

Topic : Thermodynamics & Thermochemistry
Type of Questions

Single choice Objective ('-1' negative marking) Q.8, 10, 11

(3 marks, 3 min.)

M.M., Min.

[9, 9]

Subjective Questions ('-1' negative marking) Q.1 to Q.7, 9

(4 marks, 5 min.)

[32, 40]

- 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.
- The enthalpies of combustion of $\text{C}_2\text{H}_4(\text{g})$, $\text{C}_2\text{H}_6(\text{g})$ & $\text{H}_2(\text{g})$ are -1409.5 kJ, -1558.3 kJ and -285.6 kJ respectively. Calculate the enthalpy of hydrogenation of ethylene.
- 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.
- Calculate the enthalpy of combustion of carbon monoxide at constant volume, given the following enthalpy of reactions at constant pressure at 17°C :
 (i) $\text{C}(\text{s}) + \text{O}_2(\text{g}) \longrightarrow \text{CO}_2(\text{g})$; $\Delta H_1 = -97000$ Cal
 (ii) $\text{CO}_2(\text{g}) + \text{C}(\text{s}) \longrightarrow 2\text{CO}(\text{g})$; $\Delta H_2 = 39000$ Cal
- 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.
- 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
- Calculate the bond energy of $\text{C} = \text{C}$ from the following data. All ΔH units are in kCal.
 $2\text{C}(\text{s}) + 2\text{H}_2(\text{g}) \longrightarrow \text{C}_2\text{H}_4(\text{g})$ $\Delta H = 12.5$
 $\text{C}(\text{s}) \longrightarrow \text{C}(\text{g})$ $\Delta H = 170.9$
 $\text{H}_2(\text{g}) \longrightarrow 2\text{H}(\text{g})$ $\Delta H = 104.2$
 Bond energy of $\text{C} - \text{H}$ bond is 99 kCal/mol.
- 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 $\text{N}-\text{N}$ 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}
- 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) = 171 kCal/mol	C = O = 81 kCal/mol
- 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
- For strong acid and strong base neutralization, net chemical change is :
 $\text{H}^+(\text{aq}) + \text{OH}^-(\text{aq}) \longrightarrow \text{H}_2\text{O}(\ell)$; $\Delta_r H^\circ = -57.1$ 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

DPP No. # 51

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

Hints & Solutions

DPP No. # 51

1. - 372.0 kCal. 2. - 136.8 kJ. 3. - 121 kJ/mole.
 4. $\Delta H = -67710 \text{ Cal}$ 5. - 22 kCal/mol.
 6. $\text{C}_2\text{H}_4(\text{g}) + \text{H}_2 \longrightarrow \text{C}_2\text{H}_6$
 $\Delta H = (\Delta H)_{\text{sup}} - (\Delta H)_{\text{req}}$
 $\Delta H = [145 + 104] - [80 + 2 \times 99]$
 $\Delta H = -29 \text{ kCal/mol}$
 7. $\text{C}_2\text{H}_4(\text{s}) \longrightarrow 2\text{C}(\text{o}) + 4\text{H}(\text{g})$
 $\Delta H_{\text{reaction}} = 4 \times 52.1 + 2 \times 170.9 - 12 \times 53.7 = 53.7 = \Delta H_{\text{C}=\text{C}} + 4 \times 99$
 $\Delta H_{\text{C}=\text{C}} = 141.7$
 8. $= \frac{3y - 4x}{3} \text{ kCal mol}^{-1}$. 9. 49 kCal/mol.
 11. $-49.86 = \Delta H_{\text{ion}} - 55.84$
 $\Delta H_{\text{ion}} = 55.84 - 49.86 = 5.98 \text{ KJ/mol.}$