Daily Tutorial Sheet-1	JEE Main (Archive)

1.(D) $ZnO + C \rightarrow Zn + Co$

2.(A) $C + O_2 \rightarrow CO_2; \quad \Delta H = -393.5\,kJ$

$CO + \frac{1}{2}O_2 \rightarrow CO_2; \ \Delta H = -283.5\,kJ$

$- \quad - \quad - \quad +$

$C + \frac{1}{2}O_2 \rightarrow CO; \quad \Delta H = -110\,kJ$

3.(B) $C + 2H_2 \rightarrow CH_4$

$\Delta_f H^\circ = [e_{C(S\rightarrow g)} + 2 \times e_{H-H} - 4 \times e_{C-H}]$

4.(D) $I_2 + Cl_2 \rightarrow 2ICl$

$\Delta H = e_{I_2 S\rightarrow g} + e_{I-I} - 2 \times e_{I-Cl} = 62.76 + 151.0 + 242.3 - 2 \times 211.3 = 33.46\,kJ$ for $2\,mol\,ICl$

$\therefore \ \Delta H / mol = \frac{33.46}{2} = 16.73\,kJ\,mol^{-1}$

5.(C) $1/2X_2 + 3/2Y_2 \rightarrow XY_3$

$\Delta S_{rection} = 50 - \left(\frac{3}{2} \times 40 + \frac{1}{2} \times 60\right) = -40\,J\,mol^{-1}$

$\Delta G = \Delta H - T\Delta S$

At equilibrium $\Delta G = 0$

$\Delta H = T\Delta S$

$\Delta H = -3\,kJ$ (Given)

$= -30 \times 1000\,J = -30000\,J$

$\therefore \quad T = \frac{\Delta H}{\Delta S} = \frac{-30,000}{-40} = 750\,K$

6.(D) Percentage efficiency of the fuel cell $= \frac{\Delta G}{\Delta H} \times 100$. The concerned reaction is

$CH_3OH(l) + 3/2O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$

$\Delta G_r[\Delta G_f(CO_{2,g}) + 2\Delta G_f H_2O, l)]$

$[-\Delta G_f CH_3OH, l) - 3/2\Delta G_f(O_2, g)]$

$= -394.4 + 2(-237.2) - (-166.2) - 0 = -394.4 - 474.4 + 166.2 = -702.6\,kJ\,mol^{-1}$

Percentage efficiency $= \frac{702.6}{726} \times 100 = 96.78\% = 97\%$

7.(B) Consider the heat of formation of H_2O

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

$\Delta H = -286.20\,kJ$

$\Delta H_r = \Delta H_f(O_2, g) = -286.20 = \Delta H_f(H_2O, l) - 0 - 0$

$\Delta H_f(H_2O, l) = -286.20$

Now, consider the ionization of H_2O

$H_2O(l) \rightarrow H^+(aq) + OH^-(aq)$

$\Delta H = 57.32\,kJ$

$$\Delta H_r = \Delta H_f(H^+, aq) + \Delta H_f(OH^-, aq) - \Delta H_f(H_2O, l)$$

$$57.32 = 0 + \Delta H_f(OH^-, aq) - (286.20)$$

Thus, $\Delta H_f(OH^-, aq) = 57.32 - 286.20 = -228.80\,kJ$

8.(B) $\frac{1}{2}N_2(g) + \frac{3}{2}H_2(g) \rightarrow NH_3(g), \Delta_f H = -46\,kJ\,mol^{-1}$

Bond enthalpy of $H_2 = 436\,kJ\,mol^{-1}$

[+ve sign is taken because energy is supplied to break the H–H bond into its atoms]

Similarly, bond enthalpy of $N_2 = +712\,kJ\,mol^{-1}$

$$\Delta_f H = \left[\frac{1}{2}BE(N_2) + \frac{3}{2}BE(H_2)\right] - BE(N-H)$$

$$-46 = \left[\frac{1}{2}\times 712 + \frac{3}{2}\times 436\right] - 3BE(N-H)$$

$$-46 = (356 + 654) - 3BE(N-H)$$

$$3BE(N-H) = (1010) + 46$$

$$3BE(N-H) = 1056$$

$$Be(N-H) = 1056/3 = 352\,kJ\,mol^{-1}$$

9.(C) Relation between ΔH (enthalpy change) and ΔE (internal energy change) is

$$\Delta H = \Delta E + \Delta_g nRT$$

Where, Δn_g = (moles of gaseous products) – (moles of gaseous reactants)

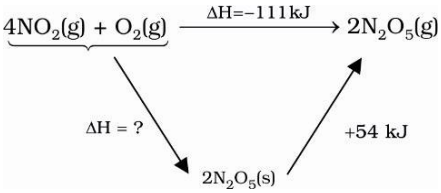
For the given reaction,

$$\Delta n_g = 2 - 3 = -1$$

$$\Rightarrow \quad -1366.5 = \Delta E - 1\times 8.314\times 10^{-3}\times 300$$

$$\therefore \quad \Delta E = -1364.0\,kJ\,mol^{-1}$$

10.(A)



From Hess's law.

$$-111 = \Delta H + 54$$

$$\Delta H = -165 \text{ kJ}$$

11.(A) $C_2H_5OH(l) + 3O_2(g) \rightarrow 2CO_2(g) + 3H_2O(l)$

Amount of heat produced in bomb calorimeter.

$$\Delta U = -1364.47\,kJ\,mol^{-1}$$

Enthalpy of a combustion reaction is

$$\Delta H = \Delta U + \Delta n_g RT$$

Where, ΔU = internal energy

Δn_g = moles of gas (products-reactants)

ΔR = Gas constant

T = Temperature in K

As per equation,

$\Delta n_g = 2 - 3 = -1$

$T = 25^\circ C = 25 + 273\,K \quad \Rightarrow \quad T = 298\,K$

Thus, $\Delta H = -1364.47 + \left[\dfrac{(-1)\times 8.314 \times 298}{1000}\right]$

$\Delta H = -1364.47 - 2.477 = -1366.947\,kJ\,mol^{-1}$

Hence, the enthalpy of combustion, $\Delta_C H$ for the given reaction will be $-1366.947\,kJ\,mol^{-1}$.

12.(B) $C_6H_6(\ell) + \dfrac{15}{2}O_2(g) \longrightarrow 6CO_2(g) + 3H_2O(\ell)$

$\Delta n_{(g)} = -\dfrac{3}{2}$

$\Delta H = \Delta U + \Delta n_{(g)}RT = -3263.9 - \dfrac{1.5 \times 8.314 \times 298}{1000} = -3267.6\ kJ/mol$

13.(B) $\Delta H = \Delta U + \Delta n_g RT \qquad \Delta n_g = 0 \qquad \Delta H = \Delta U$

14.(B) $\Delta G_{reaction} = \Delta G_1 + 3\Delta G_2 = 1487 + 3\times(-514.4) = -56.2\ kJ\,mol^{-1}$

15.(B) More P, less entropy.

16.(D) Reaction (3) = reaction (1) – (2)

$\Delta H_3 = \Delta H_1 - \Delta H_2$

$z = x - y$

$x = z + y$

17.(A) Heptane $C_7H_{16}(\ell) + 11O_2(g) \longrightarrow 7CO_2(g) + 8H_2O(\ell)$

Since temperature T is given assume it at room temperature.

$\Delta H = \Delta U + \Delta n(g)RT$

$\Delta H - \Delta U = -4RT$

$\Delta n(g) = 7 - 11 = -4$

18.(B) $I_2(s) \longrightarrow I_2(g)$

$\Delta H_2 = \Delta H_1 + \Delta C_p(T_2 - T_1)$

$\Delta C_p = C_pI_2(g) - C_pI_2(s) = 0.055 - 0.031 = 0.024\ cal\ g^{-1}K^{-1}$

$\Delta H_2 = 24 - 0.024 \times 50 = 22.8 cal\ g^{-1}K^{-1}$

19.(–192.5)

$2C(s) + 3H_2(g) \longrightarrow C_2H_6(g)$

$\Delta H_f^\circ(C_2H_6) = \sum \Delta H_C^\circ(\text{reactants}) - \sum \Delta H_C^\circ(\text{Products})$

$= 2 \times \Delta H_C^\circ C(s) + 3\Delta H_C^\circ H_2(g) - \Delta H_C^\circ C_2H_6(g)$

$= 2\times(-286) + 3\times(-393.5) - (-1560) = -192.5\,kJ$

20.(C) $Br_2(l) \longrightarrow Br_2(g) \longrightarrow 2Br(g)$ (Bond Enthalpy = y kJ/mol; Enthalpy of atomisation = x kJ/mol)

Clearly, x > y