Class 11 Some Basic Concepts of Chemistry Important Questions with Answers

Short Answer Type Questions

Q1. What will be the mass of one atom of C-12 in grams?

Answer.
The mass of 1 mole of C-12 atoms = 12 g
1 mole of C-12 atoms = 6.022×10^{23} atoms
The mass of 1 atom of C-12 = $12 / (6.022 \times 10^{23})$
= 1.99×10^{-23} g

Q2. How many significant figures should be present in the answer of the following calculations?

$$\frac{2.5 \times 1.25 \times 3.5}{2.01}$$

Answer.
The number of significant figures that should be present in the calculation

$$\frac{2.5 \times 1.25 \times 3.5}{2.01}$$

is 2.

Q3. What is the symbol for SI unit of mole? How is the mole defined?

Answer.
The symbol for SI Mole is the unit of measurement for moles.
One mole is defined as the amount of a substance containing the same number of particles or entities as there are atoms in exactly 12 g (0.012 kg) of the C – 12 isotope.

Q4. What is the difference between molality and molarity?

Answer.

Molarity	Molality

The molarity of a given solution is defined as the total number of moles of solute per litre of solution.	Molality is defined as the total moles of a solute contained in a kilogram of a solvent.
The mathematical expression is- M = number of moles of the solute /Volume of solution given in terms of litres.	The mathematical expression is- m = Numbers of moles of solute/Mass of solvent in kgs m = (g × 1000)/(W × m).
Depends on the volume of the whole solution.	Depends on the mass of the solvent.
Unit sign expressed as (M).	Unit sign expressed as (m).
Molarity has a unit of moles/litre.	Molality has units of moles/kg.

Q5. Calculate the mass percent of calcium, phosphorus and oxygen in calcium phosphate $Ca_3(PO_4)_2$

Answer.
Molecular formula of calcium phosphate is $Ca_3(PO_4)_2$
Its molar mass will be - 3(40) + 2(31) + 8(16) = 310 g/mol.

- Mass percent of calcium

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

- Mass percent of phosphorus

$$\%Phosphorus = \frac{62}{310} \times 100 = 20\%$$

- Mass percent of oxygen

$$\%Oxygen = \frac{128}{310} \times 100 = 41.29\%$$

Q6. 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:
$2N_2(g) + O_2(g) \rightarrow 2N_2O(g)$
Which law is being obeyed in this experiment? Write the statement of the law?

Answer.
Since the volumes of dinitrogen and dioxygen that combine (i.e., 45.4 L and 22.7 L) have a simple ratio of 2: 1. As a result, it follows Gay Lussac's law of gaseous volumes.
According to this law, "when gases combine or are produced in a chemical reaction, they do so in a simple volume ratio provided all gases are at the same temperature and pressure."

Q7. 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 a whole-number ratio.

(a) Is this statement true?
(b) If yes, according to which law?
(c) Give one example related to this law.

Answer.
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 a whole-number ratio.

(a) Yes the statement is true.
(b) According to the law of multiple proportions.
(c) Consider the example
$H_2 + O_2 \rightarrow H_2O$
$H_2 + O_2 \rightarrow H_2O_2$

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

Q8. Calculate the average atomic mass of hydrogen using the following data:

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

Answer.
Average atomic mass is given by the following formula-

$$\frac{Natural\,Abundance\,Of\,^1\mathrm{H} \times Molar\,Mass + Natural\,Abundance\,Of\,^2\mathrm{H}}{100}$$

$$\frac{(99.985 \times 1) + (0.015 \times 2)}{100} = 1.00015u$$

Hence, the average atomic mass will be 1.00015 μ.

Q9. Hydrogen gas is prepared in the laboratory by reacting dilute HCl with granulated zinc.

Following reaction takes place.

$Zn + 2HCl \rightarrow ZnCl2 + H2$

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.

Answer.
65.3 g of Zn reacts with HCl to form 22.7 of H_2 gas.
∴ 32.65 g of Zn at STP reacts with HCl to form =

$$\frac{22.7 \times 32.65}{65.3} = 11.35L$$

Q10. The density of the 3 molal solution of NaOH is 1.110 g mL^{-1}. Calculate the molarity of the solution.

Answer.
Molality is 3 m

$$Molality = \frac{number of moles of solute}{mass of solvent}$$

$$3 = \frac{n}{mass of solvent}$$

$$mass of solvent = \frac{1000}{3}$$

Also, number of moles=mass/molar mass
For NaOH,

$$n = \frac{m}{40}$$

Density of solution ρ = 1.110 g/mol
Mass of 1 mL solution = 1.11g = m_{solute} + $m_{solvent}$
n = 2.97×10^{-3} mol

$$M = \frac{2.97 \times 10^{-3}}{0.001} = 2.97M \approx 3M$$

Q11. Volume of a solution changes with change in temperature, then, will the molality solution be affected by temperature? Give reason for your answer.

Answer.
The temperature has no effect on the molality of the solution because molality is expressed in mass, and mass remains constant as temperature changes.

Q12. If 4 g of NaOH dissolves in 36 g of H_2O, calculate the mole fraction of each component in the solution. Also, determine the molarity of solution (specific gravity of solution is l g ml^{-1})

Answer.

Mass of NaOH = 4 g
Number of moles of NaOH = 4g/40g = 0.1 mol

Mass of H_2O = 36 g
Number of moles of H_2O = 36g/18g = 2 mol

$$Mole fraction of water = \frac{Number of moles of H_2O}{Number of moles of water + Number of moles of NaOH}$$

$$Mole fraction of water = \frac{2}{2+0.1} = \frac{2}{2.1} = 0.95$$

$$Mole fraction of NaOH = \frac{Number of moles of NaOH}{Number of moles of water + Number of moles of NaOH}$$

$$Mole fraction of NaOH = \frac{0.1}{2+0.1} = \frac{0.1}{2.1} = 0.047$$

Mass of solution = mass of water + mass of NaOH = 36g+4 g = 40 g
Volume of solution =40×1=40 mL.(Since specific gravity of solution is =1 g mL^{-1})

$$Molarity = \frac{number of moles of solute}{Volume of solution(V)}$$

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

Q13. The reactant which is entirely consumed in the reaction is known as a limiting reagent.
In the reaction 2A + 4B → 3C + 4D, 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?

Answer.
$2A + 4B \rightarrow 3C + 4D$
According to the above equation, 2 moles of 'A' require 4 moles of 'B' for the reaction. As a result, the moles of 'B' required for 5 moles of 'A' are 10 moles.

(i) The limiting agent is B, as 5 moles of A requires 10 moles of B but only 6 moles are present.
(ii) The amount of 'C' formed will be determined by the amount of 'B' formed. Since 4 moles of 'B' produce 3 moles of 'C'. As a result, 6 moles of 'B' will produce

$$\frac{6 \times 3}{4} = 4.5 moles$$

Matching Type Questions

Q1. Match the following:

(i) 88 g of CO_2	(a) 0.25 mol
(ii) 6.022 x 10^{23} molecules of H2O	(b) 2 mol
(iii) 5.6 litres of O, at STP	(c)1 mol
(iv) 96 g of O	(d) 6.022 x 10^{23} molecules
(v) 1 mol of any gas	(e) 3 mol

Answer.

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

Q2. Match the following physical quantities with units

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	(f) Candela
(vii) Density	(g) mol kg^{-1}
(viii) Mass	(h) Nm^{-1}
	(i) kg

Answer.

Physical quantity	Unit
(i) Molarity	(e) mol L^{-1}
(ii) Mole fraction	(d)Unitless
(iii) Mole	(b) mol
(iv) Molality	(g) mol kg^{-1}
(v) Pressure	(c) Pascal, (h) Nm^{-1}
(vi) Luminous intensity	(f) Candela
(vii) Density	(a) g mL^{-1}
(viii) Mass	(i) kg

Assertion and Reason Type Questions

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.

Q1. 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.

Answer.
Correct Option is (i) Both A and R are true and R is the correct explanation of A.

Molecular Formula = n × Empirical formula

$$n = \frac{Molecular\,Mass}{Empirical\,Formula\,Mass}$$

Empirical formula of Ethe = C_2H_4
Empirical Formula Mass = 14 amu= ½ Molecular Mass of Ethene
The ratio of Carbon and Hydrogen in the empirical formula is 1: 2.

Q2. 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.

Answer.
Correct Option is (i) Both A and R are true and R is the correct explanation of A.

Since C-12 is used as the standard atom, one atomic mass unit is defined as one-twelfth of the mass of one carbon - 12 atom. This is due to the fact that it has an equal number of protons and neutrons (6) and makes up the majority of matter.
Carbon-12 is the most abundant isotope of carbon.

Q3. Assertion (A): Significant figures for 0.200 are 3 whereas for 200 it is 1.
Reason (R): Zero at the end or right of a number is significant provided they are not on the right side of the decimal point.

(1) 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.

Answer.
Correct Option is (iii) A is true but R is false.

Zero at the end or to the right of a number is significant if it is on the right side of the decimal point. For example, 0.200 has 3 significant figures.

Q4. 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.

Answer.
Correct Option is (iii) A is false but R is true.

$CH_4 + O_2 \rightarrow CO_2 + 2H_2O$
Water is produced during the combustion of methane, but 16 g of methane on complete combustion gives 36 g of water.

Long Answer Type Questions

Q1. 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 pressure becomes half of the original pressure. Calculate

(i) volume of the new vessel.
(ii) number of molecules of dioxygen.

Answer.
(i) P_1 = 1atm, P_2 = ½ = 0.5 atm, T_1 = 273.15, V_2 = ?, V_1 = ?
32 g of dioxygen occupies = 22.4 L volume at STP
∴ 1.6 g of dioxygen will occupy = $\frac{22.4 \times 1.6g}{32g} = 1.12L$

V_1 = 1.12 L
From Boyle's law (as T is constant)
$p_1V_1 = p_2V_2$

$$V_2 = \frac{1atm \times 1.12L}{0.6atm} = 2.24L$$

V_2 = 22.4 L

(ii) Number of moles of dioxygen = Mass of dioxygen/Molar mass of dioxygen

$$Number of moles of dioxygen = \frac{1.6}{3.2} = 0.05mol$$

1 mol of dioxygen = 6.022×10^{23} molecule of dioxygen
∴ 0.05 mol of dioxygen = $6.022 \times 10^{23} \times 0.5$ molecules of dioxygen
= 0.3011×10^{23} molecules
= 3.011×10^{22} molecules.

Q2. Calcium carbonate reacts with aqueous HCl to give CaCl2 and CO2 according to the reaction given below:

$CaCO_3$ (s) + 2HCl (aq) → $CaCl_2$(aq) + CO_2(g) + H_2O(L)

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.

Answer.

Number of moles of HCl = $250mL \times \frac{0.76M}{1000} = 0.19mol$
Mass of $CaCO_3$ = 1000 g
Number of moles of $CaCO_3$ = 1000 g/100g = 10 mol
According to the equation, 1 mol of $CaCO_3$ requires 2 mol of HCl.
Hence, for the reaction of 10 mol of $CaCO_3$ number of moles of HCl required would be:

$$10molCaCO_3 \times \frac{2molHCl}{1molCaCO_3} = 20molHCl$$

There is only 0.19 mol of HCl available, hence HCl is a limiting reagent.
Therefore, the amount of $CaCl_2$ formed will depend on the amount of HCl would give-

$$0.19molofHCl \times \frac{1molCaCl_2}{2molHCl} = 0.095molCaCl_2$$

Or 0.095 × molar mass of $CaCl_2$ = 0.095 × 111 = 10.54 g.

Q3. Define the law of multiple proportions. Explain it with two examples. How does this law point to the existence of atoms?

Answer.
Dalton first studied the law of multiple proportions in 1803 and it can be found and follows.
When two elements combine to form two or more chemical compounds, the masses of one of the elements combine with a fixed mass of the other in a simple ratio.
For example, hydrogen reacts with oxygen to form two compounds: water and hydrogen peroxide.

$$\underset{2g}{\text{Hydrogen}} + \underset{16g}{\text{Oxygen}} \rightarrow \underset{18g}{H_2O}$$

$$\underset{2g}{\text{Hydrogen}} + \underset{32g}{\text{Oxygen}} \rightarrow \underset{34g}{H_2O_2}$$

In this case, the masses of oxygen (i.e. 16g and 32g) that combine with a fixed mass of hydrogen (2g) have a simple ratio, i.e. 16:32 or 1:2.
As we all know, when compounds are mixed in different proportions, they form different compounds. For example, when hydrogen is mixed with a different proportion of oxygen, it forms water or hydrogen peroxide.
It demonstrates that there are constituents that combine in a specific manner. These constituents could be atoms. As a result, the law of multiple proportions demonstrates the existence of atoms that combine to form molecules.

Q4. 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, AB_2, A_2B and A_2B_3, and show that a law of multiple proportions is applicable.

Answer.

Combination	Mass of A (g)	Mass of B (g)
AB	2	5
AB_2	2	10
A_2B	4	5
A_2B_3	4	15

When two elements combine to form two or more compounds, the different masses of one element that combine with a fixed mass of the other bear a simple ratio to one another, according to the law of multiple proportions.

The mass of B when combined with a fixed mass of A (say 1g) is 2.5g, 5g, 1.25g, and 3.75g. They have a 2:4:1 ratio, which is a simple whole-number ratio. Hence. The multiple proportions law is applicable.