

Multiple Choice Questions (Type-1)

1. Two students performed the same experiment separately and each one of them recorded two readings of mass which are given below. The correct reading of mass is 3.0 g. Based on given data, mark the correct option out of the following statements.

Student Readings

	(i)	(ii)
A	3.01	2.99
B	3.05	2.95

- (i) Results of both the students are neither accurate nor precise.
- (ii) Results of student A are both precise and accurate.
- (iii) Results of student B are neither precise nor accurate.
- (iv) Results of student B are both precise and accurate.

Solution:

Option (ii) is the answer.

2. A measured temperature on the Fahrenheit scale is 200 °F. What will this reading be on a Celsius scale?

- (i) 40 °C
- (ii) 94 °C
- (iii) 93.3 °C
- (iv) 30 °C

Solution:

Option (iii) is the answer.

3. What will be the molarity of a solution, which contains 5.85 g of NaCl(s) per 500 mL?

- (i) 4 mol L⁻¹
- (ii) 20 molL⁻¹
- (iii) 0.2 molL⁻¹
- (iv) 2molL⁻¹

Solution:

Option (iii) is the answer.

4. If 500 mL of a 5M solution is diluted to 1500 mL, what will be the molarity of the solution obtained?

- (i) 1.5 M
- (ii) 1.66 M
- (iii) 0.017 M

(iv) 1.59 M

Solution:

Option (ii) is the answer.

5. The number of atoms present in one mole of an element is equal to Avogadro number. Which of the following element contains the greatest number of atoms?

(i) 4g He

(ii) 46g Na

(iii) 0.40g Ca

(iv) 12g He

Solution:

Option (iv) is the answer.

6. If the concentration of glucose ($C_6H_{12}O_6$) in the blood is 0.9 g L^{-1} , what will be the molarity of glucose in the blood?

(i) 5 M

(ii) 50 M

(iii) 0.005 M

(iv) 0.5 M

Solution:

Option (iii) is the answer.

7. What will be the molality of the solution containing 18.25 g of HCl gas in 500 g of water?

(i) 0.1 m

(ii) 1 M

(iii) 0.5 m

(iv) 1 m

Solution:

Option (iv) is the answer.

8. One mole of any substance contains 6.022×10^{23} atoms/molecules. Number of molecules of H_2SO_4 present in 100 mL of 0.02M H_2SO_4 solution is ____.

(i) 12.044×10^{20} molecules

(ii) 6.022×10^{23} molecules

(iii) 1×10^{23} molecules

(iv) 12.044×10^{23} molecules

Solution:

Option (i) is the answer.

9. What is the mass per cent of carbon in carbon dioxide?

(i) 0.034%

(ii) 27.27%

(iii) 3.4%

(iv) 28.7%

Solution:

Option (ii) is the answer.

10. The empirical formula and molecular mass of a compound are CH_2O and 180 g respectively. What will be the molecular formula of the compound?

- (i) $\text{C}_9\text{H}_{18}\text{O}_9$
- (ii) CH_2O
- (iii) $\text{C}_6\text{H}_{12}\text{O}_6$
- (iv) $\text{C}_2\text{H}_4\text{O}_2$

Solution:

Option (iii) is the answer.

11. If the density of a solution is 3.12 g mL^{-1} , the mass of 1.5 mL solution in significant figures is _____.

- (i) 4.7g
- (ii) $4680 \times 10^{-3}\text{g}$
- (iii) 4.680g
- (iv) 46.80g

Solution:

Option (i) is the answer

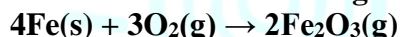
12. Which of the following statements about a compound is incorrect?

- (i) A molecule of a compound has atoms of different elements.
- (ii) A compound cannot be separated into its constituent elements by physical methods of separation.
- (iii) A compound retains the physical properties of its constituent elements.
- (iv) The ratio of atoms of different elements in a compound is fixed.

Solution:

Option (iii) is the answer.

13. Which of the following statements is correct about the reaction given below:

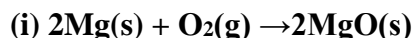


- (i) The total mass of iron and oxygen in reactants = total mass of iron and oxygen in product therefore it follows the law of conservation of mass.
- (ii) The total mass of reactants = total mass of product; therefore, the law of multiple proportions is followed.
- (iii) Amount of Fe_2O_3 can be increased by taking any one of the reactants (iron or oxygen) in excess.
- (iv) Amount of Fe_2O_3 produced will decrease if the amount of any one of the reactants (iron or oxygen) is taken in excess.

Solution:

Option (i) is the answer.

14. Which of the following reactions is not correct according to the law of conservation of mass.



- (ii) $\text{C}_3\text{H}_8(\text{g}) + \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{g})$
(iii) $\text{P}_4(\text{s}) + 5\text{O}_2(\text{g}) \rightarrow \text{P}_4\text{O}_{10}(\text{s})$
(iv) $\text{CH}_4(\text{g}) + 2\text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{g})$

Solution:

Option (ii) is the answer.

15. Which of the following statements indicates that the law of multiple proportions is being followed.

- (i) Sample of carbon dioxide taken from any source will always have carbon and oxygen in the ratio 1:2.
(ii) Carbon forms two oxides namely CO_2 and CO , where masses of oxygen which combine with a fixed mass of carbon are in the simple ratio 2:1.
(iii) When magnesium burns in oxygen, the amount of magnesium taken for the reaction is equal to the amount of magnesium in magnesium oxide formed.
(iv) At constant temperature and pressure, 200 mL of hydrogen will combine with 100 mL oxygen to produce 200 mL of water vapour.

Solution:

Option (ii) is the answer.

Multiple Choice Questions (Type-11)

In the following questions, two or more options may be correct.

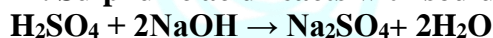
16. One mole of oxygen gas at STP is equal to _____.

- (i) 6.022×10^{23} molecules of oxygen
(ii) 6.022×10^{23} atoms of oxygen
(iii) 16 g of oxygen
(iv) 32 g of oxygen

Solution:

Option (i) and (iv) are the answers.

17. Sulphuric acid reacts with sodium hydroxide as follows:



When 1L of 0.1M sulphuric acid solution is allowed to react with 1L of 0.1M sodium hydroxide solution, the amount of sodium sulphate formed and its molarity in the solution obtained is

- (i) 0.1 mol L⁻¹
(ii) 7.10 g
(iii) 0.025 mol L⁻¹
(iv) 3.55 g

Solution:

Option (ii) and (iii) are the answers.

18. Which of the following pairs have the same number of atoms?

- (i) 16 g of $\text{O}_2(\text{g})$ and 4 g of $\text{H}_2(\text{g})$
(ii) 16 g of O_2 and 44 g of CO_2

- (iii) 28 g of N_2 and 32 g of O_2
(iv) 12 g of C(s) and 23 g of Na(s)

Solution:

Option (iii) and (iv) are the answers.

19. Which of the following solutions have the same concentration?

- (i) 20 g of NaOH in 200 mL of solution
(ii) 0.5 mol of KCl in 200 mL of solution
(iii) 40 g of NaOH in 100 mL of solution
(iv) 20 g of KOH in 200 mL of solution

Solution:

Option (i) and (ii) are the answers.

20. 16 g of oxygen has the same number of molecules as in

- (i) 16 g of CO
(ii) 28 g of N_2
(iii) 14 g of N_2
(iv) 1.0 g of H_2

Solution:

Option (iii) and (iv) are the answers.

21. Which of the following terms is unitless?

- (i) Molality
(ii) Molarity
(iii) Mole fraction
(iv) Mass per cent

Solution:

Option (iii) and (iv) are the answers.

22. One of the statements of Dalton's atomic theory is given below:

"Compounds are formed when atoms of different elements combine in a fixed ratio"

Which of the following laws is not related to this statement?

- (i) Law of conservation of mass
(ii) Law of definite proportions
(iii) Law of multiple proportions

Solution:

Option (i) and (iv)

III. Short Answer Type

23. What will be the mass of one atom of C-12 in grams?

Solution:

1 mole of carbon atom = 12g = 6.022×10^{23} atoms.

24. How many significant figures should be present in the answer to the following calculations?

2.5 1.25 3.5/2.01

Solution:

Two significant figures should be present in this.

Since the least number of significant figures from the given figure is 2 (in 2.5 and 3.5).

25. What is the symbol for the SI unit of a mole? How is the mole defined?

Solution:

The symbol for the SI unit of the mole is mol. A mole is defined as the amount of substance that contains as many entities as there are atoms in 12g carbon.

26. What is the difference between molality and molarity?

Solution:

Molarity is the number of moles of solute dissolved in 1 litre of the solution. Molality is the number of moles of solute present in 1kg of the solvent.

27. Calculate the mass percent of calcium, phosphorus and oxygen in calcium phosphate $\text{Ca}_3(\text{PO}_4)_2$

Solution:

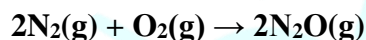
Molecular mass of $\text{Ca}_3(\text{PO}_4)_2 = 3 \times 40 + 2 \times 31 + 8 \times 16 = 310$

Mass per cent of Ca = $3 \times 40 / 310 \times 100 = 38.71\%$

Mass per cent of P = $2 \times 31 / 310 \times 100 = 20\%$

Mass per cent of O = $8 \times 16 / 310 = 41.29\%$

28. 45.4 L of dinitrogen reacted with 22.7 L of dioxygen and 45.4 L of nitrous oxide was formed. The reaction is given below:



Which law is being obeyed in this experiment? Write the statement of the law?

Solution:

The above experiment proves Gay-Lussac's law which states that gases combine or produced in a chemical reaction in a simple whole-number ratio by volume provided that all gases are the same temperature and pressure.

29. If two elements can combine to form more than one compound, the masses of one element that combine with a fixed mass of the other element, are in whole-number ratio.

(a) Is this statement true?

(b) If yes, according to which law?

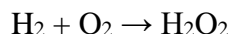
(c) Give one example related to this law.

Solution:

(a) Yes, the statement is true.

(b) According to the law of multiple proportions

(c), Hydrogen and oxygen react to form water and hydrogen peroxide



Masses of oxygen which combine the fixed mass of hydrogen are in the ratio 16:32 or 1

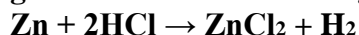
30. Calculate the average atomic mass of hydrogen using the following data :

Isotope %	Natural abundance	Molar mass
1H	99.985	1
2H	0.015	2

Solution:

Average atomic mass = $99.985 \times 1 + 0.015 \times 2 / 100$
 $= 99.985 \times 1 + 0.015 \times 2 / 100$
 $= 1.00015u$

31. Hydrogen gas is prepared in the laboratory by reacting dilute HCl with granulated zinc. Following reaction takes place.



Calculate the volume of hydrogen gas liberated at STP when 32.65 g of zinc reacts with HCl. 1 mol of a gas occupies 22.7 L volume at STP; atomic mass of Zn = 65.3 u.

Solution:

1 mol of gas occupies = 22.7L Volume at STP atomic mass of Zn = 65.3u

From the above equation,

65.3g of Zn when reacts with HCl produces = 22.7L H₂ at STP

Therefore, 32.65g of Zn when reacts with HCl will produce = $22.7 \times 32.65 / 65.3 = 11.35\text{L}$ of H₂ at STP

32. The density of 3 molal solutions of NaOH is 1.110 g mL⁻¹. Calculate the molarity of the solution.

Solution:

3 molal solution of NaOH = 3 moles of NaOH dissolved in 1000g water

3 mole of NaOH = $3 \times 40\text{g} = 120\text{g}$

Density of solution = 1.110g mL⁻¹

Volume = mass/density = $1120\text{g} / 1.110\text{g mL}^{-1} = 1.009\text{L}$

Molarity of the solution = $3 / 1.009 = 2.97\text{M}$

33. The volume of a solution changes with change in temperature, then, will the molality of the solution be affected by temperature? Give a reason for your answer.

Solution:

Mass does not change as the temperature changes. Therefore, the molality of a solution does not change.

Molality = moles of solute/ weight of solvent (in g) * 1000

34. If 4 g of NaOH dissolves in 36 g of H₂O, calculate the mole fraction of each component in the solution. Also, determine the molarity of solution (specific Gravity of solution is 1g mL⁻¹).

Solution:

Mole fraction of H_2O = No. of moles of H_2O / Total no. of moles ($\text{H}_2\text{O} + \text{NaOH}$)

No. of moles of H_2O = $36/18 = 2$ moles

No. of moles of NaOH = $4/40 = 0.1$ mol

Total no. of moles = $2 + 0.1 = 2.1$

Mole fraction of H_2O = $2/2.1 = 0.952$

Mole fraction of NaOH = $0.1/2.1 = 0.048$

Mass of solution = Mass of H_2O + Mass of NaOH = $36 + 4 = 40$ g

Volume of the solution = $40/1 = 40$ mL

Molarity = $0.1/0.04 = 2.5$ M

35. The reactant which is entirely consumed in the reaction is known as limiting reagent.

In the reaction $2\text{A} + 4\text{B} \rightarrow 3\text{C} + 4\text{D}$, when 5 moles of A react with 6 moles of B, then

(i) which is the limiting reagent?

(ii) calculate the amount of C formed?

Solution;

(i) B will be the limiting reagent as it gives a lesser amount of product.

(ii) Let B is completely consumed

4 mol B gives 3 mol C

6 mol B will give $\frac{3}{4} \times 6$ mol C = 4.5 mol C

Match The Following Type

36.

(i) 88 g of CO_2	(a) 0.25 mol
(ii) 6.022×10^{23} molecules of H_2O	(b) 2 mol
(iii) 5.6 litres of O_2 at STP	(c) 1 mol
(iv) 96 g of O_2	(d) 6.022×10^{23} molecules
(v) 1 mol of any gas	(e) 3 mol

Solution:

A \rightarrow a

B \rightarrow c

C \rightarrow a

D \rightarrow e

E \rightarrow d

37. Match the following

Physical quantity	Unit
(i) Molarity	(a) g mL^{-1}
(ii) Mole fraction	(b) mol
(iii) Mole	(c) Pascal
(iv) Molality	(d) Unitless
(v) Pressure	(e) mol L^{-1}

(vi) Luminous intensity (vii) Density (viii) Mass	(f) Candela (g) mol kg^{-1} (h) Nm^{-1} (i) kg
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Solution:

- (i \rightarrow e)
 (ii \rightarrow d)
 (iii \rightarrow b)
 (iv \rightarrow g)
 (v \rightarrow c)
 (vi \rightarrow f)
 (vii \rightarrow a)
 (viii \rightarrow i)

V. Assertion and Reason Type

In the following questions, a statement of Assertion (A) followed by a statement of Reason (R) is given. Choose the correct option out of the choices given below each question.

38. Assertion (A): The empirical mass of ethene is half of its molecular mass.

Reason (R): The empirical formula represents the simplest whole-number ratio of various atoms present in a compound.

- (i) Both A and R are true and R is the correct explanation of A.
 (ii) A is true but R is false.
 (iii) A is false but R is true.
 (iv) Both A and R are false.

Solution:

Option (i) is correct.

39. Assertion (A): One atomic mass unit is defined as one-twelfth of the mass of one carbon-12 atom.

Reason (R): Carbon-12 isotope is the most abundant isotope of carbon and has been chosen as the standard.

- (i) Both A and R are true and R is the correct explanation of A.
 (ii) Both A and R are true but R is not the correct explanation of A.
 (iii) A is true but R is false.
 (iv) Both A and R are false.

Solution:

Option (ii) is correct. Carbon-12 is considered a standard for defining the atomic and molecular mass.

40. Assertion (A): Significant figures for 0.200 is 3 whereas for 200 it is 1.

Reason (R): Zero at the end or right of a number are significantly provided they are not on the right side of the decimal point.

- (i) Both A and R are true and R is the correct explanation of A.

(ii) Both A and R are true but R is not a correct explanation of A.

(iii) A is true but R is false.

(iv) Both A and R are false.

Solution:

Option (iii) is correct. Significant figures for $0.200 = 3$ and for $200 = 1$

Zero at the end of a number without decimal point may or may not be significant depending on the accuracy of the measurement.

41. Assertion (A): Combustion of 16 g of methane gives 18 g of water.

Reason (R): In the combustion of methane, water is one of the products.

(i) Both A and R are true but R is not the correct explanation of A.

(ii) A is true but R is false.

(iii) A is false but R is true.

(iv) Both A and R are false.

Solution:

Option (iii) is correct.

16g of CH_4 on complete combustion will give 36g of water.

Long Answer Type Question

42. A vessel contains 1.6 g of dioxygen at STP (273.15K, 1 atm pressure). The gas is now transferred to another vessel at a constant temperature, where the pressure becomes half of the original pressure. Calculate

(i) the volume of the new vessel.

(ii) a number of molecules of dioxygen.

Solution:

(i) Moles of oxygen = $1.6/32 = 0.05\text{mol}$

At STP, 1 mol of $\text{O}_2 = 22.4\text{L}$

Then volume of $\text{O}_2 = 22.4 \times 0.05 = 1.12\text{L}$

$V_1 = 1.12\text{L}$

$V_2 = ?$

$P_1 = 1\text{atm}$

$P_2 = \frac{1}{2} = 0.5\text{atm}$

According to Boyle's law, $p_1V_1 = p_2V_2$

Substituting the values

$V_2 = 1 \times 1.12 / 0.5 = 2.24\text{L}$

(ii) No of molecules in 1.6g or $0.005\text{mol} = 6.022 \times 10^{23} \times 0.05 = 3.011 \times 10^{22}$

43. Calcium carbonate reacts with aqueous HCl to give CaCl_2 and CO_2 according to the reaction given below:



What mass of CaCl_2 will be formed when 250 mL of 0.76 M HCl reacts with 1000 g of CaCO_3 ? Name the limiting reagent. Calculate the number of moles of CaCl_2 formed in the reaction.

Solution:

No: of moles of HCl taken = $MV/1000 = 0.76 \times 250/1000 = 0.19$

No: of moles of $\text{CaCO}_3 = \text{Mass/Molar mass} = 1000/100 = 10$

1. When CaCO_3 is completely consumed

1 mol of $\text{CaCO}_3 = 1 \text{ mol CaCl}_2$

10 mol $\text{CaCO}_3 = 10 \text{ mol CaCl}_2$

2. When HCl is completely consumed.

2 mol $\text{HCl} = 1 \text{ mol CaCl}_2$

0.19 mol $\text{HCl} = \frac{1}{2} \times 0.19 \text{ mol CaCl}_2 = 0.095 \text{ mol CaCl}_2$

HCl will be the limiting reagent and the number of moles of CaCl_2 formed will be 0.095 mol

44. Define the law of multiple proportions. Explain it with two examples. How does this law point to the existence of atoms?

Solution:

When two elements combine to form two or more chemical compounds, then the masses of one of the elements which combine with a fixed mass of the other bear a simple ratio to one another is the law of multiple proportions.

For example, carbon combines with oxygen to form two compounds they are carbon dioxide and carbon monoxide

The masses of oxygen which combine with a fixed mass of carbon in carbon dioxide and carbon monoxide are 32 and 16. Therefore oxygen bear: 32:16 ratio or 2:1

Example 2: Sulphur combines with oxygen to form sulphur trioxide and sulphur dioxide

The masses of oxygen which combine with a fixed mass of sulphur in SO_3 and SO_2 are 48 and 32. Therefore oxygen bear a ratio of 48:32 or 3:2

45. A box contains some identical red coloured balls, labelled as A, each weighing 2 grams. Another box contains identical blue coloured balls, labelled as B, each weighing 5 grams. Consider the combinations AB, AB₂, A₂B and A₂B₃ and show that the law of multiple proportions is applicable.

Solution:

	AB	ab ₂	A ₂ B	A ₂ B ₃
Mass of A (in g)	2	2	4	4
Mass of B (in g)	5	10	5	15

Masses of B which combine with a fixed mass of A are

10g, 20g, 5g, 15g

2 : 4 : 1 : 3

This is the simple whole-number ratio.