PHYSICAL CHEMISTRY

DPP

DAILY PRACTICE PROBLEMS

DPP No. 51

Total Marks : 41

Max. Time : 49 min.

Topic : Thermodynamics & Thermochemistry

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.8, 10, 11	(3 marks, 3 min.)	[9, 9]
Subjective Questions ('–1' negative marking) Q.1 to Q.7, 9	(4 marks, 5 min.)	[32, 40]

1. The standard molar enthalpies of formation of ethane, CO_2 & liquid water are – 21.1, – 94.1 and – 68.3 kCal respectively. Calculate the standard molar enthalpy of combustion of ethane.

2. The enthalpies of combustion of C_2H_4 (g), C_2H_6 (g) & H_2 (g) are – 1409.5 kJ, – 1558.3 kJ and – 285.6 kJ respectively. Calculate the enthalpy of hydrogenation of ethylene.

3. The standard enthalpy of combustion at 25°C of hydrogen (H_2), cyclohexene (C_6H_{10}) and cyclohexane (C_6H_{12}) are – 241, – 3800 and – 3920 kJ/mole respectively. Calculate the enthalpy of hydrogenation of cyclohexene.

4. Calculate the enthalpy of combustion of carbon monoxide at constant volume, given the following enthalpy of reactions at constant pressure at 17°C :

(i) $C(s) + O_2(g) \longrightarrow CO_2(g)$; $\Delta H_1 = -97000$ Cal

(ii) $CO_2(g) + C(s) \longrightarrow 2\,CO(g)$; $\Delta H_2 = 39000$ Cal

5. The bond dissociation energies of gaseous H_2, Cl_2 & HCl are 104 , 58 & 103 kCal/mole respectively. Calculate the enthalpy of formation of HCl gas.

6. Determine the enthalpy of hydrogenation of ethylene from the following data .

Bond	Bond energy	Bond	Bond energy
H – H	104 kCal/mol	C – C	80 kCal/mol
C – H	99 kCal/mol	C = C	145 kCal/mol

7. Calculate the bond energy of C = C from the following data. All ΔH units are in kCal.

$2\,C(s) + 2\,H_2(g) \longrightarrow C_2H_4(g)$ $\Delta H = 12.5$

$C(s) \longrightarrow C(g)$ $\Delta H = 170.9$

$H_2(g) \longrightarrow 2\,H(g)$ $\Delta H = 104.2$

Bond energy of C – H bond is 99 kCal/mol.

8. Enthalpy of atomisation of NH_3 and N_2H_4 are x kcal mol^{-1} and y kcal mol^{-1} respectively. Calculate average bond energy of N—N bond :

(A) $\frac{4y-3x}{3}$ kCal mol^{-1} (B) $\frac{2y-3x}{3}$ kCal mol^{-1} (C) $\frac{4y-3x}{4}$ kCal mol^{-1} (D) $\frac{3y-4x}{3}$ kCal mol^{-1}

9. From the following bond energy and standard ΔH° values for the formation of elements in gaseous state, calculate the standard enthalpy of formation of acetone(g) :

Standard ΔH°	**Bond energies**
H (g) = 52 kCal/mol	C – H = 99 kCal/mol
O (g) = 59 kCal/mol	C – C = 80 kCal/mol
C (g) = 171kCal/mol	C = O = 81 kCal/mol

10. The enthalpy of neutralization of a strong base and strong acid is 57.0 kJ eq^{-1} . The heat evolved when 0.5 moles of HNO_3 are added to 1 L of 0.2 M NaOH solution is :

(A) 57.0 kJ (B) 28.5 kJ (C) 11.4 kJ (D) 34.9 kJ

11. For strong acid and strong base neutralization, net chemical change is :

$H^+(aq) + OH^-(aq) \longrightarrow H_2O(\ell)$; $\Delta_r H^\circ = -57.1$ kJ/mol

If enthalpy of neutralization of CH_3COOH by HCl is –50 kJ/mol, then enthalpy of ionisation of CH_3COOH is :

(A) 7.1 kJ/mol (B) –7.1 kJ/mol (C) 107.1 kJ/mol (D) –107.1 kJ/mol

Answer Key

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1.	- 372.0 kCal.	**2.**	- 136.8 kJ.	**3.**	- 121 kJ/mole.	**4.**	DH = –67710 Cal
5.	- 22 kCal/mol.	**6.**	- 29 kCal/mol	**7.**	141.7 kCal	**8.**	$= \frac{3y - 4x}{3}$ kCal mol^{-1}.
9.	49 kCal/mol.	**10.**	(C)	**11.**	(A)		

Hints & Solutions

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1. - 372.0 kCal.

2. - 136.8 kJ.

3. - 121 kJ/mole.

4. $\Delta H = -67710$ Cal

5. - 22 kCal/mol.

6. $C_2H_4(g) + H_2 \longrightarrow C_2H_6$

$\Delta H = (\Delta H)_{sup} - (\Delta H)_{req}$

$\Delta H = [145 + 104] - [80 + 2 \times 99]$

$\Delta H = -29$ kCal/mol

7. $C_2H_4(s) \longrightarrow 2C(o) + 4H(g)$

$\Delta H_{reaction} = 4 \times 52.1 + 2 \times 170.9 - 12$ 5 = 53.7 = $\Delta H_{C=C} + 4 \times 99$

$\Delta H_{C=C} = 141.7$

8. $= \frac{3y - 4x}{3}$ kCal mol^{-1}.

9. 49 kCal/mol.

11. $-49.86 = \Delta H_{ioni} - 55.84$

$\Delta H_{ion} = 55.84 - 49.86 = 5.98$ KJ/mol.