IV. Long Answer Type Questions
Question 1. (a) How do atoms exist?
(b) What is atomicity?
(c) What are polyatomic ions?
Answer: (a) Atoms of some elements are not able to exist independently. For such elements atoms form molecules and ions. In case of metals and inert gases atoms can exist independently.

Atoms of metals and inert gases: *E.g.,* $\underbrace{\text{Na, Mg, Al,}}_{\text{Metals}}$ $\underbrace{\text{He, Ne, Ar}}_{\text{Inert gases}}$

Non-metals: *E.g.,* H_2, Cl_2, P_4, S_8
Exceptional non-metal C

(b) The number of atoms constituting a molecule is known as its atomicity.
E.g., $O_3 \rightarrow$ atomicity is 3
$O_2 \rightarrow$ atomicity is 2
(c) Polyatomic ions: When more than two atoms combine together and act like an atom with a charge on it is called polyatomic ion.
E.g., OH^-, NO_3^-, NH_4^+

Question 2. Calculate
(a) the mass of one atom of oxygen
(b) the mass of one molecule of oxygen
(c) the mass of one mole of oxygen gas
(d) the mass of one ion of oxygen
(e) the number of atoms in 1 mole of oxygen molecule
Answer:

(a) Mass of one atom of oxygen
1 mole of oxygen atom = 16 gm = 6.022×10^{23} atoms.

$\therefore$ Mass of one atom of oxygen = $\dfrac{16}{6.022 \times 10^{23}}$ = 2.65×10^{-23}

(b) Mass of one molecule of oxygen
1 molecule of oxygen = O_2
= 2 × 16
= 32 u

(c) Mass of one mole of oxygen gas
1 mole of oxygen gas is O_2 = 32 u

(d) Mass of one ion of oxygen
One mole of oxygen = 6.022×10^{23} atoms = 16g.

Mass of one ion of oxygen = $\dfrac{16}{6.022 \times 10^{23}}$
= 2.65×10^{-23}

(e) Number of atoms in one mole of oxygen molecule
1 mole of oxygen molecule *i.e.,*
O_2 = 6.022×10^{23} molecules.
1 molecule of O_2 = 2 atoms.

$\therefore$ Number of atoms in 1 mole of oxygen molecule = $6.022 \times 10^{23} \times 2$ atoms
= 1.2044×10^{24} atoms

Question 3. What is meant by atomic mass, gram atomic mass of

an element? Why is the mass have different expressions i.e., 'u' and 'g'?

Answer: The atoms are very tiny and their individual mass cannot be calculated as it is negligible. Hence the mass of atoms is expressed in units with respect to a fixed standard. Initially hydrogen atom with mass 1 was taken as standard unit by Dalton. Later, it was replaced by oxygen atom (O=16). But due to the isotopes the masses were found in fractions instead of whole number. Hence, carbon (C=12) isotope was taken as standard unit and was universally accepted.

The atomic mass unit is equal to one twelfth (1/12) the mass of an atom of carbon-12, its unit is u.

Gramatomic mass: When the atomic mass of an element is expressed in grams, it is called the gramatomic mass of the element.

The mass of atoms, molecules is expressed in 'u' and the mass of moles i.e., molar mass is expressed in g.

Question 4. Define a mole. Give the significance of the mole.

Answer: Mole-One mole of any species (atoms, molecules, ions or particles) is that quantity or number having a mass equal to its atomic or molecular mass in grams.

1 mole = 6.022×10^{23} in number (atoms, molecules, ions or particles)

Significance of the mole

1. A mole gives the number of entities present i.e, 6.022×10^{23} particles of the substance.

2. Mass of 1 mole is expressed as M grams.

3. Mass of 1 mole = mass of 6.022×10^{23} atoms of the element.

$$E.g., \quad \text{1 mole of } O_2 = 6.022 \times 10^{23} \text{ atoms}$$
$$2 \times 16 = 32\,g$$
$$6.022 \times 2 \times 10^{23} = 1.2044 \times 10^4 \text{ atoms}$$
$$\text{1 mole of (compound) HCl} = 6.022 \times 10^{23} \text{ atoms of H and Cl atoms}$$
$$(1 + 35.5 = 36.5\,g) \quad (6.022 \times 10^{23} \text{ molecules of HCl})$$

V. Activity-Based Questions

- Take one of the following sets X and Y of chemicals—

  X   -   Y

  (i) Copper sulphate - Sodium carbonate

  (ii) Barium chloride - Sodium sulphate
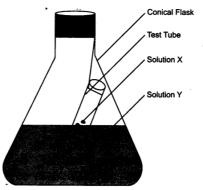
  (iii) Lead nitrate - Sodium chloride

Fig *Ignition tube containing solution of X, dipped in a coical flask containing solution of Y.*

- Prepare separately 95% solution of any one pair of substances listed under X and Y in water.
- Take little amount of solution of Y in a conical flask and some solution of X in an ignition tube.
- Hang the ignition tube in the flask carefully; see that the solutions do not get mixed.
- Put a cork on the flask as shown in figure.
- Weigh the flask with its contents carefully.
- Now tilt and swirl the flask, so that the solutions X and Y get mixed.

- Weigh again.
- What happens in the reaction flask?
- Do you think that a chemical reaction has taken place?
- Why should we put a cork on the mouth of the flask?
- Does the mass of the flask and its contents change?

Answer:

- In the reaction flask both the reactants combined to give new products.
- Yes.
- We should put a cork on the mouth of the flask so that no other gases in the air combine or get added into the reaction, neither any gas formed in the reaction should escape.
- No. The mass of the flask before and after reaction do not change.

VI. Value - Based Questions

Question 1. A customer buys a gold jewellery, he is told that the jewellery has 90% gold and the rest copper. He is given a bill which amounts 100% charges of gold. The customer refuses to pay the bill for 100% gold but brings it to 90% gold amount and settles the bill.
(a) How many atoms of gold are present in 1 gram of gold?
(b) What is the ratio of gold and copper in the jewellery?
(c) What value of customer is reflected in the above statement?
Answer:

(a)   1 gram of gold will contain $\dfrac{90}{100}$ = 0.9g of gold.

∴   Number of moles of gold = $\dfrac{\text{Mass of gold}}{\text{Atomic mass of gold}}$

= $\dfrac{0.9}{197}$

= 0.0046

∴ 0.0046 mole of gold will contain = $0.0046 \times 6.022 \times 10^{23}$
= 2.77×10^{21} atoms

(b) Ratio of gold : copper = 90 : 10
(c) Values of customer are responsible behaviour and self awareness.

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