Daily Tutorial Sheet-1	JEE Advanced (Archive)

1. $\Delta H^o = \sum BE(\text{reactants}) - \sum BE(\text{products})$

$\Rightarrow \quad -10.06 = \frac{1}{2}(104.18) + \frac{1}{2}(118.32) - BE(O-H)$

$BE(O-H) = 121.21\,\text{kcal}$

2. $\Delta H = -94.1 + 4\times(-22.1) - [-25.5 + 2\times -57.8] = -94.1 - 88.4 + 25.5 + 115.6 = -41.4$ Kcal

3. $C_2H_2(g) + 2.5O_2(g) \rightarrow 2CO_2 + H_2O$ $\quad -310.62$ Kcal $\quad$ .....(a)

$C_{(\text{graphite})} + O_2(g) \rightarrow CO_2(g)$ $\quad -94.05$ Kcal $\quad$ .....(b)

$H_2(g) + 1/2O_2(g) \rightarrow H_2O(\ell)$ $\quad -68.32$ Kcal $\quad$ .....(c)

$2C_{(\text{graphite})} + H_2(g) \rightarrow C_2H_2(g) \quad \Delta H = 2a + c - b$

$\Delta H = -2\times 94.05 - 68.32 + 310.62 = 54.2$ Kcal

4. Heat absorb by gas at constant pressures will be equal to ΔH

5. $C_2H_2 + H_2 \rightarrow C_2H_4$

$\Delta H^o = \sum \Delta H^o_{comb}(\text{reactants}) - \sum \Delta H^0_{comb}(\text{products}) = -310.6 - 68.3 - (-337.2) = -41.7\,\text{k cal}$

6. $\frac{1}{2}H_2 + \frac{1}{2}Cl_2 \rightarrow HCl$

$\frac{104}{2} + \frac{58}{2} - 103 = -22$ k cal

7. $\Delta H = \sum \Delta H^o_f(\text{products}) - \sum \Delta H^o_f(\text{reactants}) = -2\times 94.1 - 3\times 68.3 - (-21.1) = -372\,\text{k cal/mol}$

8. $Fe_2O_3(s) + 2Al(s) \rightarrow Al_2O_3(s) + 2Fe(s)$

$\Delta H^o_r = \Delta H^o_f(\text{products}) - \Delta H^o_f(\text{reactants}) = -399 - (-199) = -200\,\text{kcal}$

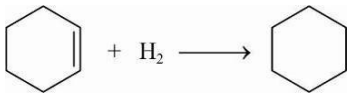
Mass of reactants $= 56\times 2 + 16\times 3 + 27\times 2 = 214$g

$\Rightarrow \quad$ Fuel value/gram $= \frac{200}{214} = 0.93\,\text{kcal/g}$

Volume of reactants $= \frac{160}{5.2}\text{cc} + \frac{54}{2.7}\text{cc} = 50.77\text{cc} \Rightarrow$ Fuel value/ cc $= \frac{200}{50.77} = 3.94\,\text{cal/cc}$

9. Moles of H_2O needs to perspire $= \frac{1560}{2\times 44} = 17.72$

Weight of water needs to perspire $= 17.72\times 18 = 318.96\,\text{g}$

10. 

$\Delta H = \sum \Delta H^o_{comb}(\text{reactants}) - \sum \Delta H^o_{comb}(\text{products}) = -3800 - 241 - (-3920) = -121\,\text{kJ/mol}$

11. Let x kcal be the $C-C$ bond energy and y kcal be the $C-H$ bond energy per mole.

$\Rightarrow \quad 2C(gr) + 3H_2(g) \rightarrow C_2H_6(g);$

$\Delta H^o = -2\times 94 - 3\times 68 + 372 = -20\,\text{kcal}$

$\Rightarrow \quad -20\text{kcal} = 2\times 172 + 3\times 104 - BE(C_2H_6) \Rightarrow \quad BE(C_6H_6) = 676\,\text{kcal}$

Similarly, $3C(gr) + 4H_2(g) \rightarrow C_3H_8(g)$; $\Delta H^o = -3\times 94 - 4\times 68 + 530 = -24\,kcal$

$\Rightarrow$ $-24kcal = 3\times 172 + 4\times 104 - BE(C_3H_8)$ $\Rightarrow$ $BE(C_3H_8) = 956\,kcal$

Also, $BE(C_2H_6) = 676\,kcal = x + 6y$ ... (i)

$BE(C_2H_8) = 956\,kcal = 2x + 8y$ ... (ii)

Solving eqs. (i) and (ii) gives: $y = 99\,kcal(C-H)BE$, $x = 82\,kcal(C-C)BE$

12. Let the mixture contain x litre of CH_4 and $3.67 - x$ litre of ethylene.

$$\begin{array}{ccc} CH_4 + O_2 & \rightarrow & CO_2 \\ x & & x \\ C_2H_4 + O_2 & \rightarrow & 2CO_2 \\ 3.67 - x & & 2(3.67 - x) \end{array}$$

Given: $x + 2(3.67 - x) = 6.11\,L$ $\Rightarrow$ $x = 1.23\,L$

Volume of ethylene $= 2.44\,L$

Total moles of gasses in 1 litre $= \dfrac{pV}{RT} = \dfrac{1\times 1}{0.082\times 298} = 0.04$

Also, CH_4 and ethylene are in 1 : 2 volume (or mole) ratio, moles of $CH_4 = \dfrac{0.04}{3}$ and moles of ethylene $= \dfrac{2\times 0.04}{3}$

$\Rightarrow$ Heat evolved due to methane $= \dfrac{0.04}{3}\times 891 = 11.88\,kJ$

Heat evolved due to ethylene $= \dfrac{2\times 0.04}{3}\times 1423 = 37.94\,kJ$

$\Rightarrow$ Total heat evolved on combustion of $1.0L$ gaseous mixture at 25°C is 11.88 + 37.94 = 49.82 kJ

13. First we need to determine heat of combustion of C_3H_8

$3C(gr) + 4H_2(g) \rightarrow C_3H_8(g)$ $\Delta H_f^o = -103\,kJ$

$\Rightarrow$ $-103kJ = -3\times 393 - 4\times 285.80 - \Delta H_{comb}^o(C_3H_8)$

$\Rightarrow$ $\Delta H_{comb}^o(C_3H_8) = -2219.20\,kJ$

$\Rightarrow$ $\Delta H_r^o = \sum \Delta H_{comb}^o(\text{reactants}) - \sum \Delta H_{comb}^o(\text{products})$

$= -2219.20 - 285.80 + 1560 + 890 = -55\,kJ$

14. Endothermic

15. Per mole of ethylene polymerized, one $C=C$ bond is broken and $C-C$ bonds are formed.

$\Delta H°(Polym.) = 590 - 2\times 311 = -32\,kJ/mol$