}{T}$

$\Delta S_{surr} = \frac{-P_{ext}(V_f - V_i)}{T} = \frac{-3(2-1)}{300} L\,atm\,K^{-1}$

$= -0.01\,L\,atm\,K^{-1} = -0.01 \times 101.3\,JK^{-1} = -1.013\,JK^{-1}$

137.(32) $\frac{u_{rmsT_1}}{u_{rmsT_2}} = \sqrt{\frac{T_1}{T_2}}$

$\frac{2 \times u}{u} = \sqrt{\frac{T_1}{T_2}}$

$\frac{T_1}{T_2} = 4$

$T_2 = \frac{T_1}{4}$

From $TV^{\gamma-1} =$ constant for adiabatic expansion

$T_1 V_1^{\gamma-1} = T_2 V_2^{\gamma-1}$

$\left[\frac{V_1}{V_2}\right]^{\gamma-1} = \frac{T_2}{T_1} = \frac{1}{4}$

$\left[\frac{V_1}{V_2}\right]^{1.4-1} = \frac{1}{4} \quad \Rightarrow \quad \frac{V_2}{V_1} = 32$

138.(2.7) $\Delta H = \Delta U + \Delta nRT = 2100 + 2 \times 2 \times 300 = 3300\,cal/mol$

$\Delta G = \Delta H - T\Delta S = 3300 - 300 \times 20 = 2700\,cal$

139.(6.3) $\Delta H = \Delta U + P\Delta V$

$P = \frac{\Delta H - \Delta U}{\Delta V} = \frac{50 - 113}{-10} = 6.3\,k\,Nm^{-2}$

140.(114.51)

$\Delta H = n \times C_p \times \Delta T$ and $C_p = C_v + R = 12.48 + 8.314 = 20.794\, JK^{-1}\, mol^{-1}$

For a given sample of argon gas, mole (n)

$$n = \frac{PV}{RT} = \frac{1 \times 1.25}{0.0821 \times 300} = 0.05\,\text{mole}$$

Also, for reversible adiabatic change $TV^{\gamma-1}$ = constant

$$T_2V_2^{\gamma-1} = T_1V_1^{\gamma-1}$$

or $$T_2 = T_1 \times \left(\frac{V_1}{V_2}\right)^{\gamma-1} = 300 \times \left(\frac{1.25}{2.50}\right)^{1.66-1} = 300 \times \left(\frac{1}{2}\right)^{0.66}$$

$$T_2 = 189.86\,K$$

$\Delta T = T_2 - T_1 = 189.86 - 300 = -110.14\,K$

$\Delta H = 0.05 \times 20.794 \times (-110.14) = -114.51\,J$