PHYSICAL CHEMISTRY

DPP

DAILY PRACTICE PROBLEMS

DPP No. 50

Total Marks : 31

Max. Time : 35 min.

Topic : Thermodynamics & Thermochemistry

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.5	(3 marks, 3 min.)	[15, 15]
Subjective Questions ('–1' negative marking) Q.6 to Q.9	(4 marks, 5 min.)	[16, 20]

1. For the reaction,

$\frac{1}{2}A_2(g) + \frac{1}{2}B_2(g) \longrightarrow AB(g)$; $\Delta H = -50$ KCal.

If the bond energies of A_2, B_2 and 'AB' are respectively x, $\frac{x}{2}$ and x KCal, the value of x is :

(A) 50 (B) 100 (C) 200 (D) 400

2. The enthalpy of neutralization of 40 g of NaOH by 60 g of CH_3COOH will be :

(A) 57.1 kJ equiv^{-1} (B) less than 57.1 kJ equiv^{-1}

(C) more than 57.1 kJ equiv^{-1} (D) 13.7 kJ equiv^{-1}

3. The heat evolved in neutralizing a solution containing 1mole of HCN with a strong alkali is 3 KCal. The enthalpy of dissociation of HCN is :

(A) 10.2 KCal (B) 13.7 KCal (C) 10.7 KCal (D) 16.7 KCal

4. ΔH_f° for the chloride ion (aq) from the following data will be :

$\frac{1}{2}H_2(g) + \frac{1}{2}Cl_2(g) \longrightarrow HCl(g)$; $\Delta H_f^\circ = -92.4$ kJ

$HCl(g) + nH_2O \longrightarrow H^+(aq) + Cl^-(aq.)$; $\Delta H^\circ = -74.8$ kJ

$\Delta H_f^\circ\ H^+(aq.) = 0.0$ kJ

(A) 167.2 kJ (B) – 167.2 kJ (C) 334.4 kJ (D) – 334.4 kJ

5. The polymerisation of ethylene to linear polyethylene is represented by the reaction :
$n\ CH_2 = CH_2 \longrightarrow (CH_2 - CH_2)_n$ where *n* has a large integral value. Given that the average enthalpies of bond dissociation for C = C & C – C at 298 K are +590 & + 331 KJ mol^{-1} respectively. Then the enthalpy of polymerisation per mole of ethylene at 298 K will be :

(A) 72 kJ/mol (B) – 72 kJ/mol (C) 36 kJ/mol (D) – 36 kJ/mol

6. Assuming that 50% of the heat is useful, how many kg of water at 15ºC can be heated to 95ºC by burning 280 litre of methane at STP ? The heat of combustion of methane is 240 KCal/mol.

7. One litre sample of a mixture of CH_4 and O_2 measured at 27ºC and 760 torr, was allowed to react at constant pressure in a calorimeter. The complete combustion of CH_4 to CO_2 and water caused a temperature rise in calorimeter of 0.667 K. Calculate mole % of CH_4 in original mixture. (R = 1/12L atm/K/mole)

8. The specific heats of iodine vapour and solid are 0.031 Calg^{-1} ºC^{-1} and 0.055 Calg^{-1} ºC^{-1} respectively. If heat of sublimation of iodine is 24 Cal/g at 200ºC, what is its value at 250ºC ?

9. Calculate the heat of formation of HCl (g) from :

$NH_3(aq) + HCl(aq.) \longrightarrow NH_4Cl(aq.)$; $\Delta H = -12.1$ KCal

$\frac{1}{2}N_2(g) + \frac{3}{2}H_2(g) \longrightarrow NH_3(g)$; $\Delta H = -11.0$ KCal

Heat of formation of $NH_4Cl(s)$; $\Delta H = -75.3$ KCal

Heat of solution of $NH_3(g)$; $\Delta H = -8.8$ KCal

Heat of solution of $HCl(g)$; $\Delta H = -17.5$ KCal

$NH_4Cl(s) + Aq. \longrightarrow NH_4Cl(aq.)$; $\Delta H = +3.8$ KCal

Answer Key

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1.	(C)	**2.**	(B)	**3.**	(C)	**4.**	(B)	**5.**	(B)
6.	8.33 kg.	**7.**	10%.	**8.**	22.8 Cal/g.	**9.**	– 22.1 KCal		

Hints & Solutions

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2. Since it is neutralisation of a weak acid with strong base.

3. enthalpy of dissociation = (13.7 – 3) KCal = 10.7 KCal

6. $n_{CH_4} = \frac{280}{22.4}$

$\therefore \quad \Delta H_{obntained} = \frac{240 \times 280}{22.4}$ KCal

$\therefore \quad m = \frac{240 \times 280}{22.4 \times 2 \times 1 \times 180}$ kg = 8.33 kg.

7. Heat generated = $C_T \Delta T$ = 1260 × 0.667 cal.

$\therefore \quad n_{CH_4} = \frac{1260 \times 0.667}{210 \times 10^3}$

$n_{total} = \frac{PV}{RT} = 4 \times 10^{-2}$ $\quad \therefore \quad$ mol% = $\frac{4 \times 10^{-3}}{4 \times 10^{-2}} \times 100\% = 10\%$ Ans.

8. $\Delta H_2 - 24 = -0.024 \times (523 - 473)$ Cal/g.

$\therefore \quad \Delta H_2 = 22.8$ Cal/g.

9. **Target eq** $1/2\ H_2\ (g) + 1/2\ Cl_2\ (g) \longrightarrow HCl\ (g)$

$NH_3\ (aq) + HCl\ (aq) \longrightarrow NH_4Cl\ (aq)$	$\Delta H = -12.1$	....(1)
$1/2N_2(g) + 3/2H_2(g) \longrightarrow NH_3(g)$;	$\Delta H = -11$	....(2)
$1/2N_2 + 2H_2 + 1/2Cl_2\ (g) \longrightarrow NH_4Cl(s)$;	$\Delta H = -75.3$	....(3)
$NH_3(g) + aq \longrightarrow NH_3\ (aq)$	$\Delta H = -8.8$	....(4)
$NCl(g) + aq \longrightarrow HCl\ (aq)$	$\Delta H = 17.5$	....(5)
$NH_4Cl(s) + aq \longrightarrow NH_4Cl\ (aq)$	$\Delta H = 3.8$	....(6)

ΔH = eq (6) – eq (3) + eq (2) + eq (4) + eq (5)

$= -12.1 - 3.8 - (-75.3) - 11 - 8.8 - 17.5$

$= +22.1$

from this we get equation

$$HCl\ (g) \longrightarrow 1/2\ H_2(g) + 1/2\ Cl_2\ (g)$$

$\therefore$ ΔH of target eq = $-\Delta H = -22.1$ Kcal Ans.