PHYSICAL CHEMISTRY

DPP

DAILY PRACTICE PROBLEMS

DPP No. 5

Total Marks : 33

Max. Time : 34 min.

Topic : Mole Concept

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1,2,3,5	(3 marks, 3 min.)	[12, 12]
Multiple choice objective ('–1' negative marking) Q.4,6	(4 marks, 4 min.)	[8, 8]
Subjective Questions ('–1' negative marking) Q.7	(4 marks, 5 min.)	[4, 5]
Comprehension ('–1' negative marking) Q.8 to 10	(3 marks, 3 min.)	[9, 9]

1. Sulphur trioxide is prepared by the following two reactions :

$S_8(s) + 8O_2(g) \rightarrow 8SO_2(g)$

$2SO_2(g) + O_2(g) \rightarrow 2SO_3(g)$

How many grams of SO_3 are produced from 1 mole of S_8 :

(A) 1280 (B) 640 (C) 960 (D) 320

2. 3L of N_2 gas are mixed with 6L of H_2 gas to form NH_3 gas. What volume of NH_3 gas can be produced, if all volumes are measured under same temperature and pressure conditions :

(A) 6L (B) 4L (C) 9L (D) 2L

3. Zinc and hydrochloric acid react according to the reaction :

$Zn(s) + 2HCl(aq.) \longrightarrow ZnCl_2(aq.) + H_2(g)$

If 0.30 mole of Zn are added to hydrochloric acid containing 0.52 mole HCl, how many moles of H_2 are produced:

(A) 0.26 (B) 0.52 (C) 0.14 (D) 0.30

4.* 3 moles of gas C_2H_6 are mixed with 60 g of this gas and 2.4×10^{24} molecules of the gas are then removed. The left over gas is burnt in the presence of excess oxygen.

Then : ($N_A = 6 \times 10^{23}$) (Density of water = 1g/mL)

(A) 2 moles of C_2H_6 are left for combustion.

(B) Volume of CO_2 at S.T.P. produced after combustion is 44.8 litre.

(C) Volume of liquid water produced is 54 mL.

(D) None of these

5. 3.68 g of a mixture of $CaCO_3$ and $MgCO_3$ is heated to liberate 0.04 mole of CO_2. The mole % of $CaCO_3$ and $MgCO_3$ in the mixture is respectively :

(A) 50%, 50% (B) 60%, 40% (C) 40%, 60% (D) 30%, 70%

6.* Amongst the following, select the **false** statements :

(A) Limiting reagent must have the least moles among all the reactants available in a chemical reaction.

(B) If equal masses of aluminium and oxygen are made to combine to produce Al_2O_3, then aluminium will be the limiting reagent.

(C) A 2 : 3 molar ratio mixture of Na_2CO_3 and $MgCO_3$ produces 0.3 mole of CO_2 per mole of the initial mixture upon strong heating.

(D) All of these

7. 120 g Mg was burnt in air to give a mixture of MgO and Mg_3N_2. The mixture is now dissolved in HCl to form $MgCl_2$ and NH_4Cl. If 107 grams NH_4Cl is produced, then determine the moles of $MgCl_2$ formed.

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Comprehension # (Q. 8 to Q. 10)

For a reaction :

$$aA + bB \longrightarrow cC + dD$$

Three students stated different ways of determining limiting reagent.

Student 1 : Calculate the minimum moles of 'A' needed to completely consume 'B', and if available amount of 'A' exceeds what is needed, then 'B' is limiting reagent, otherwise 'A' will be limiting reagent.

Student 2 : Calculate the mole ratio (ratio of moles of the reactants initially taken) of reactant, then compare it with theoretical mole ratio (according to stoichiometry of the reaction). If the theoretical ratio exceeds ratio of moles actually taken, then reactant in denominator will be limiting reagent.

Student 3 : Calculate the amount of product (any one of the product) that can be obtained if each reactant is completely consumed and that reactant is limiting reagent, which has produced least mass of product.

8. Which student(s) has/have defined limiting reagent correctly :

(A) Student – 1 (B) Student – 2

(C) Student – 3 (D) All are correct

9. If student 1 in first experiment finds that, when 1 mole of 'A' reacted with excess of reagent 'B' and in second experiment when 1 mole of 'B' reacted with excess of reagent 'A', then in the later experiment, mass of the product produced was greater. Then which should be the limiting reagent :

(A) A (B) B

(C) None of these (D) Cannot be predicted

10. If initially 'x' moles of 'A' are taken with 'y' moles of 'B', which of the following is correct :

(i) If $\frac{a}{b} = \frac{x}{y}$, then no reactant is left over

(ii) If $\frac{a}{b} > \frac{x}{y}$, then 'B' reactant is llimiting reagent

(iii) If $\frac{a}{b} < \frac{x}{y}$, then 'B' is limiting reagent

(iv) If $\frac{x}{y} > \frac{a}{b}$, then 'A' is limiting reagent.

(A) i & iv (B) i & iii (C) Only i (D) i , ii & iv

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Answer Key

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1.	(B)	**2.**	(B)	**3.**	(A)	**4.***	(B,C)	**5.**	(A)
6.*	(A,C)	**7.**	5	**8.**	(D)	**9.**	(A)	**10.**	(B)

Hints & Solutions

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1. For Ist reaction $\frac{\text{Mole of } S_8}{1} = \frac{\text{Mole of } SO_2}{8}$

Mole of $SO_2 = \frac{1 \times 8}{1} = 8$

For IInd reaction $\frac{\text{Mole of } SO_2}{2} = \frac{\text{Mole of } SO_3}{2} = 8$

wt of $SO_3 = 8 \times 80 = 640$ g.

2. $N_2(g) + 3H_2(g) \longrightarrow 2NH_3(g)$

Vol. 3 6 ($\because V \propto n$)

L.R. $\frac{6 \times 2}{3} = 4$ L.

3. LR $\rightarrow$ HCl, so Mole of $H_2 = \frac{\text{Mole of HCl}}{2} = \frac{0.52}{2} = 0.26$

4.* Moles of $C_2H_6 = 3$

moles of C_2H_6 mixed $= \frac{60}{30} = 2$

total mole of $C_2H_6 = 5$

moles removed $= \frac{2.4 \times 10^{24}}{6 \times 10^{23}} = 4$

$\therefore$ moles of C_2H_6 left = 1

Now, $C_2H_6 + 7/2\ O_2 \longrightarrow 2CO_2 + 3H_2O$

clearly 3 moles of H_2O or 54 gm H_2O will be formed

volume of H_2O = 54 ml **Ans. 54**

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5. Let the mass of $CaCO_3$ = x g
then ,mass of $MgCO_3$ = (3.68 – x) g

moles of $CaCO_3 = \frac{x}{100}$

moles of $MgCO_3 = \frac{3.68 - x}{84}$

Applying POAC for C-atoms

$$\frac{x}{100} + \frac{3.68 - x}{84} = 0.04$$

x = 2 g

$\therefore$ $n_{CaCO_3} = \frac{2}{100} = 0.02$ and $n_{MgCO_3} = \frac{1.68}{84} = 0.02$

$\therefore$ mole % of $CaCO_3 = \frac{0.02}{0.04} \times 100 = 50\%$

$\therefore$ mole % of $MgCO_3 = \frac{0.02}{0.04} \times 100 = 50\%$

6.* **(A)** Limiting reagent may neither have the least mass nor the least moles among all the reactants available in a chemical reaction.

(B) :

	$4Al$	+	$3O_2$	$\longrightarrow$	$2Al_2O_3$
Mass	m		m		
Mole	$\left(\frac{m}{27}\right)$		$\left(\frac{m}{32}\right)$		
$\frac{\text{mole}}{\text{st. coeff.}}$	$\frac{m}{27\times4}$		$\frac{m}{32\times3}$		
	$\left(=\frac{m}{108}\right)$		$\left(=\frac{m}{96}\right)$		
	(LR)				

(C) $Na_2CO_3 \xrightarrow{\Delta}$ Does not decomposes upon heating.

$MgCO_3 \xrightarrow{\Delta} MgO + CO_2$

$\frac{3}{5} \times 1$ mole $\qquad\qquad$ $\frac{3}{5} \times 1$ mole

So, moles of CO_2 produced = $\frac{3}{5} \times 1 = 0.6$ mole.

7. $Mg + \frac{1}{2}O_2 \longrightarrow MgO$, $3Mg + N_2 \longrightarrow Mg_3N_2$

a $\qquad$ a $\quad (5 - a)$ $\qquad$ $\frac{(5-a)}{3}$

$MgO + 2HCl \longrightarrow MgCl_2 + H_2O$ $\qquad$ $Mg_3N_2 + 8HCl \longrightarrow 2NH_4Cl + 3MgCl_2$

$MgO + 2HCl \longrightarrow MgCl_2 + H_2O$ $\qquad$ $Mg_3N_2 + 8HCl \longrightarrow 2NH_4Cl + 3MgCl_2$

a $\qquad$ a $\qquad$ $\frac{5-a}{3}$ $\qquad$ $\frac{2(5-a)}{3}$ $\qquad$ $(5 - a)$

$\therefore$ Total moles of $MgCl_2$ = a + (5 – a) = 5 moles

Alternatively :

Apply POAC on Mg

$Mg \longrightarrow MgCl_2$

5 moles $\qquad$ x moles

$1 \times 5 = x \times 1 \Rightarrow x = 5$ moles

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