Miscellaneous Exercise Question Bank

1.(C) $\Delta H_{evaporation} = 9.72$ kcal / mol

$= 540$ cal/g

$\Delta H = 90 \times 540 = 48600$ cal

$\Delta H = \Delta E + P\Delta V$

$\Delta V = (V_{vapour} - V_{liq})$

V_{liq} is negligible

$= V_{vapour}$

$\Delta H = \Delta E + PV_{vapour} = \Delta E + nRT$

$\Delta E = \Delta H - nRT = 48600 - \frac{90}{18} \times 2 \times 373 = 44870$ cal $= 44.87$ k cal

2.(D) $\Delta H_{diss} = -\Delta H_{neut}(SA + SB) + \Delta H_{reaction} = -(-57.1) + (-53.35) = 3.92$ kJ/mol

For oxalic acid, 2 moles H^+ is neutralized so, $\Delta H = 3.92 \times 2 = 7.9$ kJ/mole

3.(BD) Fact **4.(A)** Fact **5.(A)** Hydration of $F^- >$ Hydration of Cl^-

6.(A) ΔH for condensation is $-$ve and it adds into ΔH_f of $H_2O(\ell)$

7.(D) Mass independent properties are intensive properties.

8.(4) $\Delta H_{neut} = \Delta H_{ion} + \Delta H_{hyd}$

$\Delta H_{hyd} = 5.91\ kJ - 2 kJ mol^{-1} = 3.91 kJ\ mol^{-1} \approx 4\ kJ\ mol^{-1}$

9.(D)

$$S_{(rhombic)} + O_2 \longrightarrow SO_2 \quad \Delta H = -297.5 \text{ kJ}$$

$$+ \quad SO_2 \longrightarrow S_{(monoclinic)} + O_2 \quad \Delta H = +300 \text{ kJ}$$

$$S_{(rhombic)} \longrightarrow S_{(monoclinic)} \quad \underbrace{\Delta H = 2.5 \text{ kJ}}_{\text{endothermic}}$$

10.(B) $Ca(OH)_2 = 50 \times 0.01 \times 2 = 1$ meq

$HCl = 25 \times 0.01 = 0.25$ meq

So, 0.25 meq undergoes neutralization.

1000 meq $\longrightarrow 140 \times 10^3$ cal/eq

0.25 meq $\longrightarrow \frac{140 \times 10^3 \times 0.25}{1000} = 35$ cal

11.(D) $C + O_2 \rightarrow CO_2$ $(-4x)$

$S + O_2 \rightarrow SO_2$ $(-3x)$

$CS_2 + 3O_2 \rightarrow CO_2 + 2SO_2 \quad \Delta H = -265$ kcal

$C + 2S \rightarrow CS_2 \quad \Delta H = 26$ kcal

$2S + 2O_2 \rightarrow 2SO_2 \quad 4x + 26 - 265 = 239 + 4x$

$239 + 4x = -6x$ So, $-3x = -23.9 \times 3$

$x = 23.9$ $= -71.7$ kcal/mol

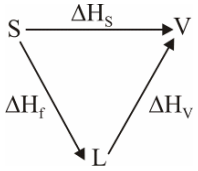
12.(A) With HF reaction is exothermic, spontaneous, with HCl its not.

13. $\Delta_{sys}S = \frac{q_{rev}}{T_{sys}} = \frac{-300}{400} = \frac{-3}{4}\ Jk^{-1}$

$\Delta_{surr}S = \frac{-q_{process}}{T_{surr}} = \frac{300}{300} = 1\ Jk^{-1}$

$\Delta_{Total}\, S = \frac{-3}{4} + 1 = \frac{1}{4} = 0.25\ Jk^{-1}$

$0.05x = 0.25 \qquad \boxed{x = 5}$

14. Since, sublimation involves According to 

Hess's law,

$\Delta H_{(f)} + \Delta H_{(v)} = \Delta H_{(s)}$

15.(B) $\Delta G = \Delta H - T\Delta S$

Let us assume for, for $\Delta G < 0$ (spontaneous)

$\Delta G = 0 \qquad \Delta S < -\frac{x}{298}$

$\Delta H = T\Delta S$

$\Delta S = \frac{\Delta H}{T} = -\frac{x}{298}$

16. $C_2H_5OH + \frac{7}{2}O_2 \rightarrow 2CO_2 + 3H_2O \qquad \Delta H = -300$ kcal.....(a)

$C + O_2 \rightarrow CO_2 \qquad \Delta H = -94.3$ kcal.....(b)

$H_2 + \frac{1}{2}O_2 \rightarrow H_2O \qquad \Delta H = -68.5$ kcal.....(c)

$2C + 3H_2 + \frac{1}{2}O_2 \rightarrow C_2H_5OH \qquad \Delta H = 2b + 3c - a$

$\Delta H = -94.1$ kcal

17. $H_3NSO_2 \longrightarrow NH_3 + SO_2 \quad \Delta H = 40\ kJmol^{-1}$.....(a)

$\frac{1}{2}N_2 + 3/2H_2 \longrightarrow NH_3 \quad \Delta H = -46.17\ kJmol^{-1}$.....(b)

$S + O_2 \longrightarrow SO_2 \quad \Delta H = -296.83\ kJmol^{-1}$.....(c)

$\frac{1}{2}N_2 + 3/2H_2 + S + O_2 \longrightarrow H_3NSO_2 \qquad \Delta H = b + c - a$

$\Delta H = -383\ kJmol^{-1}$

18. $CH_4(g) + Cl_2(g) \longrightarrow CH_3Cl(g) + HCl(g) \quad \Delta H = -100.3$ kJ

$\Delta H_{reaction} = 4B.E_{C-H} + 1B.E_{Cl-Cl} - 3 \times B.E_{C-H} - 1 \times B.E_{C-Cl} - 1 \times B.E_{H-Cl}$

$B.E_{Cl-Cl} = 243.7\ kJmol^{-1}$

19. $CH_2Cl_2(g) \longrightarrow C(g) + 2H(g) + 2Cl(g)$

$\Delta H_r = 2C - H + 2C - Cl = 2 \times 414 + 2 \times 330 = 1488\ kJmol^{-1}$

20. $2C_2H_2(g) + 5O_2(g) \longrightarrow 4CO_2(g) + 2H_2O(g)$

$\Delta H = 4(C - H) + 2(C \equiv C) + 5(O = O) - 8(C = O) - 4(O - H)$

$= 4 \times 414 + 2 \times 814 + 5 \times 499 - 8 \times 724 - 4 \times 640 = -2573\ kJmol^{-1}$

21. $AgCl(s) + aq \longrightarrow Ag^+(aq) + Cl^-(aq) \qquad \Delta H = ?$

$\Delta H = \Delta H_f^0(Ag^+) + \Delta H_f^0(Cl^-) - \Delta H_f^0(AgCl, s)$

$= 65.49\ kJmol^{-1}$

22. $BaCl_2(s) + aq \rightarrow Ba^{2+}(aq) + 2Cl^-(aq) \qquad \Delta H = -20$.....(a)

$BaCl_2.2H_2O(s) + aq \rightarrow Ba^{2+}(aq) + 2Cl^-(aq) \quad \Delta H = 8$.....(b)

$BaCl_2(s) \rightarrow BaCl_2.2H_2O \qquad \Delta H = a - b = -28\ kJmol^{-1}$

23. In neutralization of H_2SO_4, 2 moles of H^+ are getting neutralized, So, double heat is liberated so, $\boxed{b = 2a}$.

24. For 1 mole heat evolved $= -57$kJ
$\therefore$ (0.15×0.5) mol, heat evolved $= -57 \times 0.15 \times 0.5 = -4.275$kJ

25. $H^+ + OH^- \rightarrow H_2O$

$\Delta H_r = \Delta H^o_{f(H_2O)} - \Delta H^o_{f(H^+)} - \Delta H^o_{f(OH^-)}$

$\Delta H_{f(OH)} = -285 + 57 = -228 \text{ kJ mol}^{-1}$

26.(A) By definition.

27.(D) $C_{(diamond)} + O_2 \rightarrow CO_2(g).....(a)$ $\Delta H = -94.3$ Kcal mol^{-1}

$C_{(graphite)} + O_2 \rightarrow CO_2(g).....(b)$ $\Delta H = -97.6$ Kcal mol^{-1}

$C_{(diamond)} \rightarrow C_{(graphite)}$ $\Delta H = a - b$ $= 3.3$ Kcal mol^{-1}

$\therefore$ for 1g , heat $= \dfrac{3.3}{12} = 0.275$ Kcal

28.(A) For 1 mole of sucrose $\rightarrow$ 1350 Kcal mol^{-1}

For $\dfrac{17.1}{342}$ i.e. 0.05 mole $\rightarrow$ 1350×0.05 $\Rightarrow$ 67.5 Kcal

29.(B) 1411 kJ $\rightarrow$ for 1 mole

5644 kJ $\rightarrow$ for $\dfrac{1}{1411} \times 5644 = 4$ moles

$C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$

1 mole C_2H_4 uses $\rightarrow$ 3 moles O_2

So, 4 mole uses $\rightarrow$ 12 moles O_2

Volume of $O_2 = 12 \times 22.4 = 268.8$L

30.(D) $CH_4 \rightarrow C + 4H$ $\Delta H = 320.....(a)$

$C_2H_6 \rightarrow 2C + 6H$ $\Delta H = 600.....(b)$

From (a)

$\Delta H = 4C - H$

$C - H = 80$ cal

From (b)

$\Delta H = 1C - C + 6C - H$ $\boxed{C - C = 120 \text{ cal}}$

$600 = 1C - C + 6 \times 80$

31.(C) Theoretical heat of hydrogenation of benzene $= 3x_1$

Exp. $= x_2$

So, R.E $= 3x_1 - x_2$

32.(B) $\dfrac{1}{2}H_2(g) + \dfrac{1}{2}Cl_2(g) \longrightarrow HCl(g)$

$\Delta_f H = \dfrac{1}{2}\varepsilon_{H-H} + \dfrac{1}{2}\varepsilon_{Cl-Cl} - \varepsilon_{H-Cl}$

$-22 = \dfrac{1}{2}(104) + \dfrac{1}{2}(58) - \varepsilon_{H-Cl}$

$\varepsilon_{H-Cl} = 22 + 52 + 29 = 103$ kcal / mol

33.(A) $MgCl_2 + aq \longrightarrow MgCl_2\ (aq)$ $\Delta H = -25$ cal / mol.....(1)

$MgCl_2 + aq \longrightarrow MgCl_2.2H_2O$ $\Delta H = -30$ cal / mol.....(2)

(1) – (2)

$MgCl_2.H_2O + aq \longrightarrow MgCl_2(aq)$

$\Rightarrow \ -25 + 30 = +5$ cal / mol

34.(D) Fact **35.(C)** By definition

36.(C) For strong acid and strong base $\Delta_{neut}H = -13.6$ Kcal

37.(D) Some heat is consumed in dissociation of weak acid, so, heat evolved will be lesser than expected.

38.(C) $CH_3COOH + OH^- \longrightarrow CH_3COO^- + H_2O$ $-q_1$

$H^+ + OH^- \longrightarrow H_2O$ $-q_2$

$CH_3COOH \rightarrow CH_3COO^- + H^+$ $\Delta H = \Delta H_1 - \Delta H_2$

$= q_2 - q_1$

$\boxed{\Delta H = q_2 - q_1}$

39. $A \rightarrow p, q$; $B \rightarrow q, r, s$; $C \rightarrow p$; $D \rightarrow r$ By definition

40.(A) $C + 1/2\,O_2 \longrightarrow CO$ $\Delta H_1 = -x_1$

$C + O_2 \rightarrow CO_2$ $\Delta H_2 = -x_2$

$\Delta H_1 + \Delta H_2 = -(x_1 + x_2) = -57.5$ Kcal

$-94.05 - 21.41 = -115.46$ gives one mole CO

-57.5 gives $= \dfrac{-115.46}{-57.5} = \boxed{0.5\,\text{mole}}$

41.(C) $\Delta H_{reaction} = 4 \times (Xe - F) - 1 \times (F - F) + I.E. + EGE$

$= 4 \times 34 - 38 + 279 - 85$ (EGE = –EA) $= 292$ Kcal / mol .

42.(B) Number of H^+ ions in H_2SO_4 = 2 Number of H^+ ions in HCl

$Y = 2x$

43.(B) More ΔH_{ion} , less acidic character, more pK_a .

So, $pK_a HCN > pK_a CH_3COOH$

44.(A) $q = mC_p\Delta T$

= 100g (solution) × 4.18 × 3

= 1254 J released

For 5 meq $\rightarrow$ 1254 J released

For 1000 meq $\rightarrow \dfrac{1254}{5} \times 1000 = 250 \times 10^3$ J $= 2.5 \times 10^2$ kJ / mole released.

45.(B) $\Delta H_r = n(C = C) + 4n(C - H) - 2n(C - C) - 4n(C - H) = -100$ kJ per mole

$600n - 2n\,C - C = -100n$

$700n = 2n\,C - C$

$C - C = \dfrac{700}{2}$ kJ/mole = 350 kJ/mole.

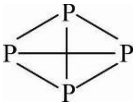
$\rightarrow$ as one C = C breaks, 2 new C – C are formed.

46.(C) $\frac{1}{4}P_4(s) + \frac{3}{2}H_2(g) \rightarrow PH_3(g)$

$\Delta H = \frac{1}{4} \times 6(P-P) + \frac{3}{2}(H-H) - 3(P-H)$

$5.5 = \frac{1}{4}6(53.2) + \frac{3}{2}(104.2) - 3 \times P - H$

$P - H = 76.9\ \text{Kcal mol}^{-1}$



47.(9) $\Delta H_{diss} = \Delta H_r - \Delta H_{neut.}$

$= -4.7 - (-13.6) = 8.9 \sim 9\ \text{Kcal/mole.}$

48.(9) $H_2 + \frac{1}{2}O_2 \rightarrow H_2O \quad -241\ \text{kJ mole}^{-1}$ .....(a)

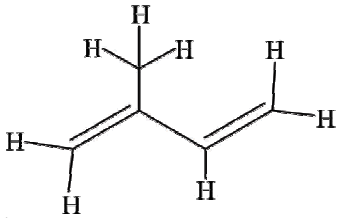
$C_6H_{12} + 9O_2 \rightarrow 6CO_2 + 6H_2O \quad -3920\ \text{kJ mole}^{-1}$ .....(b)

$C_6H_{10} + 17/2\ O_2 \rightarrow 6CO_2 + 5H_2O \quad -3717\ \text{kJ mole}^{-1}$ .....(c)

$C_6H_{10} + H_2 \rightarrow C_6H_{12} \quad \Delta H = ?$

$c + a - b = \boxed{9\ \text{Kcal mole}^{-1}} = 38\ \text{kJ mole}^{-1}$

49.(5)



$5C_{(graphite)} + 4H_{2(g)} \longrightarrow C_5H_8(g) \quad \Delta H = 79\ \text{kJmol}^{-1}$

$C_{(graphite)} \longrightarrow C(g) \quad \Delta H = 718\ \text{kJmol}^{-1}$

$5C(g) + 4H_2(g) \longrightarrow C_5H_8(g) \quad \Delta H = 79 - 5 \times 718 = -3511\ \text{kJmol}^{-1}$

$\Delta H = 4(H-H) - 2(C=C) - 8(C-H) - 2(C-C)$

$= 1740 - 1230 - 3304 - 696 = -3490\ \text{kJmol}^{-1}$

Resonance E $= -3490 - (-3511) = 21\ \text{kJmol}^{-1}$ or $5\ \text{kcal mol}^{-1}$

50.(5) $Br_2(\ell)$, C(graphite), $N_2(g)$ $F_2(g)$, $Cl_2(g)$

51. $C_3H_6 + \frac{9}{2}O_2 \longrightarrow 3CO_2 + 3H_2O$ .....(a)

$C + O_2 \longrightarrow CO_2$ .....(b)

$H_2 + \frac{1}{2}O_2 \longrightarrow H_2O$ .....(c)

$3C + 3H_2 \longrightarrow C_3H_6 \quad \Delta H = 3b + 3c - a$

$\Delta H = 3 \times -39.35 + 3 \times -285.8 + 2091 = 53\ \text{kJmole}^{-1}$

52. $N_2 + 3H_2 \rightarrow 2NH_3$

$\Delta H = (N \equiv N) + 3(H-H) + 6 \times (N-H)$

$= 945 + 3 \times 435 + 6 \times 391 = \boxed{96\ \text{kJmol}^{-1}}$

53. Let x be the % of ionization of weak acid

$\Delta H = \Delta H_{neu} + \Delta H_{ion}$

$-56.1 = -57.3 + 1.5(1 - 0.01x)$ amount left which needs to ionize, out of 1, $\frac{x}{100}$ self dissociated.

$x = 20\%$

54.(B) $PV^{\gamma} =$ constant, $P \cdot \gamma V^{\gamma-1} \cdot dV + V^{\gamma} \cdot V^{\gamma} .dP = 0$

$\therefore \quad \frac{dP}{P} = -\gamma . \frac{dV}{V}$

55.(ABD) (A) ΔH for gas, liquid and solid are different.

(B) for reaction at constant p, its ΔH

for reaction at constant V, its ΔU

(D) By Kirchoff's equation

56.(ABCD) Fact **57.(ABC)** Fact (by definition)

58.(AB) $C(s) + 2H_2(g) \rightarrow CH_4(g)$

$\Delta H = -393.5 - 285.8 \times 2 + 890.3 = -74.8\ kJmol^{-1}$ or $-17.87\ kcal$

59.(CD) For strong acid and strong base. **60.(ABC)** By definition

61.(BCD) Fact

62.(A) $\Delta H_r = \Delta H_{ion} + \Delta H_{neu}$

$-49.86 = \Delta H_{ion} - 55.84$

$\Delta H_{ion} = 5.98\ kJ / mol$

63.(B) As number of OH^- is double, ΔH_{neut} gets double

$2H^+(aq) + 2OH^-(aq) \longrightarrow 2H_2O(\ell)$

$\Delta H = 2 \times -55.84\ kJmol^{-1} = -111.68\ kJ$

64.(B) 50 : 50

Maximum acid and base is neutralized as compared to other options.

$0.1 \times 50 = 0.05 \times 2 \times 50$

5 meq = 5 meq (both)

65.(B) $3C_{(graphite)} + 4H_2(g) \rightarrow C_3H_8(g) \quad \Delta_f H^{\ominus} = -85$

$\Delta_f H^{\ominus} = 3 \times \Delta_{sub} H_{(graphite)} + 4\varepsilon_{H-H} - 2\varepsilon_{C-C} - 8\varepsilon_{C-H}$

$\varepsilon_{C-C} = \frac{3 \times 719 + 4 \times 435 - 8 \times 414 + 85}{2} = 335\ kJ / mol$

66.(C) $2C_{(graphite)} + \frac{1}{2}N_2(g) + \frac{3}{2}H_2(g) \rightarrow CH_3CN(g)\ \Delta_f H^{\ominus} = 88\ kJ / mol$

$\Delta H_f^0 = 2\Delta_{sub} H_{C(graphite)} + \frac{1}{2}\varepsilon_{N \equiv N} + \frac{3}{2}\varepsilon_{H-H} - 3\varepsilon_{C-H} - \varepsilon_{C-C} - \varepsilon_{C \equiv N}$

$(\varepsilon_{C \equiv N}) = 2 \times 719 + \frac{1}{2}(948) + \frac{3}{2}(435) - 3 \times 414 - 335 - 88 = 899.5\ kJ\,mol^{-1}$

67.(A) $CH_3CN + 2H_2 \rightarrow CH_3CH_2NH_2$

$\Delta H_{hydrogenation} = 3\varepsilon_{C-H} + \varepsilon_{C-C} + \varepsilon_{C \equiv N} - 5 \times \varepsilon_{C-H} - \varepsilon_{C-C} - \varepsilon_{C-N} - 2\varepsilon_{N-H}$

$= 3 \times 414 + 335 + 899.5 + 2 \times 435 - 5 \times 414 - 335 - 378 - 2 \times 426$

$-288.5\ kJ / mol$

68.(C) Fact **69.(B)** Fact

70.(A) $\Delta H_{solution} = \frac{(125+8)\times 4.2\times 6}{8}\times 80 = 33516$ J/mol or 33.51 kJ/mol.

71.(C) $H_2C_2O_4(\ell) + \frac{1}{2}O_2(g) \longrightarrow H_2O(\ell) + 2CO_2(g)$

$\Delta n_g = 3/2$

$\Delta U_c = -\frac{0.312\times 8.75}{1}\times 90 = -245.7$ kJ/mol

$\Delta H = \Delta U + \Delta n_g RT = -245.7 + \frac{3}{2}\times\frac{8.314\times 300}{1000} = -241.947$ kJ/mol

72.(B) $H_2O(s) \longrightarrow H_2O(l)$, $\Delta H = 1440$ cal

$\Delta H \cong \Delta U$ for solids and liquids

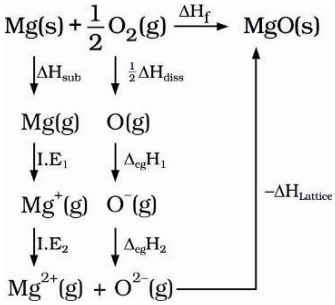
73.(A) $C_3H_8(g) + 5O_2(g) \rightarrow 3CO_2(g) + 4H_2O(\ell)$

$$\Delta_c H = \begin{bmatrix} 8\times \text{B.E.}(C-H) \\ +2\times \text{B.E.}(C-C) \\ +5\times \text{B.E.}(O=O) \end{bmatrix} - \begin{bmatrix} 6\times \text{B.E.}(C=O) \\ +8\times \text{B.E.}(O-H) \\ +3\times |\text{ R.E. }| \text{ of } CO_2 \\ +4\times \Delta_{vap}H(H_2O) \end{bmatrix}$$

74.(B) $H_2(g) + \frac{1}{2}O_2(g) \longrightarrow H_2O(l)$; ΔH_{comb}, H_2

$\Delta H_{comb} = \Delta H_{H-H} + \frac{1}{2}\Delta H_{O=O} - 2\Delta H_{O-H} - \Delta H_{vap} = x_1 + \frac{x_2}{2} - 2x_3 - x_4$

75.(A)



$-602 = 148 + 738 + 1450 + \frac{1}{2}\times 498 - 141 + 844 - \Delta H_{Lattice}$

$-\Delta H_{Lattice} = -602 - 148 - 738 - 1450 - \frac{498}{2} + 141 - 844$

$\Delta H_{Lattice} = +3890$ kJ / mole

76.(A) $H^+(aq) + OH^-(aq) \longrightarrow H_2O(\ell)$

So $\Delta H^o = -57.3 = -285.5 - \Delta H_f^o(H+, aq) - \Delta H_f^o(OH^-, aq)$

So $\Delta H_f^o(OH^-, aq) = -22.85$ kJ / mole (as $\Delta H_f^o(H^+, aq) = 0$)

77.(D) $C_2H_5 - S - C_2H_5 + S \longrightarrow C_2H_6 - S - S - C_2H_5$

$\Delta H_f^o(C_2H_5 - S - C_2H_5) = \Delta H_f^o(C_2H_5 - S - S - C_2H_5) - \Delta H_{S-S} + \Delta H_{sub}S.$

$-201.9 = -147.2 - \Delta H_{S-S} + 222.8$

$\Delta H_{S-S} = 277.5$ kJ/mol

78.(A) $\Delta G^\circ = -RT \ln K = -8.314 \times 10^{-3} \times 400 \ln 10^5$

$\Delta G^\circ = -38.294$ kJ

79.(B) For $H_2(g) + O_2(g) \longrightarrow H_2O_2(\ell)$

$$\Delta_r H^o_{H_2O_2(\ell)} = \Delta_r H^o_3 + \frac{\Delta_r H^o_2}{2} - \frac{\Delta_r H^o_1}{2}$$

80.(A) $\frac{1}{2}N_2(g) + 2H_2(g) + \frac{1}{2}Cl_2(g) \longrightarrow NH_4Cl(s)$

$$\Delta_r S^o(NH_4Cl, s) \text{ at } 300 \text{ K} = S^o_{NH_4Cl(s)} - \left[\frac{1}{2}S^o_{N_2} + 2S^o_{H_2} + \frac{1}{2}S^o_{Cl_2}\right] = -374 \text{ JK}^{-1}\text{mol}^{-1}$$

$\Delta_r C_p = 0$

$\therefore \quad \Delta_r S^o_{310} = \Delta_f S^o_{300} = -374 \text{ JK}^{-1}\text{mol}^{-1}$

$\Delta_f H^o_{310} = \Delta_f H^o_{300} = -314.5$

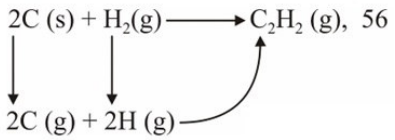
$$\Delta_f G^o_{310} = \Delta_f H^o_{310} - T\Delta S^o = -314.5 - \frac{310(-374)}{1000} = -198.56 \text{ kJ/mol}$$

81.(ABC) (D) $BOH(g) + \text{aqueous} \longrightarrow B^+(aq) + OH^-(aq)$ $\quad \Delta H = -20$ kJ/mole

82.(9) $H - C \equiv C - H + \frac{5}{2}O_2 \longrightarrow 2CO_2 + H_2O, \quad -312$ kcal

$-312 = 2x(-94) + (-68) - \Delta H_{f(C_2H_2)}$

$\Delta H_{f(C_2H_2)} = 56$ Kcal



$56 = 2 \times 150 + 50 - 2 \times 93 - x$

x = 108 Kcal

$\frac{\Delta H_{C \equiv C}}{12} = \frac{108}{12} = 9$.

83.(5) Heat evolved per mol of 'B' atoms $= \frac{5}{2} \times 200 = 500$ kJ

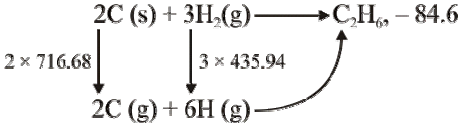
84.(C) $\Delta U = \Delta H - P\Delta V$

$= -0.5 - [1.5(5-10)] \times 0.1 = -0.5 + 1.5 \times 5 \times 0.1 = +0.25$ kJ (1 L atm = 0.1 KJ)

85.(A) $\Delta H = \Delta H_{neu} + \Delta H_{diss} = -13.7 + 0.7 = -13$ Kcal

86.(A) $C_2H_6(g) + \frac{7}{2}O_2(g) \longrightarrow 2CO_2 + 3H_2O(l), \quad -1559.8$

$-1559.8 = 2 \times (-393.5) + 3 \times (-285.8) - \Delta H_{f(C_2H_6)} \quad \Rightarrow \quad \Delta H_{f(C_2H_6)} = -84.6$



$2 \times 716.68 + 3 \times 435.94 - 6BE_{C-H} - BE_{C-C} = -84.6$

$6BE_{C-H} + BE_{C-C} = 2741.18$ kJ $\quad$ .....(i)

$CH_3CHO + \frac{5}{2}O_2 \longrightarrow 2CO_2 + 2H_2O, \quad -1192.3$

$-1192.3 = 2 \times (-393.5) + 2 \times (-285.8) - \Delta H_{f(CH_3CHO)}$

$\Delta H_{f(CH_3CHO)} = -166.3\,kJ$.

$$2C + 2H_2 + 1/2O_2 \longrightarrow CH_3CHO, -166.3\ kJ.$$
$$\downarrow 2\times716.68 \quad \downarrow 2\times435.94 \quad \downarrow 1/2\times498.94$$
$$2C(g) + 4H(g) + O(g) \longrightarrow CH_3CHO$$

$\Delta H' = 0 - 4 \times BE_{C-C} - BE_{C=O}$

$$-166.3 = 2\times716.68 + 2\times435.94 + \frac{1}{2}\times498.94 - 4BE_{C-H} - BE_{C=O} \qquad .....(ii)$$

$$C(s) + O_2 \longrightarrow CO_2(g), -393.5$$
$$\downarrow 716.68 \quad \downarrow 498.94$$
$$C(g) + 2O(g) \longrightarrow CO_2$$

$\Delta H' = 0 - 2 \times BE_{C=O}$

$716.68 + 498.94 - 2 \times BE_{C=O} = -393.5$

$BE_{C=O} = 804.56$ kJ .....(iii)

Now we can find all bond energies.

87.(A) $\Delta H = \Delta E + \Delta nRT$ and $\Delta H = -651\times10^3$ cal

R = 2 cal

T = 290 K

and $\Delta n = 6 + 6 - 6 = 6$

$\therefore\ -651 \times 10^3 = \Delta E + 6 \times 2 \times 290$ or $\Delta E = 654480$ cal $= -654.48$ kcal

88.(B) $Q = \frac{5.8}{58} \times \frac{5756}{2} = 287.8$ kJ

89.(B) $C(s) + O_2(g) \rightarrow CO_2(g)$ $\Delta H = -97$ Kcal

$CO_2(g) + C(s) \rightarrow 2CO(g)$ $\Delta H = 39$ Kcal

Subtracting equation (ii) from equation (i), we get

$2CO + O_2 \longrightarrow 2CO_2$, $\Delta H = -136$ Kcal

$\therefore\ \Delta H_{(Combustion)} = -68$ Kcal

90.(C)

$CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$	$\Delta H^o = 42.8$ kcals
$CaO(s) + 3C(s) \rightarrow CaC_2(s) + CO(g)$	$\Delta H^o = 111$ kcals

$CaCO_3(s) + 3C(s) \rightarrow CaC_2(s) + CO(g) + CO_2(g)$ $\Delta H = 153.8$ kcals

Thus, heat required to prepare 1 mole of CaC_2 from $CaCO_3$ = 153.8 kcals

Molecular weight of CaC_2 = 40 + 24 = 64

64 gm of CaC_2 requires 153.8 kcals of heat

128 gm of CaC_2 requires 307.6 kcals of heat

Hence, **(C)** is the correct answer.

91.(C) If $AlCl_3$ is present in ionic state in aqueous solution, it will have Al^{3+} and $3Cl^-$ ions.

Standard heat of hydration of Al^{3+} and $3Cl^-$ ions

$= -4665 + 3 \times (-381) = 5808$ kJ/mole

Required energy of ionization of Al = 5137 kJ $mole^{-1}$

Hydration energy overcomes ionization energy

$\therefore$ $AlCl_3$ would be ionic in aqueous solution. Hence, **(C)** is the correct answer.

92.(A) Heat evolved at constant volume = $0.16 \times 17.7 \times 0.5$ kJ

Heat of combustion of methane (heat evolved per mole) = $\frac{16 \times 17.7 \times 0.5}{0.16}$ = 885 kJ / mol

$\Delta E = -885$ kJ / mol

$CH_4(g) + 2O_2(g) \longrightarrow CO_2(g) + 2H_2O(l)$

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

$\Delta H = \Delta E + \Delta nRT = -885 + (-2) \times 8.314 \times 10^{-3} \times 298$

$\Delta H = -889.95$ kJ / mole

93.(C) $6C(s) + 3H_2(g) \longrightarrow C_6H_6(l)$ $\Delta H_{exp} = -358.5$ kJ

$\Delta H_{cal} = \sum B.E_{(R)} - \sum B.E_{(P)}$

$= [6 \times 716.8 + 3 \times 436.9] - [3 \times 340 + 3 \times 620 + 6 \times 490] = -208.5$ kJmol^{-1}

Resonance energy $\Delta H_{f(exp)} - \Delta H_{f(calculated)} = -358.15 - (-208.5) = -150.0$ kJ mol^{-1}

94.(C) $\Delta C_{P(reaction)} = 35.1 \times 2 - 29.1 - 28.8 \times 3 = -45.3$

$(\Delta H)_{T_2} - (\Delta H)_{T_1} = (\Delta C_p)_{rxn}(T_2 - T_1)$

$\Delta C_P < O$ so, ΔH will dec. with inc. in T.

So reaction will be more exothermic

95.(B) Total heat evolved = Total heat absorbed

$n_1 \times 2 \times 110 = n_2 \times 132$

$\frac{n_1}{n_2} = \frac{0.6}{1}$

$n_1 \rightarrow n_{O_2}$ $n_2 \rightarrow n_{H_2O}$

$\frac{n_{H_2O}}{n_{O_2}} = \frac{1}{0.6}$ So, (B)

96. $\Delta U = \Delta H - P\Delta V$

$= -92 - 40(-1.25) \times 0.1 = -87$ kJ

97.(B) Energy gained by athlete $= 780 \times \frac{20}{100} = 156$ kJ

$\therefore$ Amount of water evaporated $= \frac{156}{44} \times 18 = 63.8$ gm

98. $\Delta H - \Delta U = \Delta n_g RT = -3 \times 8.314 \times 10^{-3} \times 298 = -7.432$ kJ

99. $\Delta T = 1K$

$C_V = 2108$ Cal / k

$P = 760$ torr $= 1$ atm

$V = 1L$

$T = 32 + 273 = 305$ K

$q = -C_V \Delta T$

$= -2108 \times 1$

-2108 cal

$\downarrow$

exothermic

Heat lost by system (mix) = heat gained by bomb calorimeter (same magnitude, opp. signs)

Enthalpy of combustion for 16 g $CH_4 = -210.8$ Kcal / mol $= -210800$ cal / mol

Heat

$-210800 \longrightarrow 16\,g$

$-2108 \longrightarrow \frac{16}{210800} \times 2108 = 0.16\,g$

Moles of $CH_4 = \frac{0.16}{16} = 0.01$

For gas mix, PV = nRT

$1 \times 1 = n \times \frac{1}{12} \times 305 = 0.04$

Mole % $= \frac{0.01}{0.04} \times 100 = 25\%$

100.(B) (A) – 110 kJ

(C) Heat is required to initiate combustion.