

EXERCISE - 01**CHECK YOUR GRASP****SELECT THE CORRECT ALTERNATIVE (ONLY ONE CORRECT ANSWER)**

1. All samples of carbon dioxide contain carbon and oxygen in the mass ratio of 3 : 8. This is in agreement with the law of :
(A) conservation of mass (B) constant proportion
(C) multiple proportions (D) gaseous volumes
2. That the atom is indivisible was proposed by :
(A) Rutherford (B) Dalton (C) Bohr (D) Einstein
3. Atomic mass of an element is :
(A) actual mass of one atom of the element
(B) relative mass of an atom of the element
(C) average relative mass of different atoms of the element
(D) always a whole number
4. Which of the following expressions is correct (n = no. of moles of the gas, N_A = Avogadro constant, m = mass of 1 molecule of the gas, N = no. of molecules of the gas) ?
(A) $n = mN_A$ (B) $m = N_A$ (C) $N = nN_A$ (D) $m = n/N_A$
5. The volume of 1 mol of a gas at standard temperature and pressure is :
(A) 11.2 litres (B) 22.4 litres (C) 100 litres (D) none of these
6. The charge on 1 gram ions of Al^{3+} is :
(A) $\frac{1}{27} N_A e$ coulomb (B) $\frac{1}{3} N_A e$ coulomb (C) $\frac{1}{9} N_A e$ coulomb (D) $3 N_A e$ coulomb
7. In which of the following pairs do 1 g of each have an equal number of molecules :
(A) N_2O and CO (B) N_2 and C_3O_2 (C) N_2 and CO (D) N_2O and C_2O
8. A quantity of aluminium has a mass of 54.0 g. What is the mass of the same number of magnesium atoms ? (At. wt. $Al = 27$, $Mg = 24$)
(A) 12.1 g (B) 23.3 g (C) 48 g (D) 97.2 g
9. Which of the following samples contains the largest number of atoms ?
(A) 1 g of $Ni(s)$ (B) 1 g of $Ca(s)$ (C) 1 g of $N_2(g)$ (D) 1 g of $B(s)$
10. Which of the following contains greatest number of oxygen atoms :
(A) 1 g of O (B) 1 g of O_2
(C) 1 g of O_3 (D) all have the same number of atoms
11. A sample of ammonium phosphate, $(NH_4)_3PO_4$, contains 3.18 mol of hydrogen atoms. The number of moles of oxygen atoms in the sample is :
(A) 0.265 (B) 0.795 (C) 1.06 (D) 3.18
12. How many moles of electron weigh one kilogram :
(A) 6.023×10^{23} (B) $\frac{1}{9.108} \times 10^{31}$ (C) $\frac{6.023}{9.108} \times 10^{54}$ (D) $\frac{1}{9.108 \times 6.023} \times 10^8$
13. A compound was found to contain 5.37% nitrogen. What is the minimum molecular wt. of compound :
(A) 26.07 g (B) 2.607 (C) 260.7 (D) none

14. Under the same conditions, two gases have the same number of molecule. They must :
 (A) be noble gases (B) have equal volumes
 (C) have a volume of 22.4 dm³ each (D) have an equal number of atoms
15. Four 1 litre flasks are separately filled with the gases H₂, He, O₂ and O₃ at the same temperature and pressure. The ratio of total number of atoms of these gases present in different flask would be :
 (A) 1 : 1 : 1 : 1 (B) 1 : 2 : 2 : 3 (C) 2 : 1 : 2 : 3 (D) 3 : 2 : 2 : 1
16. The atomic weight of Cu is 63.546. There are only two naturally occurring isotopes of copper ⁶³Cu and ⁶⁵Cu. The natural abundance of the ⁶³Cu isotope must be approximately :
 (A) 10% (B) 30% (C) 50% (D) 70%
17. If the percentage of water of crystallization in MgSO₄·x H₂O is 13%. What is the value of x :
 (A) 1 (B) 4 (C) 5 (D) 7
18. A pure gas that is 14.3% hydrogen and 85.7% carbon by mass has a density of 2.5 g L⁻¹ at 0 C and 1 atm pressure. What is the molecular formula of the gas :
 (A) CH₂ (B) C₂H₄ (C) C₄H₈ (D) C₆H₁₂
19. A certain alkaloid has 70.8% carbon, 6.2% hydrogen, 4.1% nitrogen and the rest oxygen. What is its empirical formula :
 (A) C₂₀H₂₁NO₄ (B) C₂₀H₂₀NO₄ (C) C₂₁H₂₀NO₃ (D) C₂₀H₁₉NO₃
20. The empirical formula of a compound of molecular mass 120 is CH₂O. The molecular formula of the compound is :
 (A) C₂H₄O₂ (B) C₄H₈O₄ (C) C₃H₆O₃ (D) all of these
21. 0.250 g of an element M, reacts with excess fluorine to produce 0.547 g of the hexafluoride MF₆. What is the element : [Cr = 52, Mo = 96, S = 32, Te = 127.6]
 (A) Cr (B) Mo (C) S (D) Te
22. A 1000 gram sample of NaOH contains 3 moles of O atoms, what is the % purity of NaOH :
 (A) 14% (B) 100% (C) 12% (D) 24%
23. A 15 mL sample of 0.20 M MgCl₂ is added to 45 mL of 0.40 M AlCl₃, What is the molarity of Cl⁻ions in the final solution:
 (A) 1.0 M (B) 0.60 M (C) 0.35 M (D) 0.30 M
24. Mole fraction of ethanol in ethanol and water mixture is 0.25. Hence percentage concentration of ethanol by weight of mixture is :
 (A) 25% (B) 75% (C) 46% (D) 54%
25. How many moles of Na⁺ ions are in 20 mL of 0.40 M Na₃PO₄ :
 (A) 0.0080 (B) 0.024 (C) 0.050 (D) 0.20
26. Out of Molarity (M), Molality (m), Formality (F) and Mole fraction (x), those independent of temperature are :
 (A) M,m (B) F,x (C) m,x (D) M,x
27. The molality of a 1 L solution with x % H₂SO₄ is 9. The weight of solvent present in the solution is 910 grams. The value of x is :
 (A) 90 (B) 80.3 (C) 30.38 (D) 46.87
28. Density of ozone relative to oxygen is under the same temperature & pressure :
 (A) 1 (B) 2 (C) 1.5 (D) 2.5

29. Mole fraction of A in H_2O is 0.2. The molality of A in H_2O is :
(A) 13.8 (B) 15.5 (C) 14.5 (D) 16.8
30. The molarity of the solution containing 2.8% mass-volume solution of KOH/(Given atomic mass of K = 39) is :
(A) 0.1 M (B) 0.5 M (C) 0.2 M (D) 1 M
31. The molality of a sulphuric acid solution is 0.2 mol/kg. Calculate the total weight of the solution :
(A) 1000 g (B) 1098.6 g (C) 980.4 g (D) 1019.6 g
32. What volume of a 0.8 M solution contains 100 millimoles of the solute :
(A) 100 mL (B) 125 mL (C) 500 mL (D) 62.5 mL
33. 500 mL of a glucose solution contains 6.02×10^{22} molecules. The concentration of the solution is :
(A) 0.1 M (B) 1.0 M (C) 0.2 M (D) 2.0 M
34. 50 mL of CO is mixed with 20 mL of oxygen and sparked, After the reaction, the mixture is treated with an aqueous KOH solution. Choose the correct option :
(A) the volume of CO that reacts = 30 mL
(B) volume of CO_2 formed = 50 mL
(C) volume of CO that remains after treatment with KOH = 10 mL
(D) the volume of the CO that remains after treatment with KOH = 20 mL

[illegible]

EXERCISE-02**BRAIN TEASERS****SELECT THE CORRECT ALTERNATIVES (ONE OR MORE THEN ONE CORRECT ANSWERS)**

1. An alloy of gold and silver contains 38.5% silver by mass and has a density of 14.6 g.mL^{-1} . What is the molar concentration of silver in this alloy :
(A) 52.1 mol.L^{-1} (B) 45.6 mol.L^{-1} (C) 3.57 mol.L^{-1} (D) 2.64 mol.L^{-1}
2. "Suvarnabhasm", an ayurvedic drug, is found to contain 400 ppm of colloidal gold. Mass % of gold (atomic mass of Au = 197) will be :
(A) 0.040 % (B) 7.88 % (C) 0.0788 % (D) $4 \times 10^{-4} \%$
3. A solution containing 12.0% sodium hydroxide by mass has a density of 1.131 g/mL . What volume of this solution contains 5.00 mol of NaOH :
(A) 0.0240 L (B) 1.67 L (C) 1.47 L (D) 1.00 L
4. An aqueous solution of concentrated hydrobromic acid contains 48% HBr by mass. If the density of the solution is 1.50 g / mL , what is its concentration :
(A) 11.4 mol/L (B) 8.9 mol/L
(C) 5.9 mol/L (D) 18.5 mol/L
5. An antifreeze mixture consists of 40% ethylene glycol ($\text{C}_2\text{H}_6\text{O}_2$) by weight in aqueous solution. If the density of this solution is 1.05 g/mL , what is the molar concentration :
(A) 6.77 M (B) 6.45 M (C) 0.017 M (D) 16.9 M
6. What is the molality m, of methanol in a solution prepared by dissolving 160 g of methanol, CH_3OH , in 200.0 g of water :
(A) 1.0 m (B) 5.0 m (C) 10.0 m (D) 25.0 m
7. XeF_6 fluorinates I_2 to IF_7 and liberates Xenon (g). 210 mmol of XeF_6 can yield a maximum of ___ mmol of IF_7 :
(A) 420 (B) 180 (C) 210 (D) 245
8. When 100 g of ethylene polymerises entirely to polyethene, the weight of polyethene formed as per the equation $n\text{CH}_2 = \text{CH}_2 \rightarrow (\text{CH}_2 - \text{CH}_2)_n$ is :
(A) $(n/2)\text{g}$ (B) 100g (C) $(100/n)\text{g}$ (D) $100n \text{ g}$
9. A 10 gram sample of natural gas containing CH_4 and C_2H_4 was burnt in excess of oxygen to give 29.0 grams of CO_2 and some water. How many grams of water are formed :
(A) 9.42 g (B) 18.81 g (C) 11.42 g (D) 15.31 g
10. 50 g of ZnS are strongly heated in air to effect partial oxidation and the resultant mass weighed 44 g. What is the ratio of ZnO to ZnS in the resultant mixture :
(A) 13.5 : 30.5 (B) 27 : 12.58 (C) 27 : 15.31 (D) 30.52 : 13.48
11. The % loss in weight after heating a pure sample of potassium chlorate (M. wt. 122.5) will be :
(A) 12.25 (B) 24.50
(C) 39.17 (D) 49.0
12. In a gaseous reaction of the type $a\text{A} + b\text{B} \rightarrow c\text{C} + d\text{D}$, which is wrong :
(A) a litre of A combines with b litre of B to give C & D
(B) a mole of A combines with b mole of B to give C & D
(C) a g of A combines with b g litre of B to give C & D
(D) a molecules of A combines with b molecule of B to give C & D

13. Iodobenzene (C_6H_5I) is prepared from aniline ($C_6H_5NH_2$) in a two step process as shown below
 $C_6H_5NH_2 + HNO_2 + HCl \rightarrow C_6H_5N_2^+Cl^- + 2H_2O$ $C_6H_5N_2^+Cl^- + KI \rightarrow C_6H_5I + N_2 + KCl$
 In an actual preparation 9.30 g of aniline was converted to 16.32 g of iodobenzene. The percentage yield of iodobenzene is :
 (A) 8 % (B) 50 % (C) 75 % (D) 80 %
14. In an organic compound of molar mass greater than 100 containing only C, H and N, the percentage of C is 6 times the percentage of H while the sum of the percentages of C and H is 1.5 times the percentage of N. What is the least molar mass :
 (A) 175 (B) 140 (C) 105 (D) 210
15. The simplest formula of a compound containing 50% of element X (atomic mass = 10) and 50% of the element Y (atomic mass = 20) by weight is :
 (A) XY (B) X_2Y (C) XY_2 (D) X_2Y_3
16. The sodium salt of methyl orange has 7% sodium. What is the minimum molecular weight of the compound? :
 (A) 420 (B) 375 (C) 329 (D) 295
17. In the preceding problem, if the compound contains 12.8% nitrogen 9.8% sulphur how many nitrogen and sulphur atoms are present per atom of sodium :
 (A) 2 and 1 (B) 1 and 3 (C) 1 and 2 (D) 3 and 1
18. How many grams of urea on heating yield 10^{22} molecules of biuret by the reaction :

$$2 CO (NH_2)_2 \longrightarrow H_2N - CO - NH - CO - NH_2 + NH_3 ?$$

 (A) 1.495 (B) 0.995 (C) 1.99 (D) 1.753
19. A certain compound has the molecular formula X_4O_6 . If 10 g of X_4O_6 has 5.72 g of X, atomic mass of X is :
 (A) 32 amu (B) 37 amu (C) 42 amu (D) 98 amu
20. DNA has density 1.1 g/mL and its molecular weight is 6×10^3 g/mol. Average volume occupied by its single molecule will be :
 (A) 9.1×10^{-20} cc (B) 9.1×10^{-21} cc
 (C) 9.8×10^{-21} cc (D) 9.6×10^{-20} cc
21. For an infinitely dilute aqueous solution molality will be equal to :
 (A) formality (B) molarity (C) mole fraction (D) ppm
22. If 1 g of HCl and 1 g of MnO_2 heated together the maximum weight of Cl_2 gas evolved will be :
 $[MnO_2 + 4HCl \rightarrow MnCl_2 + Cl_2 + 2H_2O]$:
 (A) 2 g (B) 0.975 g (C) 0.486 g (D) 0.972 g
23. Molarity of H_2SO_4 is 18 M. Its density is 1.8 g/cm^3 , hence molality is :
 (A) 18 (B) 100 (C) 36 (D) 500
24. If $1\frac{1}{2}$ moles of oxygen combine with Al to form Al_2O_3 , the weight of Al used in the reaction is (Al = 27):
 (A) 27 g (B) 54 g (C) 40.5 g (D) 81 g
25. $Na_2SO_4 \cdot xH_2O$ has 50% H_2O . Hence, x is :
 (A) 4 (B) 5 (C) 6 (D) 8

EXERCISE-03**MISCELLANEOUS TYPE QUESTIONS****TRUE / FALSE**

- Two elements always combine together in a fixed ratio by weight.
- There is no difference between one mole and one gram molecule.
- Equal volumes of different gases under similar conditions of temperature and pressure contain equal number of atoms.
- Empirical formula represents the actual number of atoms present in a molecule of the substance.
- A balanced equation contains equal number of atoms of each element on both sides of the equation.
- Mass of reactants is always equal to the mass of the products.

FILL IN THE BLANKS

- Law of conservation of mass was put forward by
- The formation SO_2 and SO_3 illustrates the law of
- The number of atoms present in one molecule of an elementary substance is called its
- The mass of an atom of carbon is
- The reactant which reacts completely in a reaction is called
- According to Dulong and Petit's law, Atomic wt. Specific heat = (approx)
- The SI unit of density is

MATCH THE COLUMN

1.	Column-I	Column-II
(A)	Law of conservation of mass	(p) CH_4 has carbon and hydrogen in 3 : 1 mass ratio.
(B)	Law of multiple proportion	(q) 10 mL N_2 combines with 30 mL of H_2 to form 20 mL of NH_3
(C)	Law of definite proportion	(r) S and O_2 combine to form SO_2 and SO_3
(D)	Law of reciprocal proportion	(s) In H_2S and SO_2 mass ratio of H and O w.r.t. sulphur is 1 : 16, hence in H_2O , mass ratio of H and O is 1 : 8.
(E)	Gay Lussac's Law	(t) 4.2 g MgCO_3 gives 2.0 g residue on heating.

2.	Column-I	Column-II (mass of product)
(A)	$2\text{H}_2 + \text{O}_2 \longrightarrow 2\text{H}_2\text{O}$ 1g 1g	(p) 1.028 g
(B)	$3\text{H}_2 + \text{N}_2 \longrightarrow 2\text{NH}_3$ 1g 1g	(q) 1.333 g
(C)	$\text{H}_2 + \text{Cl}_2 \longrightarrow 2\text{HCl}$ 1g 1g	(r) 1.125 g
(D)	$2\text{H}_2 + \text{C} \longrightarrow \text{CH}_4$ 1g 1g	(s) 1.214 g

ASSERTION & REASON

These questions contains, Statement I (assertion) and Statement II (reason).

(A) Statement-I is true, Statement-II is true ; Statement-II is correct explanation for Statement-I.

(B) Statement-I is true, Statement-II is true ; Statement-II is NOT a correct explanation for statement-I

(C) Statement-I is true, Statement-II is false

(D) Statement-I is false, Statement-II is true

1. **Statement-I** : 16 g each O_2 and O_3 contains $\frac{N_A}{2}$ and $\frac{N_A}{3}$ atoms respectively.

Because

Statement-II : 16 g O_2 and O_3 contains same no. of atoms.

2. **Statement-I** : 44 g of CO_2 , 28 g of CO have same volume at STP.

Because

Statement-II : Both CO_2 and CO are formed by C and oxygen.

3. **Statement-I** : Law of conservation of mass hold good for nuclear reaction.

Because

Statement-II : Law states that mass can be neither created nor destroyed in a chemical reaction.

4. **Statement-I** : A reactant that is entirely consumed when a reaction goes to completion is known as limiting reactant.

Because

Statement-II : The amount of reactant limits the amount of product formed.

5. **Statement-I** : The balancing of chemical equations is based on law of conservation of mass.

Because

Statement-II : Total mass of reactants is equal to total mass of products.

6. **Statement-I** : Pure water obtained from different sources such as, river, well, spring, sea etc. always contains hydrogen and oxygen combined in the ratio 1 : 8 by mass.

Because

Statement-II : A chemical compound always contains elements combined together in same proportion by mass, it was discovered by French chemist, Joseph Proust (1799).

7. **Statement-I** : The percentage weight of a compound A in a solution is given by

$$\% \text{ of A} = \frac{\text{Mass A}}{\text{Total mass of solution}} \times 100$$

Because

Statement-II : The mole fraction of a component A is given by,

$$\text{Mole fraction of A} = \frac{\text{No. of moles of A}}{\text{Total no. of moles of all components}}$$

8. **Statement-I** : A one molal solution prepared at 20 C will retain the same molality at 100 C, provided there is no loss of solute or solvent on heating.

Because

Statement-II : Molality is independent of temperature.

9. **Statement-I** : The molality and molarity of dilute aqueous solutions differ very little.

Because

Statement-II : The density of water is 1.0 g cm^{-3} at room temperature.

10. **Statement-I** : The average mass of one Mg atom is 24.305 amu, which is not the actual mass of one Mg atom.

Because

Statement-II : Three isotopes, ^{24}Mg , ^{25}Mg and ^{26}Mg , of Mg are found in nature.

11. **Statement-I** : A molecule of butane, C_4H_{10} has a mass of 58.12 amu.
Because
Statement-II : One mole of butane contains 6.022×10^{23} molecules and has a mass of 58.12 g.
12. **Statement-I** : Both 12 g. of carbon and 27 g. of aluminium will have 6.02×10^{23} atoms.
Because
Statement-II : Gram atomic mass of an element contains Avogadro's number of atoms.

COMPREHENSION BASED QUESTIONS

Comprehension # 1

Potash is any potassium mineral that is used for its potassium content. Most of the potash produced in the United States goes into fertilizer. The major sources of potash are potassium chloride (KCl) and potassium sulphate (K_2SO_4). Potash production is often reported as the potassium oxide (K_2O) equivalent or the amount of K_2O that could be made from a given mineral. KCl costs Rs. 50 per kg.

- What is the cost of K per mole of the KCl sample?
 (A) Rs. 13.42 mol^{-1} (B) Rs. 3.73 mol^{-1} (C) Rs. 1.00 mol^{-1} (D) Rs. 2.00 mol^{-1}
- For what price must K_2SO_4 be sold in order to supply the same amount of potassium as in KCl ?
 (A) Rs. 58.40 kg^{-1} (B) Rs. 50.00 kg^{-1} (C) Rs. 42.82 kg^{-1} (D) Rs. 25.00 kg^{-1}
- What mass (in kg) of K_2O contains the same number of moles of K atoms as 1.00 kg KCl?
 (A) 0.158 kg (B) 0.315 kg (C) 1.262 kg (D) 0.631 kg

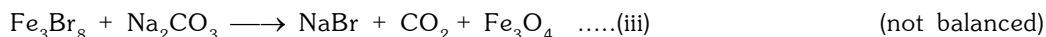
Comprehension # 2

Calcium lactate is used in the food and beverage industries. It has also been used medicinally for treatment of various allergies, for treatment of muscular leg cramps, and as an antidote for a variety of poisons, including lead, arsenicals and carbon tetrachloride. A 0.8274 g sample of anhydrous calcium lactate is found by analysis to contain 0.2732 g of C, 0.0382 g H, 0.1520 g Ca and 0.3640 g O. Each mole of calcium lactate is found to contain one mole of calcium ions. Calcium lactate can be crystallised from water as pentahydrate salt.

- Simplest formula of the calcium lactate is :
 (A) $CaO_6C_6H_{10}$ (B) $CaO_3C_3H_5$ (C) $CaO_2C_3H_3$ (D) $CaO_2C_3H_5$
- Formula weight of calcium lactate is :
 (A) 129 g mol^{-1} (B) 111 g mol^{-1} (C) 218 g mol^{-1} (D) 113 g mol^{-1}
- How many grams of calcium lactate pentahydrate would be recovered from 1 g of anhydrous salt :
 (A) 1.41 g (B) 1.00 g (C) 1.27 g (D) 1.51 g

Comprehension # 3

NaBr, used to produce AgBr for use in photography can be self prepared as follows :



How much Fe in kg is consumed to produce 2.06×10^3 kg NaBr $\dots(iv)$

- Mass of iron required to produce 2.06×10^3 kg NaBr
 (A) 420 g (B) 420 kg (C) 4.2×10^5 kg (D) 4.2×10^8 g
- If the yield of (ii) is 60% & (iii) reaction is 70% then mass of iron required to produce 2.06×10^3 kg NaBr.
 (A) 10^5 kg (B) 10^5 g (C) 10^3 kg (D) none

3. If yield of (iii) reaction is 90% then mole of CO_2 formed when $2.06 \times 10^3 \text{ kg}$ NaBr is formed.
 (A) 20 (B) 10 (C) 40 (D) none

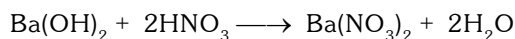
Comprehension # 4

A monobasic acid of weight 15.5 g is heated with excess of oxygen & evolved gases when passed through KOH solution increased its weight by 22 g and when passed through anhydrous CaCl_2 , increased its weight by 13.5 g. When the same mass of this organic acid is reacted with excess of silver nitrate solution form 41.75 g silver salt of the acid which on ignition gave the residue of weight 27 g.

- The molecular formula of the organic acid is.
 (A) C_2H_6 (B) $\text{C}_2\text{H}_5\text{O}_2$ (C) $\text{C}_2\text{H}_6\text{O}_2$ (D) $\text{C}_2\text{H}_4\text{O}$
- The molar masses of the acid & its silver salt respectively are:
 (A) 60, 168 (B) 167, 60 (C) 60, 167 (D) 168, 60

Comprehension # 5

342 g of 20% by mass of Ba(OH)_2 solution (sp. gr. 0.57) is reacted with 200 mL of 2 M HNO_3 according to given balanced reaction :



- The nature of the final solution is :
 (A) acidic (B) neutral (C) basic (D) can't say
- Find the molarity of the ion in resulting solution by which nature of the above solution is identified, is
 (A) 0.5 M (B) 0.8 M (C) 0.4 M (D) 1 M

MISCELLANEOUS TYPE QUESTION	ANSWER KEY	EXERCISE -3
<ul style="list-style-type: none"> <u>True / False</u> <ol style="list-style-type: none"> F T F F T T <u>Fill in the Blanks</u> <ol style="list-style-type: none"> Lavoisier Multiple proportions Atomicity $1.99 \times 10^{-23} \text{ g}$ Limiting reagent kg m^{-3} kg m^{-3} <u>Match the Column</u> <ol style="list-style-type: none"> (A) \rightarrow t ; (B) \rightarrow r ; (C) \rightarrow p ; (D) \rightarrow s ; (E) \rightarrow q (A) \rightarrow r ; (B) \rightarrow s ; (C) \rightarrow p ; (D) \rightarrow q <u>Assertion - Reason Questions</u> <ol style="list-style-type: none"> D B D A A A B A A A A A <u>Comprehension Based Questions</u> <p>Comprehension # 1:</p> <ol style="list-style-type: none"> (B) (C) (D) <p>Comprehension # 2:</p> <ol style="list-style-type: none"> (A) (C) (A) <p>Comprehension # 3:</p> <ol style="list-style-type: none"> (B) (C) (B) <p>Comprehension # 4:</p> <ol style="list-style-type: none"> (C) (A) <p>Comprehension # 5:</p> <ol style="list-style-type: none"> (C) (A) 		

EXERCISE-04 [A]**CONCEPTUAL SUBJECTIVE EXERCISE**

1. 1.375 g of cupric oxide was reduced by heating in a current of hydrogen and the weight of copper obtained was 1.098 g. In another experiment, 1.179 g of copper was dissolved in nitric acid and the resulting solution was evaporated to dryness. The residue of copper nitrate when strongly heated was converted into 1.4476 g of cupric oxide. Show that the results are in agreement with the law of constant proportion.
2. Elements X and Y from two different compounds. In the first 0.324 g of X is combined with 0.471 g of Y. In second, 0.117 g of X is combined with 0.509 g of Y. Show that these data illustrate the law of multiple proportions.
3. How many g of element are present in 35.125 g atom of Si. (Given at. wt. of Si = 28.)
4. Calculate the no. of molecules in a drop of water weighing 0.07 g.
5. Calculate no. of each atom present in 106.5 g of NaClO_3 .
6. Find the no. of mole of phosphorus in 92.9 g of phosphorus assuming that molecular formula of phosphorus is P_4 . Also determine the no. of atoms and molecules of phosphorus in the sample.
7. Calculate the number of moles in 5.75 g of sodium. (Atomic mass of sodium = 23.)
8. How many grams of each of the following elements must be taken to get 1 mol of the element?
(a) Sodium (b) Chlorine (c) Copper
9. The density of liquid mercury is $13.6 / \text{cm}^3$. How many moles of mercury are there in 1 litre of the metal ? (Atomic mass of Hg = 200)
10. 50 g of CaCO_3 is allowed to react with 70 g of H_3PO_4 . Calculate :
(i) amount of $\text{Ca}_3(\text{PO}_4)_2$ formed (ii) amount of unreacted reagent
11. N_2H_4 , Hydrazine a rocket fuel can be produced according to the following reaction :
$$\text{ClNH}_2 + 2\text{NH}_3 \longrightarrow \text{N}_2\text{H}_4 + \text{NH}_4\text{Cl}$$

When 1000 g ClNH_2 is reacted with excess of NH_3 , 473 g N_2H_4 is produced. What is the % yield of the reaction.
12. Carbon disulphide ' CS_2 ', can be made from by product SO_2 . The overall reaction is
$$5\text{C} + 2\text{SO}_2 \longrightarrow \text{CS}_2 + 4\text{CO}$$

How much CS_2 can be produced from 450 kg of waste SO_2 with excess of coke if the SO_2 conversion is 82%.
13. Calculate the percent of BaO in 29.0 g of a mixture of BaO and CaO which just reacts with 100.8 mL of 6.00 M HCl.
$$\text{BaO} + 2\text{HCl} \rightarrow \text{BaCl}_2 + \text{H}_2\text{O}$$
$$\text{CaO} + 2\text{HCl} \rightarrow \text{CaCl}_2 + \text{H}_2\text{O}$$
14. Calculate the amount of 95% pure Na_2CO_3 required to prepare 5 litre of 0.5 M solution.
15. Calculate the molality of a sulphuric acid solution of specific gravity 1.2 containing 27% H_2SO_4 by weight.
16. A gaseous alkane is exploded with oxygen. The moles of O_2 for complete combustion and CO_2 formed is in the ratio 7 : 4. Deduce molecular formula of alkane.
17. When 2.86 g of a mixture of 1-butene, C_4H_8 and butane C_4H_{10} was burned in excess of oxygen, 8.80 g of CO_2 and 4.14 g of H_2O were obtained. What is percentage by mass of butane in the mixture.

18. If v mL of a gaseous hydrocarbon, after explosion with excess of oxygen, showed a contraction of $2.5 v$ mL and a further contraction of $2v$ mL with caustic potash, Find the formula of hydrocarbon.
19. The average mass of one gold atom in a sample of naturally occurring gold is 3.2707×10^{-22} g. Use this to calculate the molar mass of gold.
20. A plant virus is found to consist of uniform symmetrical particles of 150 \AA in diameter and 5000 \AA long. The specific volume of the virus is $0.75 \text{ cm}^3/\text{g}$. If the virus is considered to be a single particle, find its molecular weight.
21. Density of a gas relative to air is 1.17. Find the mol. mass of the gas [$M_{\text{air}} = 29 \text{ g/mol}$]
22. One type of artificial diamond (commonly called YAG for yttrium aluminium garnet) can be represented by the formula $\text{Y}_3\text{Al}_5\text{O}_{12}$.
- (a) Calculate the weight percentage composition of this compound.
- (b) What is the weight of yttrium present in a 200 – carat YAG if 1 carat = 200 mg ? (Y = 89, Al = 27)
23. A chemical commonly called "dioxin" has been very much in the news in the past few years. (It is the by product of herbicide manufacture and is thought to be quite toxic.) Its formula is $\text{C}_{12}\text{H}_4\text{Cl}_4\text{O}_2$. If you have a sample of dirt (28.3 g) that contains $1.0 \times 10^{-4} \%$ dioxin, how many moles of dioxin are in the dirt sample?
24. A chemist wants to prepare diborane by the reaction
- $$6 \text{ LiH} + 8 \text{ BF}_3 \longrightarrow 6 \text{ Li BF}_4 + \text{B}_2\text{H}_6$$
- If it starts with 2.0 moles each of LiH & BF_3 . How many moles B_2H_6 can be prepared.
25. One gram of an alloy of aluminium and magnesium when heated with excess of dil. HCl forms magnesium chloride, aluminium chloride and hydrogen. The evolved hydrogen collected over mercury at 0°C has a volume of 1.2 litres at 0.92 atm pressure. Calculate the composition of the alloy.
26. A 10 g sample of a mixture of calcium chloride and sodium chloride is treated with Na_2CO_3 to precipitate calcium as calcium carbonate. This CaCO_3 is heated to convert all the calcium to CaO and the final mass of CaO is 1.62 g. Calculate % by mass of NaCl in the original mixture.
27. By the reaction of carbon and oxygen, a mixture of CO and CO_2 is obtained. What is the composition of the mixture by mass obtained when 20 grams of O_2 reacts with 12 grams of carbon ?
28. The action of bacteria on meat and fish produces a poisonous compound called cadaverine. As its name and origin imply, it stinks ! It is 58.77% C, 13.81 % H, and 27.42 % N. Its molar mass is 102 g/mol. Determine the molecular formula of cadaverine.
29. Given the following empirical formulae and molecular weight, compute the true molecular formulae :
- | | Empirical formula | Molecular weight |
|-----|-----------------------|------------------|
| (a) | CH_2 | 84 |
| (b) | CH_2O | 150 |
| (c) | HO | 34 |
| (d) | HgCl | 472 |
| (e) | HF | 80 |
30. What is the percentage of nitrogen in an organic compound 0.14 g of which gave by Dumas method 82.1 c.c. of nitrogen collected over water at 27°C and at a barometric pressure of 774.5 mm? (aqueous tension of water at 27°C is 14.5 mm)

31. Calculate the molarity of the following solutions :
- 4g of caustic soda is dissolved in 200 mL of the solution.
 - 5.3 g of anhydrous sodium carbonate is dissolved in 100 mL of solution.
 - 0.365 g of pure HCl gas is dissolved in 50 mL of solution.
32. A mixture of ethanol and water contains 54 % water by mass. Calculate the mole fraction of alcohol in this solution.
33. 10 mL of a mixture of CO, CH₄, and N₂ exploded with excess of oxygen gave a contraction of 6.5 mL. There was a further contraction of 7 mL, when the residual gas treated with KOH. What is the composition of the original mixture?
34. When 100 mL of a O₂ – O₃ mixture was passed through turpentine, there was reduction of volume by 20 mL. If 100 mL of such a mixture is heated, what will be the increase in volume?
-

CONCEPTUAL SUBJECTIVE EXERCISE			ANSWER KEY		EXERCISE-4(A)		
3.	983.5 g of Si		4.	2.34 10 ²¹ molecules of H ₂ O			
5.	6.023 10 ²³ atom Na, 6.023 10 ²³ atom Cl, 18.06 10 ²³ atom O						
6.	0.75 mol, 4.52 10 ²³ molecules P ₄ , 18.04 10 ²³ atom P						
7.	0.25 mol		8.	(a) 23 g (b) 35.5 g (c) 63.5 g			
9.	68		10.	(i) 51.66 g (ii) 37.31 g			
11.	76.12%	12.	219.09 kg CS ₂	13.	65.65%	14.	278.94 g
15.	3.8	16.	C ₂ H ₆	17.	60.8 %	18.	C ₂ H ₆
19.	196.2	20.	7.09 10 ⁷	21.	33.9		
22.	(a) Y = 44.95%, Al = 22.73 %, O = 32.32%		(b) 17.98 g		23.	8.8 10 ⁻⁸ mol	
24.	0.250	25.	Al = 0.546 g, Mg = 0.454g		26.	67.9%	
27.	CO : CO ₂ =21 : 11	28.	C ₅ H ₁₄ N ₂	29.	(a) C ₆ H ₁₂ (b) C ₅ H ₁₀ O ₅ (c) H ₂ O ₂ (d) Hg ₂ Cl ₂ (e) H ₄ F ₄		
30.	66.7 %	31.	(a) 0.5M, (b) 0.5 M, (c) 0.2 M		32.	0.25	
33.	CO = 5mL, CH ₄ = 2 mL, N ₂ = 3 mL		34.	10 mL			

EXERCISE-04 [B]**BRAIN STORMING SUBJECTIVE EXERCISE**

1. A crystalline hydrated salt on being rendered anhydrous, loses 45.6% of its weight. The percentage composition of anhydrous salt is : Al = 10.5%, K = 15.1%, S = 24.8% and I = 49.6%. Find the empirical formula of the anhydrous and crystalline salt :
2. How much quantity of zinc will have to be reacted with excess of dilute HCl solution to produce sufficient hydrogen gas for completely reacting with the oxygen obtained by decomposing 5.104 g of potassium chlorate?
3. A 1.85 g sample of mixture of CuCl_2 and CuBr_2 was dissolved in water and mixed thoroughly with 1.8 g portion of AgCl. After reaction, the solid which now contain AgCl and AgBr was filtered, dried and weighed to be 2.052 g. What was the % by weight of CuBr_2 in the mixture?
4. 1.0 g of a sample containing NaCl, KCl and some inert impurity is dissolved in excess of water and treated with excess of AgNO_3 solution. A 2.0 g precipitate to AgCl separate out. also sample is 23% by mass in sodium. Determine mass percentage of KCl in the sample :
5. A mixture of $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ and $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$ was heated until all the water was driven-off. If 5.0 g of mixture gave 3 g of anhydrous salts, what was the percentage by mass of $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ in the original mixture :
6. A compound containing Ca, C, N and S was subjected to quantitative analysis and formula mass determination. A 0.25 g of this compound was mixed with Na_2CO_3 to convert all Ca into 0.16 g CaCO_3 . A 0.115 g sample of compound was carried through a series of reactions until all its S was changed into SO_4^{2-} and precipitated as 0.344 g of BaSO_4 . A 0.712 g sample was processed to liberate all of its N as NH_3 and 0.155 g NH_3 was obtained. The formula mass was found to be 156. Determine the empirical and molecular formula of the compound :
7. A 0.2 g sample, which is mixture of NaCl, NaBr and NaI was dissolved in water and excess of AgNO_3 was added. The precipitate containing AgCl, AgBr and AgI was filtered, dried and weighed to be 0.412 g. The solid was placed in water and treated with excess of NaBr, which converted all AgCl into AgBr. The precipitate was then weighed to be 0.4881 g. It was then placed into water and treated with excess of NaI, which converted all AgBr into AgI. The precipitate was then weighed to be 0.5868 g. What was the percentage of NaCl, NaBr and NaI in the original mixture :
8. 2.5 g of a sample containing Na_2CO_3 ; NaHCO_3 and some non-volatile impurity on gentle heating loses 12% of its weight. Residue is dissolved in 100 mL water and its 10 mL portion required 15 mL 0.1 M aqueous solution of BaCl_2 for complete precipitation of carbonates. Determine mass percentage of Na_2CO_3 in the original sample ?
9. Based on the following information, determine value x and y :
$$\begin{array}{ccccccc} (\text{CH}_3)_x\text{AlCl}_y & \longrightarrow & x\text{CH}_4(\text{g}) + y\text{Cl}^- + \text{Al}^{3+} & \xrightarrow{\text{AgNO}_3} & \text{AgCl}(\text{s}) \\ 0.643 \text{ g} & & 0.222 \text{ g} & & 0.996 \text{ g} \end{array}$$
10. A 5.0 g sample of felspar containing Na_2O , K_2O and some inert impurity is dissolved in dilute HCl solution and NaCl and KCl formed are separated by fractional crystallization. During crystallization some less soluble impurities also comes out. Mass of NaCl, KCl and impurity accompanying these salts was found to be 6.47 g. Solid crystal was then re-dissolved and required 300 mL of 0.3 M AgNO_3 for complete precipitation of chlorides. The precipitate this, obtained was found to contain 4.23 % insoluble impurity. Determine mass percentage of Na_2O and K_2O in the original sample :
11. $\text{Pb}(\text{NO}_3)_2$ and KI reacts in aqueous solution to form an yellow precipitate of PbI_2 . In one series of experiments, the masses of two reactants varied, but the total mass of the two was held constant at 5.0 g. What maximum mass of PbI_2 can be produced in the above experiment :
12. Uranium is isolated from its ore by dissolving it as $\text{UO}_2(\text{NO}_3)_2$ and separating it as solid $\text{UO}_2(\text{C}_2\text{O}_4) \cdot x\text{H}_2\text{O}$. A 1.0 g sample of ore on treatment with nitric acid yielded 1.48 g $\text{UO}_2(\text{NO}_3)_2$ which on further treatment with 0.4 g $\text{Na}_2\text{C}_2\text{O}_4$ yielded 1.23 g $\text{UO}_2(\text{C}_2\text{O}_4) \cdot x\text{H}_2\text{O}$. Determine weight percentage of uranium in the original sample and x :

13. A mother cell disintegrate into sixty identical cells and each daughter cell further disintegrate into 24 smaller cells. The smallest cells are uniform cylindrical in shape with diameter of 120 Å and each cell is 6000 Å long. Determine molar mass of the mother cell if density of the smallest cell is 1.12 g/cm³ :
14. A sample is a mixture of Mohr's salts and (NH₄)₂SO₄. A 0.5 g sample on treatment with excess of BaCl₂ solution gave 0.75 g BaSO₄. Determine percentage composition of the salt mixture . What weight of Fe₂O₃ would be obtained if 0.2 g of the sample were ignited in air ?
15. A chloride mixture is prepared by grinding together pure BaCl₂·2H₂O, KCl and NaCl. What is the smallest and largest volume of 0.15 M AgNO₃ solution that may be used for complete precipitation of chloride from a 0.3 g sample of the mixture which may contain any one or all of the constituents ?
16. One mole of a mixture of N₂, NO₂ and N₂O₄ has a mean molar mass of 55.4. On heating to a temperature at which N₂O₄ may be dissociated : N₂O₄ → 2NO₂, the mean molar mass tends to the lower value of 39.6. What is the mole ratio of N₂ : NO₂ : N₂O₄ in the original mixture?
17. 10 mL of gaseous organic compound contain C, H and O only was mixed with 100 mL of O₂ and exploded under identical conditions and then cooled. The volume left after cooling was 90 mL. On treatment with KOH a contraction of 20 mL was observed, if vapour density of compound is 23 derive molecular formula of the compound.
18. Fluorocarbon polymers can be made by fluorinating polyethylene according to the reaction (CH₂)_n + 4nCoF₃ → (CF₂)_n + 2nHF + 4nCoF₂, where n is a large integer. The CoF₃ can be regenerated by the reaction 2 CoF₂ + F₂ → 2CoF₃. If the HF formed in the first reaction cannot be reused, how many kg of fluorine are consumed per kg of fluorocarbon produced, (CF₂)_n? If HF can be recovered and electrolyzed to hydrogen and fluorine, and if this fluorine is used for regenerating CoF₃, what is the net consumption of fluorine per kg of fluorocarbon?
19. $A_2 + 2B_2 \longrightarrow A_2B_4$
 $\frac{3}{2}A_2 + 2B_2 \longrightarrow A_3B_4$
 Two substance A₂ & B₂ react in the above manner when A₂ is limited it gives A₂B₄ in excess gives A₃B₄. A₂B₄ can be converted to A₃B₄ when reacted with A₂. Using this information calculate the composition of the final mixture when the mentioned amount of A & B are taken :c
 (a) 4 moles A₂ & 4 moles B₂
 (b) $\frac{1}{2}$ moles A₂ & 2 moles B₂
 (c) 1.25 moles A₂ & 2 moles B₂
20. In a water treatment plant, Cl₂ used for the treatment of water is produced from the following reaction 2KMnO₄ + 16HCl → 2KCl + 2MnCl₂ + 8H₂O + 5Cl₂. If during each feed 1 L KMnO₄ having 79% (w/v) KMnO₄ & 9 L HCl with d = 1.825 g/mL & 10% (w/w) HCl are entered & if that percent yield is 80% then calculate :
 (a) amount of Cl₂ produced.
 (b) amount of water that can be treated by Cl₂ if 1 litre consumes 28.4 g of Cl₂ for treatment.
 (c) calculate efficiency η of the process if $\eta = \frac{\text{vol. of water treated}}{\text{vol. of total feed}}$
21. A sea water sample has a density of 1.03 g/cm³ and 2.8% NaCl by mass. A saturated solution of NaCl in water is 5.45 M NaCl. How much water would have to be evaporated from 1.00 × 10⁶ L of the sea water before NaCl would precipitate ?
22. A sample of oleum is such that ratio of "free SO₃" by "combined SO₃" is equal to unity. Calculate its labelling in terms of percentage oleum.

23. One litre of milk weighs 1.035 kg. The butter fat is 4% (v/v) of milk has density of 875 kg/m^3 . Find the density of fat free skimmed milk.
24. A sample of fuming sulphuric acid containing H_2SO_4 , SO_3 and SO_2 weighing 1.00 g is found to require 23.47 mL of 1.00 M alkali (NaOH) for neutralisation. A separate sample shows the presence of 1.50% SO_2 . Find the percentage of "free" SO_3 , H_2SO_4 and "combined" SO_3 in the sample.
25. In one process for waterproofing, a fabric is exposed to $(\text{CH}_3)_2\text{SiCl}_2$ vapour. The vapour reacts with hydroxyl groups on the surface of the fabric or with traces of water to form the waterproofing film $[(\text{CH}_3)_2\text{SiO}]_n$, by the reaction ;
- $$n(\text{CH}_3)_2\text{SiCl}_2 + 2n\text{OH} \longrightarrow 2n\text{Cl}^- + n\text{H}_2\text{O} + [(\text{CH}_3)_2\text{SiO}]_n$$
- where n stands for a large integer. The waterproofing film is deposited on the fabric layer upon layer. Each layer is 6.0 \AA thick [the thickness of the $(\text{CH}_3)_2\text{SiO}$ group]. How much $(\text{CH}_3)_2\text{SiCl}_2$ is needed to waterproof one side of a piece of fabric, 1.00 m by 3.00 m, with a film 300 layers thick ? The density of the film is 1.0 g/cm^3 .
26. 20 mL of a mixture of methane and a gaseous compound of Acetylene series were mixed with 100 mL of oxygen and exploded. The volume of the products after cooling to original room temperature and pressure, was 80 mL and on treatment with potash solution a further contracting of 40 mL was observed. Calculate (a) the molecular formula of the hydrocarbon, (b) the percentage composition of the mixture.
27. In a solution the concentration of CaCl_2 is 5 M & that of MgCl_2 is 5 m. The specific gravity of solution is 1.05, calculate the concentration of Cl^- in the solution in terms of Molarity.

BRAIN STORMING SUBJECTIVE EXERCISE	ANSWER KEY	EXERCISE-4(B)
1. KAlS_2O_8 , $\text{KAlS}_2\text{O}_8 \cdot 12 \text{ H}_2\text{O}$	2. 8.124 g Zn	3. 34.18
4. 29.28	5. 74.4	6. $\text{CaC}_2\text{N}_2\text{S}_2$, $\text{CaC}_2\text{N}_2\text{S}_2$
7. 50, 20.23, 29.77	8. 42.4 % Na_2CO_3	9. 2, 1
10. 31.16, 37.34	11. 3.464 g	12. 89.4, 3
13. 6.6 10^{10} g	14. 18.77 mg	15. 16.38 mL, 34.18 L
16. 0.5 : 0.1 : 0.4	17. $\text{C}_2\text{H}_6\text{O}$	18. 1.52 kg, 0.76 kg
19. (a) $\text{A}_3\text{B}_4 = 2$ & $\text{A}_2 = 1$; (b) $\text{A}_2\text{B}_4 = \frac{1}{2}$ & $\text{B}_2 = 1$ (c) $\text{A}_2\text{B}_4 = 0.5$ & $\text{A}_3\text{B}_4 = 0.5$	21. 9.095 10^5 L	22. 110.11 %
20. (a) 10 mol, (b) L, (c) 2.5		
23. 1.041 g/mL		
24. $\text{H}_2\text{SO}_4 = 35.38\%$, Free $\text{SO}_3 = 63.1\%$, combined $\text{SO}_3 = 28.89\%$		25. 0.9413 gram
26. (b) 50	27. $[\text{Cl}^-] = 13.36 \text{ M}$	

JEE-[MAIN] : PREVIOUS YEAR QUESTIONS

- | PREVIOUS YEARS QUESTIONS | | | | | ANSWER KEY | | | EXERCISE-5 [A] | | |
|--------------------------|----|---|---|---|------------|---|---|----------------|---|----|
| Que. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Ans. | 1 | 1 | 4 | 1 | 1 | 4 | 3 | 1 | 1 | 3 |
| Que. | 11 | | | | | | | | | |
| Ans. | 1 | | | | | | | | | |

EXERCISE - 05 [B] JEE-[ADVANCED] : PREVIOUS YEAR QUESTIONS

1. How many moles of e^- weight one Kg : [JEE '2002 (Scr), 1]
- (A) 6.023×10^{23} (B) $\frac{1}{9.108} \times 10^{31}$ (C) $\frac{6.023}{9.108} \times 10^{54}$ (D) $\frac{1}{9.108 \times 6.023} \times 10^8$
2. Calculate the molarity of pure water using its density to be 1000 kg m^{-3} : [JEE' 2003]
3. One gm of charcoal adsorbs 100 mL 0.5 M CH_3COOH to form a monolayer, and there by the molarity of CH_3COOH reduces to 0.49. Calculate the surface area of the charcoal adsorbed by each molecule of acetic acid. Surface area of charcoal = $3.01 \times 10^2 \text{ m}^2/\text{g}$: [JEE' 2003]
4. Which has maximum number of atoms : [JEE 2003]
- (A) 24 g C(12) (B) 56 g Fe(56) (C) 27 g Al (27) (D) 108 g Ag(108)
5. Calculate the amount of Calcium oxide required when it reacts with 852 g of P_4O_{10} . [JEE 2005]
- $$6\text{CaO} + \text{P}_4\text{O}_{10} \longrightarrow 2 \text{Ca}_3(\text{PO}_4)_2$$
6. 20% surface sites have adsorbed N_2 . On heating N_2 gas evolved from sites and were collected at 0.001 atm and 298 K in a container of volume is 2.46 cm^3 . Density of surface sites is $6.023 \times 10^{14}/\text{cm}^2$ and surface area is 1000 cm^2 , find out the no. of surface sites occupied per molecule of N_2 : [JEE 2005]
7. Given that the abundances of isotopes ^{54}Fe , ^{56}Fe , ^{57}Fe are 5%, 90% and 5% respectively, the atomic mass of Fe is : [JEE 2009]
- (A) 55.85 u (B) 55.95 u (C) 55.75 u (D) 56.05 u

PREVIOUS YEARS QUESTIONS		ANSWER KEY		EXERCISE -5 [B]	
1.	D	2.	55.5 mol L^{-1}	3.	$5 \times 10^{-19} \text{ m}^2$
4.	A	5.	1008 g	6.	2
7.	B				