PHYSICAL CHEMISTRY

DPP

DAILY PRACTICE PROBLEMS

DPP No. 9

Total Marks : 49

Max. Time : 54 min.

Topic : Mole Concept

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.2,4,5	(3 marks, 3 min.)	[9, 9]
True or False (no negative marking) Q.6	(2 marks, 2 min.)	[2, 2]
Subjective Questions ('–1' negative marking) Q.7, 8 & 10	(4 marks, 5 min.)	[12, 15]
Short Subjective Questions ('–1' negative marking) Q.1,3,6,10	(3 marks, 3 min.)	[9, 9]
Match the Following (no negative marking) (2 × 4) Q.9	(8 marks, 10 min.)	[8, 10]
Comprehension ('–1' negative marking) Q.11 to Q.13	(3 marks, 3 min.)	[9, 9]

1. If the mass of one atom of an element X is about 6×10^{-23} g, how many moles of X are equivalent to 144 g of X ?

2. The atomic weight of an element is 'a'. If this element occurs in nature as a triatomic gas, then the correct formula for the number of moles of gas in its 'w' g is :

(A) $\frac{3w}{a}$ (B) $\frac{w}{3a}$ (C) 3wa (D) $\frac{a}{3w}$

3. Find the total number of protons in 11.2 L of phosphine (PH_3) gas under NTP conditions.

4. The density of water at 4°C is 1×10^3 kg m^{-3}. Assuming no empty space to be present between water molecules, the volume occupied by one molecule of water is approximately :

(A) 3×10^{-23} mL (B) 6×10^{-22} mL (C) 3×10^{-21} mL (D) 9×10^{-23} mL

5. The density of air at STP is 0.001277 g mL^{-1}. Its vapour density is about :

(A) 143 (B) 14.3 (C) 1.43 (D) 0.143

6. State whether the following statements are true or false :

(i) According to law of definite proportions, two elements always combine in the same ratio by mass.

(ii) Different proportions of oxygen for a fixed mass of nitrogen in the various oxides of nitrogen prove the law of multiple proportions.

(iii) If 2.8 L of an unknown gas at NTP weighs 5.5 g, then the gas could be CO_2 or N_2O.

(iv) 5 g urea (NH_2CONH_2) and 5 g Acetic acid (CH_3COOH), both contain the same total number of atoms.

7. An oxide of Osmium (symbol Os) is pale yellow solid. If 2.794 g of the compound contains 2.09 g of osmium, what is its empirical formula ? (At. wt. of Os = 190)

8. When Dinitrogen pentaoxide (N_2O_5, a white solid) is heated, it decomposes into nitrogen dioxide and oxygen.

If a sample of N_2O_5 produces 1.6 g O_2, then how many grams of NO_2 are formed ?

$$N_2O_5(s) \xrightarrow{\Delta} NO_2(g) + O_2(g) \quad \text{(not balanced)}$$

9. **Match the following :**

	Column-I **For 1 mole of reactant placed in an open container in each reaction**		**Column-II** **Product**
(A)	$PCl_5(g) \xrightarrow{\Delta} PCl_3(g) + Cl_2(g)$	(p)	$2N_A$ molecules are produced
(B)	$CaCO_3(s) \xrightarrow{\Delta} CaO(s) + CO_2(g)$	(q)	67.2 litre gaseous product at STP
(C)	$2HCl(g) \xrightarrow{\Delta} H_2(g) + Cl_2(g)$	(r)	22.4 litre gaseous product at STP
(D)	$NH_4COONH_2(s) \xrightarrow{\Delta} 2NH_3(g) + CO_2(g)$	(s)	44.8 litre gaseous product at STP

10. An alloy of iron and carbon was treated with sulfuric acid, in which only iron reacts :

$$2Fe(s) + 3H_2SO_4(aq) \longrightarrow Fe_2(SO_4)_3(aq) + 3H_2(g)$$

If a sample of alloy weighing 140 g gave 6 g of hydrogen, what is the percentage of iron in the alloy ?

Comprehension # (Q. 11 to Q. 13)

Iodine is an important substance needed by the body of a human being. We consume it in the form of salt, which has very-very small % content of I_2. Iodine has various industrial applications also. The following process has been used to obtain iodine from oil-field brines in California :

$$NaI + AgNO_3 \longrightarrow AgI + NaNO_3$$

$$AgI + Fe \longrightarrow FeI_2 + Ag$$

$$FeI_2 + Cl_2 \longrightarrow FeCl_3 + I_2$$

11. If 381 kg of iodine is produced per hour, then mass of $AgNO_3$ required per hour will be :

(A) 170 kg (B) 340 kg (C) 255 kg (D) 510 kg

12. If above reaction is carried out by taking 150 kg of NaI and 85 kg of $AgNO_3$, then number of moles of iodine formed is :

(A) 0.5 (B) 500 (C) 250 (D) 0.25

13. If 324 g of Ag is recovered in pure form, then minimum amount of NaI required will be :

(A) 450 g (B) 150 g (C) 300 g (D) 600 g

Answer Key

DPP No. # 9

1.	4	**2.**	(B)	**3.**	$9\ N_A$	**4.**	(A)	**5.**	(B)				
6.	(i) False (ii) True (iii) True (iv) True			**7.**	OsO_4	**8.**	$9.2g$						
9.	(A - p,s) ; (B - p,r) ; (C - r) ; (D - q).			**10.**	80%.	**11.**	(D)	**12.**	(C)	**13.**	(A)		

Hints & Solutions

DPP No. # 9

1. $1.66 \times 10^{-24}\ g \longrightarrow 1\ amu$

$\therefore 6 \times 10^{-23}\ g \longrightarrow \dfrac{6\times10^{-23}\times1}{1.66\times10^{-24}} = 36\ amu$

$\therefore$ Atomic mass of X = 36 amu

$\therefore$ Moles of X = $\dfrac{144}{36} = 4$

2. Molecular wt. of gas = 3a

no. of moles of gas = $\dfrac{w}{3a}$.

3. Total number of protons = $\dfrac{11.2}{22.4}\times18\times N_A = 9N_A$.

4. $1 \times 10^3\ kg/m^3 = 1\ g/mL$. [Since, $1m^3 = 10^6\ cm^3 = 10^6\ mL$].
$= 1\ gm/cc$

$6.022 \times 10^{23}\ H_2O$ molecule weigh ——————18 g

1 H_2O molecule weigh —————— $\dfrac{18}{6.022\times10^{23}}\ g = 3 \times 10^{-23}\ g$

$d = \dfrac{mass}{volume}$, So, volume = $\dfrac{3\times10^{-23}\ g}{1(g/mL)} = 3 \times 10^{-23}\ mL$.

5. molecular weight of air at STP $= 0.001293\ g\ mL^{-1} \times 22400\ mL = 28.7\ g$

so V.D. = $\dfrac{28.7}{2} \approx 14.3$

6.

(i) False
According to law of definite proportions, two elements always combine in the same ratio by mass, only if they form the same compound.

(ii) True Refer notes.

(iii) True

$\dfrac{2.8}{22.4} \times M_{(g)} = 5.5\ g$.

So, $M_{(g)} = 44$. (CO_2 or N_2O).

(iv) True

Total number of atoms = $\dfrac{5}{60} \times N_A \times 8 = \dfrac{2N_A}{3}$ (in both cases).

7. wt. of compound = 2.89 g
wt. of osmium = 2.16 g
wt. of oxygen = 2.89 – 2.16 = 0.73 g

Mole of osmium = $\dfrac{2.16}{190} = 0.01136$ and mole of oxygen = $\dfrac{0.73}{16} = 0.04562$

so relative mole of osmium = $\dfrac{0.01136}{0.01136} = 1$

relative mole of oxygen = $\frac{0.045625}{0.01136} = 4$

so, empirical formula = OsO_4.

8. $N_2O_5(s) \xrightarrow{\Delta} 2NO_2(s) + \frac{1}{2}O_2$ (Balanced reaction)

$$\frac{\text{Mole of } O_2}{1/2} = \frac{\text{Mole of } NO_2}{2}$$

$$\frac{1.6}{32} \times 2 \times 2 = \text{Mole of } NO_2 = 0.2$$

wt of $NO_2 = 0.2 \times 46 = 9.2$ g.

9. (A) $PCl_5(g) \xrightarrow{\Delta} PCl_3(g) + Cl_2(g)$

1 mole 1 mole 1 mole

2 mole molecule $\equiv 2N_A$ molecule

$\equiv 22.4 \times 2 = 44.8$ L at STP

(C) $2HCl(g) \xrightarrow{\Delta} H_2(g) + Cl_2(g)$

1 mole 0 0

$\frac{1}{2}$ mole $\frac{1}{2}$ mole

1 mole $\equiv$ 22.4L at STP

(D) $NH_4COONH_2(s) \xrightarrow{\Delta} 2NH_3(g) + CO_2(g)$

1 mole 0 0

0 2 1

Total mole = 3

volume = 3×22.4 L = 67.2 L at STP

10. $2Fe(s) + 3H_2SO_4(aq) \longrightarrow Fe_2(SO_4)_3(aq) + 3H_2(g)$

Moles of $H_2 = \frac{6}{2} = 3$ mole

Moles of Fe $= \frac{3}{3} \times 2 = 2$

mass of Fe $= 2 \times 56 = 112$ g.

मिश्र धातु में Fe का प्रतिशत $= \frac{112}{140} \times 100 = 80\%$.

11. Moles of I_2 produced $= \frac{381 \times 10^3}{254} = \frac{3 \times 10^3}{2}$

for this much moles of I_2, moles of $AgNO_3$ required $= \frac{3}{2} \times 2 \times 10^3$

$\therefore$ mass of $AgNO_3$ required $= 3 \times 170 \times 10^3 = 510$ kg

12. moles of NaI $= \frac{150}{150} \times 10^3 = 10^3$

moles of $AgNO_3 = \frac{85}{170} \times 10^3 = 5 \times 10^2$

$\therefore$ moles of I_2 formed $= \frac{\text{moles of } AgNO_3}{2} = \frac{5 \times 10^2}{2} = 250$

13. Moles of Ag recovered $= \frac{324}{108} = 3$

Hence moles of NaI required to produce this Ag = 3

$\therefore$ mass of NaI $= 3 \times 150 = 450$ g