Day-3

→ Reactants (1 mol) → [control volume] → x mol of products

↓ Q

$Q_{reac^n} = H_P - H_R$

H_P = Total enthalpy of products
H_R = " " " reactants

If we define P, T at STP (1 atm, 298 K)
Q_{reac^n} → standard enthalpy of reac^n.

→ $H_P - H_R = [-877236 - (-74831)]$ kJ kmol^{-1}

$= -802405$ kJ kmol^{-1}

$= \frac{-802405}{16}$ kJ/kg

$= -50150.3125$ kJ/kg

→ HHV : water in liq.
LHV : water in gas.

→ Bomb calorimeter :

$Q_{reac^n} = (m_{steel} C_{steel} + m_w C_w) \Delta T$

Here, volume is constant
$U_P - U_R = Q_{reac^n, V}$

$\Rightarrow HHV = Q_{reac^n, V} - \frac{(\Sigma N_{ip} - \Sigma N_{iR}) R_u T_o}{N_{fuel} M_{fuel}}$

$(\because H_P - H_R = Q_{react} = U_P + P_P V \ldots (U_R + P_R V))$

$$= U_P - U_R + (N_P - N_R) R_u T_o$$

$$= U_P - U_R + (\Delta N) R_u T_o$$

→ 1 mol H_2 (+ O_2 molecules), measures HHV = 282 kJ. Find error in HHV

Ans) $H_2 + \frac{1}{2} O_2 \longrightarrow H_2O\ (l)$

$\Delta N = 0 - (1 + 1/2) = -3/2$

$\therefore$ Error $= -\frac{3}{2} \times 8.314 \times 298$ J

$= -3716.358$ J

≈ -3.716 kJ

% error $= \frac{3.716}{282} \times 100\ \%$

$\approx 1.32\ \%$

→ $C_{12}H_{22}O_{11}$ (solid) $+ 12 O_2$

$\longrightarrow 12 CO_2 + 11 H_2O\ (l)$

$\Delta n = 12 - 12 = 0$

Error $\simeq 0$

☆ Bomb calorimeter gives HHV only. H_2O is taken as liquid!