ANSWERS

I. Multiple Choice Questions (Type-I)

1. (ii)	2. (iii)	3. (iii)	4. (ii)	5. (iv)	6. (iii)
7. (iv)	8. (i)	9. (ii)	10. (iii)	11. (i)	12. (iii)
13. (i)	14. (ii)	15. (ii)			

II. Multiple Choice Questions (Type-II)

16. (i), (iv)	17. (ii), (iii)	18. (iii), (iv)
19. (i), (ii)	20. (iii), (iv)	21. (iii), (iv)
22. (i), (iv)		

III. Short Answer Type

23. 1.992648×10^{-23} g $\approx 1.99 \times 10^{-23}$ g

24. 2

25. Symbol for SI Unit of mole is mol.

One mole is defined as the amount of a substance that contains as many particles or entities as there are atoms in exactly 12 g (0.012 kg) of the ^{12}C isotope.

26. Molality is the number of moles of solute present in one kilogram of solvent but molarity is the number of moles of solute dissolved in one litre of solution.

Molality is independent of temperature whereas molarity depends on temperature.

27. Mass percent of calcium $= \dfrac{3 \times (\text{atomic mass of calcium})}{\text{molecular mass of } Ca_3(PO_4)_2} \times 100$

$$= \frac{120\ u}{310\ u} \times 100 = 38.71\%$$

Mass percent of phosphorus $= \dfrac{2 \times (\text{atomic mass of phosphorus})}{\text{molecular mass of } Ca_3(PO_4)_2} \times 100$

$$= \frac{2 \times 31\ u}{310\ u} \times 100 = 20\%$$

$$\text{Mass percent of oxygen} = \frac{8 \times (\text{Atomic mass of oxygen})}{\text{molecular mass of } Ca_3(PO_4)_2} \times 100$$

$$= \frac{8 \times 16 \text{ u}}{310 \text{ u}} \times 100 = 41.29\%$$

28. According to Gay Lussac's law of gaseous volumes, gases combine or are produced in a chemical reaction in a simple ratio by volume, provided that all gases are at the same temperature and pressure.

29. (a) Yes

(b) According to the law of multiple proportions

(c) $H_2 + O_2 \rightarrow H_2O$

2 g   16 g   18 g

(c) $H_2 + O_2 \rightarrow H_2O_2$

2 g   32 g   34 g

Here masses of oxygen, (i.e., 16 g in H_2O and 32 g in H_2O_2) which combine with fixed mass of hydrogen (2 g) are in the simple ratio i.e., 16 : 32 or 1 : 2

30. $$\text{Average Atomic Mass} = \frac{\{(\text{Natural abundance of } ^1H \times \text{molar mass}) + (\text{Natural abundance of } ^2H \times \text{molar mass of } ^2H)\}}{100}$$

$$= \frac{99.985 \times 1 + 0.015 \times 2}{100}$$

$$= \frac{99.985 + 0.030}{100} = \frac{100.015}{100} = 1.00015 \text{ u}$$

31. From the equation, 63.5 g of zinc liberates 22.7 litre of hydrogen. So 32.65 g of zinc will liberate

$$32.65 \text{ g Zn} \times \frac{22.7 \text{ L } H_2}{65.3 \text{ g Zn}} = \frac{22.7}{2} \text{L} = 11.35 \text{ L}$$

32. 3 molal solution of NaOH means that 3 mols of NaOH are dissolved in 1000 g of solvent.

∴ Mass of Solution = Mass of Solvent + Mass of Solute

= 1000 g + (3 × 40 g) = 1120 g

$$\text{Volume of Solution} = \frac{1120}{1.110} \text{ mL} = 1009.00 \text{ mL}$$

(Since density of solution = 1.110g mL^{-1})

Since 1009 mL solution contains 3 mols of NaOH

$$\therefore \text{ Molarity } = \frac{\text{Number of moles of solute}}{\text{Volume of solution in litre}}$$

$$= \frac{3 \text{ mol}}{1009.00} \times 1000 = 2.97 \text{ M}$$

33. No, Molality of solution does not change with temperature since mass remains unaffected with temperature.

34. Mass of NaOH = 4 g

$$\text{Number of moles of NaOH} = \frac{4 \text{ g}}{40 \text{ g}} = 0.1 \text{ mol}$$

Mass of H_2O = 36 g

$$\text{Number of moles of } H_2O = \frac{36 \text{ g}}{18 \text{ g}} = 2 \text{ mol}$$

$$\text{Mole fraction of water} = \frac{\text{Number of moles of } H_2O}{\text{No. of moles of water + No. of moles of NaOH}}$$

$$= \frac{2}{2 + 0.1} = \frac{2}{2.1} = 0.95$$

$$\text{Mole fraction of NaOH} = \frac{\text{Number of moles of NaOH}}{\text{No. of moles of NaOH + No. of moles of water}}$$

$$= \frac{0.1}{2 + 0.1} = \frac{0.1}{2.1} = 0.047$$

Mass of solution = mass of water + mass of NaOH = 36 g + 4 g = 40 g

Volume of solution = 40 × 1 = 40 mL

(Since specific gravity of solution is = 1 g mL^{-1})

$$\text{Molarity of solution} = \frac{\text{Number of moles of solute}}{\text{Volume of solution in litre}}$$

$$= \frac{0.1 \text{ mol NaOH}}{0.04 \text{ L}} = 2.5 \text{ M}$$

35. $2A + 4B \rightarrow 3C + 4D$

According to the above equation, 2 mols of 'A' require 4 mols of 'B' for the reaction.

Hence, for 5 mols of 'A', the moles of 'B' required = $5 \text{ mol of A} \times \frac{4 \text{ mol of B}}{2 \text{ mol of A}}$

$= 10 \text{ mol B}$

But we have only 6 mols of 'B', hence, 'B' is the limiting reagent. So amount of 'C' formed is determined by amount of 'B'.

Since 4 mols of 'B' give 3 mols of 'C'. Hence 6 mols of 'B' will give

$$6 \text{ mol of B} \times \frac{3 \text{ mol of C}}{4 \text{ mol of B}} = 4.5 \text{ mol of C}$$

IV. Matching Type

36. (i) → (b) (ii) → (c) (iii) → (a) (iv) → (e)
(v) → (d)

37. (i) → (e) (ii) → (d) (iii) → (b) (iv) → (g)
(v) → (c), (h) (vi) → (f) (vii) → (a) (viii) → (i)

V. Assertion and Reason Type

38. (i) 39. (ii) 40. (iii) 41. (iii)

VI. Long Answer Type

42. (i) p_1=1 atm, T_1=273 K, V_1=?

32 g of oxygen occupies 22.4 L of volume at STP*

Hence, 1.6 g of oxygen will occupy, $1.6 \text{ g oxygen} \times \frac{22.4 \text{ L}}{32 \text{ g oxygen}} = 1.12 \text{ L}$

V_1=1.12 L

$$p_2 = \frac{p_1}{2} = \frac{1}{2} = 0.5 \text{ atm.}$$

V_2=?

According to Boyle's law :

$p_1V_1 = p_2V_2$

$$V_2 = \frac{p_1 \times V_1}{p_2} = \frac{1 \text{ atm.} \times 1.12 \text{ L}}{0.5 \text{ atm.}} = 2.24 \text{ L}$$

* Old STP conditions 273.15 K, 1 atm, volume occupied by 1 mol of gas = 22.4 L.
New STP conditions 273.15 K, 1 bar, volume occupied by a gas = 22.7 L.

(ii) Number of molecules of oxygen in the vessel = $\frac{6.022 \times 10^{23} \times 1.6}{32}$

$= 3.011 \times 10^{22}$

43. Number of moles of HCl = 250 mL × $\frac{0.76\ M}{1000}$ = 0.19 mol

Mass of $CaCO_3$ = 1000 g

Number of moles of $CaCO_3 = \frac{1000\ g}{100\ g} = 10$ mol

According to given equation 1 mol of $CaCO_3$(s) requires 2 mol of HCl (aq). Hence, for the reaction of 10 mol of $CaCO_3$ (s) number of moles of HCl required would be:

$$10\ mol\ CaCO_3 \times \frac{2\ mol\ HCl\ (aq)}{1\ mol\ CaCO_3\ (s)} = 20\ mol\ HCl\ (aq)$$

But we have only 0.19 mol HCl (aq), hence, HCl (aq) is limiting reagent.

So amount of $CaCl_2$ formed will depend on the amount of HCl available.

Since, 2 mol HCl (aq) forms 1 mol of $CaCl_2$, therefore, 0.19 mol of HCl (aq) would give:

$$0.19\ mol\ HCl\ (aq) \times \frac{1\ mol\ CaCl_2\ (aq)}{2\ mol\ HCl\ (aq)} = 0.095\ mol$$

or $0.095 \times$ molar mass of $CaCl_2 = 0.095 \times 111 = 10.54$ g

45. (**Hint :** Show that the masses of B which combine with the fixed mass of A in different combinations are related to each other by simple whole numbers).