DPP SOLUTION

- **Subject – Physical Chemistry**
- **Chapter –** Thermodynamics and Thermochemistry

DPP No.- 05

By – Amit Mahajan Sir

Question-

The heat of combustion of ethanol determined in a bomb calorimeter is −670.48 K. Cals mole^{-1} at 25°C. What is ΔH at 25°C for the reaction:

$\Delta U = -670.48$ K Cal/mol

$T = 25^\circ C = 298$ K

$R \approx 2$ Cal $K^{-1} mol^{-1}$

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

$= -670.48 - \frac{1 \times 2 \times 298}{1000}$

$= -670.48 - 0.596$

$= -671.08$ K Cal

1. −335.24 K Cals.
2. −671.08 K Cals.
3. −670.48 K Cals.
4. +670.48 K Cals.

$1C_2H_5OH(l) + 3O_2(g) \rightarrow 2CO_2(g) + 3H_2O(l)$

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

Ans. (2)

Question-

From the reaction P(White) → P(Red); ΔH = –18.4 KJ. It follows that:-

1. Red P is readily formed from white P
2. White P is readily formed from red P
3. White P can not be converted to red P
4. White P can be converted into red P and red P is more stable

Ans. (4)

Question-

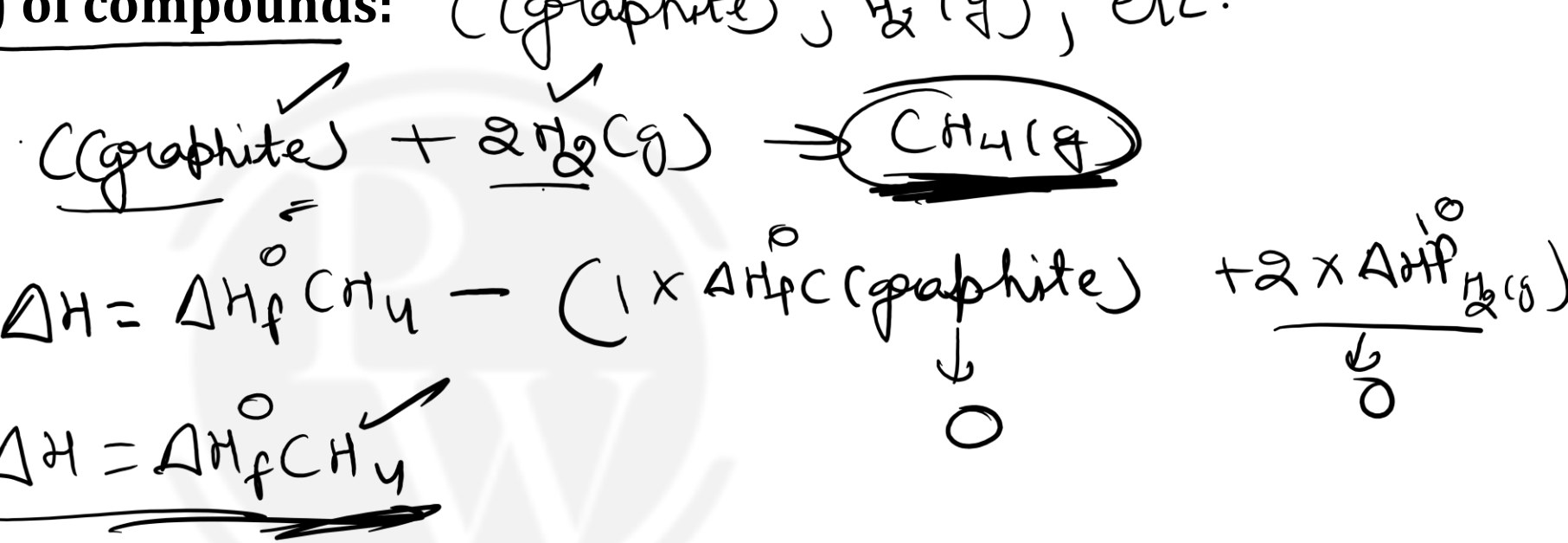
Since the enthalpy of the elements in their standard states is taken to be zero. The heat of formation (ΔH_f) of compounds:

(1) Is always negative

(2) Is always positive

(3) Is zero

(4) May be positive or negative



Ans. (4)

Question-

Which of the following equations represents standard heat of formation of CH_4?

1. $C_{(diamond)} + 2H_2(g) \rightarrow CH_4(g)$
2. $C_{(graphite)} + 2H_2(g) \rightarrow CH_4(g)$
3. $C_{(diamond)} + 4H_2(g) \rightarrow CH_4(g)$
4. $C_{(graphite)} + 4H_2(g) \rightarrow CH_4(g)$

Ans. (2)

Question-

Given enthalpy of formation of $CO_2(g)$ and $CaO(s)$ are −94.0 KJ and −152 KJ respectively and the enthalpy of the reaction: $CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$ is 42 KJ. The enthalpy of formation of $CaCO_3(s)$ is

1. −42KJ
2. −202KJ
3. +202KJ
4. −288KJ

$\Delta H = 1X -152 + 1X(-94) - (\Delta H_f CaCO_3)$

$\Delta H_f = ?$

$42 = -244 - \Delta H_f CaCO_3$

$\Delta H_f CaCO_3 = -246 - 42 = -288$ KJ

152
94

Ans. (4)

Question-

The enthalpies of combustion of carbon and carbon monoxide are –393.5 KJ and –283KJ, respectively the enthalpy of formation of carbon monoxide is

1. –676.5 KJ
2. –110.5 KJ
3. 110.5 KJ
4. 676.5 KJ

$\Delta H_{Comb}\ C = -393.5\ kJ$

$\Delta H_{Comb}\ CO = -283\ kJ$

$1C(graphite) + \frac{1}{2}O_2(g) \rightarrow 1CO(g)\quad \Delta H = \Delta H_f$

$\Delta H = 1 \times -393.5 + \frac{1}{2} \times 0 - 1 \times -283$

$= -393.5 + 283$

$= -110.5\ kJ$

Ans. (2)

Question-

The heat of combustion of $CH_4(g)$, $C(s)$ and $H_2(g)$ at 25°C are –212.4 K cal,–94.0 K cal and –68.4 K cal respectively, the heat of formation of CH_4 will be-

1. +54.4 Kcal
2. –18.4 Kcal
3. –375.2 Kcal
4. +212.8 Kcal

$1C(graphite) + 2H_2(g) \rightarrow 1CH_4 \quad \Delta H_f = ?$

$\Delta H = 1 \times -94 + 2 \times -68.4 - (1 \times -212.4)$

$= -94 - 136.8 + 212.4$

$= -230.8 + 212.4$

$= -18.4 \text{ K cal}$

136.8
94
230.8

Ans. (2)

Question-

Standard enthalpy of formation is zero for

1. $C_{diamond}$
2. $Br(g)$
3. $C_{graphite}$
4. $O_3(g)$

Ans. (3)

Question-

Heat of formation of CO_2 is –94.0 K cal. What would be the quantity of heat liberated, when 3 g of graphite is burnt in excess of oxygen:-

$\Delta H = \Delta H_f_{CO_2} = \Delta H_{comb.\ C(graphite)}$

$1C(graphite) + 1O_2(g) \rightarrow 1CO_2(g)$

$\Delta H_f CO_2 = -94$ K Cal / mole

1 mole CO_2 formed & released = 94 K Cal

1 mole C Combustion ——— = 94 K Cal

12 g ——— = 94 K Cal

3 g ——— $= \frac{94}{12} \times 3 = 23.5$ K Cal

1. 23.5 K cals
2. 2.35 K cals
3. 94.0 K cals
4. 31.3 K cals

Ans. (1)

Question-

The heat of neutralization of HCl by NaOH is –55.9 KJ/mol. If the heat of neutralization of HCN by NaOH is –12.1KJ/mol. The energy of dissociation of HCN is

1. –43.8KJ
2. 43.8KJ
3. 68KJ
4. –68KJ

W.A.

$55.9 = 12.1 + x$

$x = 55.9 - 12.1$

$= 43.8$

Let dissociation energy req. x

$H{-}C \equiv N$

energy req. $\Delta H = (+)ve$

$A + B \rightarrow A{-}B$ energy release

$\Delta H = (-)ve$

Ans. (2)

Question-

Heat evolved in the reaction $H_2 + Cl_2 \rightarrow 2HCl$ is 182 KJ. Bond energies of H – H and Cl – Cl are 430 and 242 KJ/mol respectively. The H – Cl bond energy is:

1. 245 KJ mol^{-1}
2. 427 KJ mol^{-1}
3. 336 KJ mol^{-1}
4. 154 KJ mol^{-1}

$H_2 + Cl_2 \rightarrow 2HCl \quad \Delta H = -182\ KJ$

$\Delta H = (1 \times 430 + 1 \times 242) - (2 \times B.E_{HCl})$

$-182 = 672 - 2 \times B.E_{HCl}$

$2 \times B.E_{HCl} = 672 + 182$

$B.E_{HCl} = \frac{854}{2} = 427\ KJ/mol$

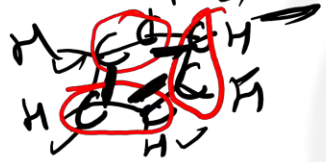
$672 + 182 = 854$

Ans. (2)

Question-

Heat of dissociation of benzene to elements is 5535 kJ mol^{-1}. The bond enthalpies of C – C, C = C and C – H are 347.3, 615.0 and 416.2 kJ mol^{-1} respectively. Resonance energy of benzene is

1. 1.51 kJ mol^{-1}
2. 15.1 kJ mol^{-1}
3. 151 kJ mol^{-1}
4. 1511 kJ mol^{-1}



$C_6H_6(g) \rightarrow 6C(g) + 6H(g)$ $\Delta H = 5535$ kJ/mol

347 | 2
×3
1041

$\Delta H = (6 \times 416.2 + 3 \times 347.3 + 3 \times 615) - 0$

$= 2497.2 + 1041.9 + 1845$

$= 5384.1$

R.E. $= 5535 - 5384.1 = 150.9$ kJ/mol

Ans. (3)

Question-

If $S + O_2 \rightarrow SO_2$; $\Delta H = -298.2\ kJ\ mol^{-1}$

$SO_2 + \rightarrow \frac{1}{2}O_2 \rightarrow SO_3$; $\Delta H = -98.7\ kJ\ mol^{-1}$

$SO_3 + H_2O \rightarrow H_2SO_4$; $\Delta H = -130.2\ kJ\ mol^{-1}$

$H_2 + \frac{1}{2}O_2 \rightarrow H_2O$; $\Delta H = -287.3\ kJ\ mol^{-1}$

Then the enthalpy of formation of H_2SO_4 at 298 K will be-

1. $-814.4\ kJ\ mol^{-1}$
2. $-650.3\ kJ\ mol^{-1}$
3. $-320.5\ kJ\ mol^{-1}$
4. $-433.5\ kJ\ mol^{-1}$

Ans. (1)

$$1S + 1H_2 + 2O_2 \Rightarrow 1H_2SO_4$$

$$\Delta H = -298.2 - 98.7 - 130.2 - 287.3$$

$$\Delta H = -814.4 \text{ KJ/mol}$$

Question-

If the bond energies of H – H, Br – Br and H – Br are 433, 192 and 364 kJ mol^{-1} respectively, then ΔH° for the reaction $H_2(g) + Br_2(g) \rightarrow 2HBr(g)$ is

1. –261 kJ
2. +103 kJ
3. +261 kJ
4. –103 kJ

$\Delta H = 1 \times 433 + 1 \times 192 - 2 \times 364$

$= 625 - 728$

$= -103\ kJ$

Ans. (4)

Question-

The absolute enthalpy of neutralisation of the reaction, $MgO(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2O(l)$ will be

1. Less than -57.33 kJ mol^{-1}
2. -57.33 kJ mol^{-1}
3. Greater than -57.33 kJ mol^{-1}
4. 57.33 kJ mol^{-1}

2HCl
2×57.3

1HCl
-1×57.3

MgO
weak base

$Be(OH)_2$ $Mg(OH)_2$ $Ca(OH)_2$ $Sr(OH)_2$ $Ba(OH)_2$

BeO MgO CaO SrO BaO

Ans. (1)

Thank You...