

Topic : Mole Concept

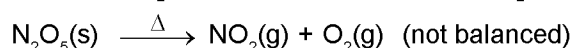
Type of Questions		M.M., Min.
Single choice Objective ('-1' negative marking) Q.2,4,5	(3 marks, 3 min.)	[9, 9]
True or False (no negative marking) Q.6	(2 marks, 2 min.)	[2, 2]
Subjective Questions ('-1' negative marking) Q.7, 8 & 10	(4 marks, 5 min.)	[12, 15]
Short Subjective Questions ('-1' negative 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]

- 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 ?
- 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) $\frac{a}{3w}$
- Find the total number of protons in 11.2 L of phosphine (PH_3) gas under NTP conditions.
- The density of water at 4°C is $1 \times 10^3 \text{ kg m}^{-3}$. 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
- The density of air at STP is $0.001277 \text{ g mL}^{-1}$. Its vapour density is about :

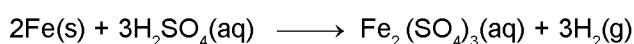
(A) 143 (B) 14.3 (C) 1.43 (D) 0.143
- State whether the following statements are true or false :
 - According to law of definite proportions, two elements always combine in the same ratio by mass.
 - Different proportions of oxygen for a fixed mass of nitrogen in the various oxides of nitrogen prove the law of multiple proportions.
 - If 2.8 L of an unknown gas at NTP weighs 5.5 g, then the gas could be CO_2 or N_2O .
 - 5 g urea (NH_2CONH_2) and 5 g Acetic acid (CH_3COOH), both contain the same total number of atoms.
- 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)
- 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 ?



9. Match the following :

Column-I For 1 mole of reactant placed in an open container in each reaction	Column-II Product
(A) $\text{PCl}_5(\text{g}) \xrightarrow{\Delta} \text{PCl}_3(\text{g}) + \text{Cl}_2(\text{g})$	(p) $2N_A$ molecules are produced
(B) $\text{CaCO}_3(\text{s}) \xrightarrow{\Delta} \text{CaO}(\text{s}) + \text{CO}_2(\text{g})$	(q) 67.2 litre gaseous product at STP
(C) $2\text{HCl}(\text{g}) \xrightarrow{\Delta} \text{H}_2(\text{g}) + \text{Cl}_2(\text{g})$	(r) 22.4 litre gaseous product at STP
(D) $\text{NH}_4\text{COONH}_2(\text{s}) \xrightarrow{\Delta} 2\text{NH}_3(\text{g}) + \text{CO}_2(\text{g})$	(s) 44.8 litre gaseous product at STP

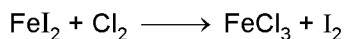
10. An alloy of iron and carbon was treated with sulfuric acid, in which only iron reacts :



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 :



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

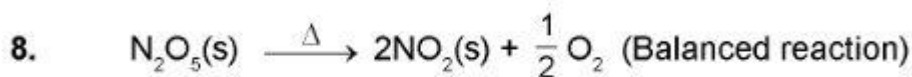
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|----|--|-----|----------------|-----|---------|-----|-----|-----|-----|
| 1. | 4 | 2. | (B) | 3. | $9 N_A$ | 4. | (A) | 5. | (B) |
| 6. | (i) False (ii) True (iii) True (iv) True | 7. | OsO_4 | 8. | 9.2 g | | | | |
| 9. | (A - p,s) ; (B - p,r) ; (C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

Hints & Solutions

DPP No. # 9

1. $1.66 \times 10^{-24} \text{ g} \longrightarrow 1 \text{ amu}$
 $\therefore 6 \times 10^{-23} \text{ g} \longrightarrow \frac{6 \times 10^{-23} \times 1}{1.66 \times 10^{-24}} = 36 \text{ amu}$
 \therefore Atomic mass of X = 36 amu
 \therefore Moles of X = $\frac{144}{36} = 4$
2. Molecular wt. of gas = 3a
no. of moles of gas = $\frac{w}{3a}$.
3. Total number of protons = $\frac{11.2}{22.4} \times 18 \times N_A = 9N_A$.
4. $1 \times 10^3 \text{ kg/m}^3 = 1 \text{ g/mL}$. [Since, $1 \text{ m}^3 = 10^6 \text{ cm}^3 = 10^6 \text{ mL}$.]
= 1 gm/cc
 $6.022 \times 10^{23} \text{ H}_2\text{O}$ molecule weigh _____ 18 g
1 H_2O molecule weigh _____ $\frac{18}{6.022 \times 10^{23}} \text{ g} = 3 \times 10^{-23} \text{ g}$
 $d = \frac{\text{mass}}{\text{volume}}$, So, volume = $\frac{3 \times 10^{-23} \text{ g}}{1(\text{g/mL})} = 3 \times 10^{-23} \text{ mL}$.
5. molecular weight of air at STP = $0.001293 \text{ g mL}^{-1} \times 22400 \text{ mL} = 28.7 \text{ g}$
so V.D. = $\frac{28.7}{2} \approx 14.3$
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
 $\frac{2.8}{22.4} \times M_{(g)} = 5.5 \text{ g}$.
So, $M_{(g)} = 44$. (CO_2 or N_2O).
(iv) True
Total number of atoms = $\frac{5}{60} \times N_A \times 8 = \frac{2N_A}{3}$ (in both cases).
7. wt. of compound = 2.89 g
wt. of osmium = 2.16 g
wt. of oxygen = $2.89 - 2.16 = 0.73 \text{ g}$
Mole of osmium = $\frac{2.16}{190} = 0.01136$ and mole of oxygen = $\frac{0.73}{16} = 0.04562$
so relative mole of osmium = $\frac{0.01136}{0.01136} = 1$

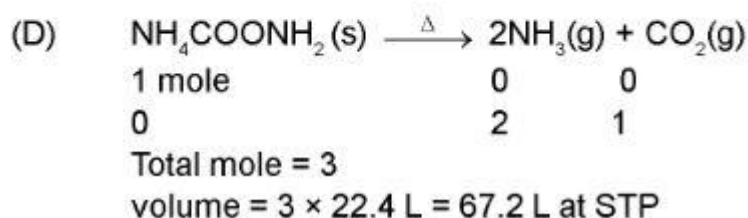
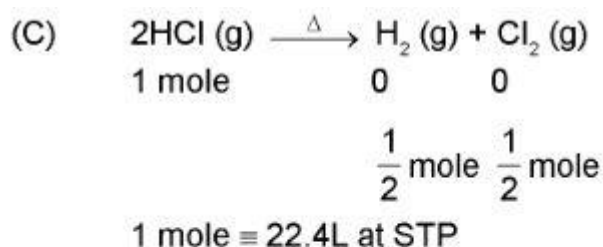
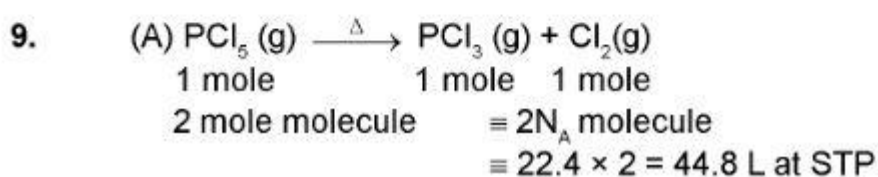
relative mole of oxygen = $\frac{0.045625}{0.01136} = 4$
 so, empirical formula = OsO_4 .

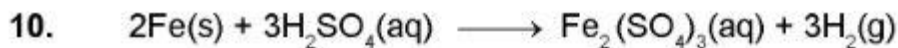


$$\frac{\text{Mole of O}_2}{1/2} = \frac{\text{Mole of NO}_2}{2}$$

$$\frac{1.6}{32} \times 2 \times 2 = \text{Mole of NO}_2 = 0.2$$

$$\text{wt of NO}_2 = 0.2 \times 46 = 9.2 \text{ g.}$$





$$\text{Moles of H}_2 = \frac{6}{2} = 3 \text{ mole}$$

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

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

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

11. $\text{Moles of I}_2 \text{ produced} = \frac{381 \times 10^3}{254} = \frac{3 \times 10^3}{2}$

$$\text{for this much moles of I}_2, \text{ moles of AgNO}_3 \text{ required} = \frac{3}{2} \times 2 \times 10^3$$

$$\therefore \text{mass of AgNO}_3 \text{ required} = 3 \times 170 \times 10^3 = 510 \text{ kg}$$

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

$$\text{moles of AgNO}_3 = \frac{85}{170} \times 10^3 = 5 \times 10^2$$

$$\therefore \text{moles of I}_2 \text{ formed} = \frac{\text{moles of AgNO}_3}{2} = \frac{5 \times 10^2}{2} = 250$$

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

$$\text{Hence moles of NaI required to produce this Ag} = 3$$

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

