# Atoms and Molecules

## Periodic Test

**Q.1. Define the atomic mass unit.**

**Answer:** One atomic mass unit is a mass unit equal to the exactly 1/12th the mass of one atom of carbon-12.

Carbon-112 was chosen as the standard reference for measuring atomic masses.

**Q.2. How many atoms are present in one molecule of aluminium sulphate?**

**Answer:** The chemical formula of aluminium sulphate is Al2(SO4)3

It contains 2 atoms of aluminum, 3 atoms of sulphate and 12 atoms of oxygen. Hence, it contains total 17 atoms.

**Q.3. Which postulate of Dalton's atomic theory is the result of the law of conservation of mass?**

**Answer:** Law of conservation of mass: This law states that "atoms are neither created nor destroyed in a chemical reaction".

The postulate of Dalton's atomic theory: Atoms are indivisible particles which cannot be created or destroyed in a chemical reaction.

**Q.4. What is an atom?**

**Answer:** Atoms are the building blocks of all matter. They are very small; they are smaller than anything we can imagine or compare with.

**Q.5. Which postulate of Dalton's atomic theory can explain the law of definite proportions?**

**Answer:** Law of definite proportions: This law states that "in a chemical substance, the elements are always present in definite proportions".

Postulate of Dalton's atomic theory: Atoms of given elements are identical in mass and chemical properties.

**Q.6. Calculate the molar mass of the Sulphur and phosphorus molecule.**

**Answer:** For Sulphur:

Molar mass of S = 32g/mol

Sulphur is made up of 8 Sulphur atoms.

Hence, molar mass of Sulphur ($S_8$) is:

8 × 32mol/g = 256mol/g

**For phosphorus:**

Molar mass of P = 31g/mol

Phosphorus molecule is made up of 4 phosphorus atoms.

Hence, molar mass of Sulphur ($P_4$) is:

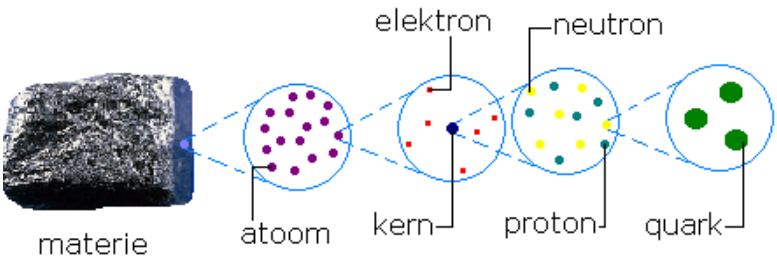
4 × 31mol/g = 124 mol/g

**Q.7. Give Reasons for the Following:**

**Why is incorrect to say that, 'atoms are indivisible particles'?**

**Answer:** It is incorrect to say that atoms are indivisible particles because later on it was discovered that atoms can be further divided. It contains some fundamental sub-atomic particles which are electrons, protons, and neutrons. Even neutrons and protons are sub divided into different types.

**The following diagram shows the division of particles in matter:**




**Q.8. Give Reasons for the Following:**

**Atoms of most elements are not able to exist independently. Then how these atoms form the matter that we can feel, see or touch?**

**Answer:** Atoms of most elements are not able to exist independently. Atoms form molecules and ions. These molecules or ions aggregate in large numbers to form the matter that we can see, feel or touch.

**Q.9. Give Reasons for the Following:**

**It is said that molecules of many elements, such as argon (Ar), helium (He), neon (Ne), etc., are made-up of only one atom of the element. Why is it so?**

**Answer:** Molecules of many elements, such as argon (Ar), helium (He), neon (Ne), etc., are made-up of only one atom of the element because:

**i.** These elements are noble gases which are unreactive in nature.

**ii.** They have a completely filled outermost shells.

**iii.** As a result, they are unable to combine with any other element.

**iv.** Hence, they exist independently in the form of a single atom.

**Q.10. Give Reasons for the Following:**

**The atoms of elements such as helium, neon, argon, radon, etc., do not form ions easily. Why is it so?**

**Answer:** The atoms of elements such as helium, neon, argon, radon, etc., do not form ions easily because:

**i.** These elements are noble gases which are unreactive in nature.

**ii.** They have a completely filled outermost shells.

**iii.** As a result, they do not lose or gain any electron.

**iv.** Hence, they exist independently in the form of a single atom and do not form ions easily.

**Q.11. Give Reasons for the Following:**

**Why valency of an element is considered very important?**

**Answer: Importance of valency:**

**i.** The combining power of an element is known as its valency.

**ii.** Valency can be used to find out how the atoms of an element will combine with the atoms of another element to form a compound.

**Q.12. Give differences between an atom and an ion.**

**Answer:** Difference between ion and atom:

| Atom | Ion |
|---|---|
| The building blocks of all matter are atoms. | Compounds composed of metals and non-metals has charged species. The charge species are known as ions. |
| Atoms are divided into protons, neutrons, and electrons. | Ions are divided into cations and anions. |
| Atoms may or may not be able to exist independently. | Ions exist only independently. |
| For example Na, $S_8$, $P_4$ etc. | For ex: Sodium ion ($Na^+$), calcium ion ($Ca^{2+}$) |

**Q.13. Differentiate between the cation and an anion.**

**Answer:** Difference between cation and anion:

| Cation | Anion |
|---|---|
| A positively charged ion is called cation. | A negatively charged ion is called anion. |
| When any atom loses electrons, it becomes cation | When any atom gains electrons, it become anion. |
| For example: $Na^+$, $Ca^{2+}$, $Mg^{2+}$ | For ex: $Cl^-$, $SO_4^{2-}$, $CO_3^{2-}$ |

**Q.14. What is meant by:**

**(a) Molecular mass** **(b) Chemical formula** **(c) Mole**

**Answer:**

**(a) Molecular mass:** The molecular mass of a substance is the sum of atomic masses of all the atoms in a molecule of the substance. It is used for those substances whose constituent particles are molecules.

For example: The molecular mass of $CO_2$ = 1 × atomic mass of carbon + 2 × atomic mass of oxygen

$\Rightarrow 12 + 2 \times 16$

$\Rightarrow 12 + 32 = 44u$

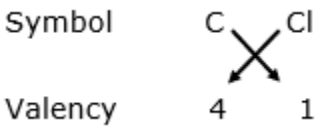
**(b) Chemical formula:** The chemical formula of a compound is a symbolic representation of its composition. The chemical formula for different compounds can be written easily. For writing a chemical formula, we need to learn the symbols and combining the capacity of elements.

**For example, Chemical formula of carbon tetrachloride:**

Valency of carbon is 4

Valency of chlorine is 1

**By applying the crisscross method:**




Formula: $CCl_4$

Thus, the formula for carbon tetrachloride is $CCl_4$.

**(c)** One mole of any species (atoms, ions or molecules) having that quantity in number having a mass equal to its atomic or molecular mass in grams.

**Q.15. Give the main postulates of Dalton ’s atomic theory.**

**Answer:** Postulates of Dalton’s atomic theory are:

**i.** Elements are made up of very small indivisible particles called atoms.

**ii.** All atoms of a particular element are identical in shape.

**iii.** The properties of atoms of a particular element are different from the atoms of other elements.

**iv.** An atom can neither be created nor destroyed.

**v.** Atoms of one element cannot be converted into those of another element.

**Q.16 A. Explain giving a suitable example:**

**Law of conservation of mass**.

**Answer: Law of conservation of mass:**

This law states that “atoms are neither created nor destroyed in a chemical reaction”. This means that the total mass of the products formed in a chemical reaction must be equal to the mass of reactants consumed.

**For example:**

$$CaCO_3 \rightarrow CaO + CO_2$$
$$100g \quad 56g \quad 44g$$

Sum of mass of reactants = Sum of masses of products

**Q.16 B. Explain giving a suitable example:**

**Law of constant proportions.**

**Answer: Law of constant proportions:**

This law states that “in a chemical substance, the elements are always present in definite proportions by mass”.

For example: In ammonia ($NH_3$), nitrogen and hydrogen are always present in the ratio of 14:3 by mass, whatever the method or source from which it is obtained.

In water, hydrogen and oxygen are always present in the ratio of 1:8 by mass, whatever the method or source from which water is obtained.

**Q.17. Give the formula of the following compounds:**

(i) Magnesium bicarbonate.
(ii) Cupric oxide.
(iii) Ferric oxide.

(iv) Ammonium hydroxide.
(v) Calcium carbonate.
(vi) Potassium carbonate.

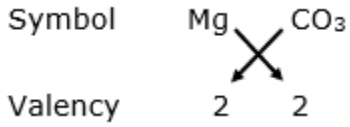
**Answer:**

**(i) Magnesium bicarbonate:**

Valency of magnesium = 2

Valency of carbonate = 2

By applying crisscross method:



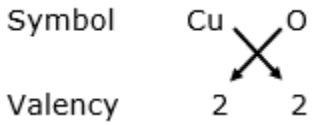

Formula: $MgCO_3$

**(ii) Cupric oxide:**

Valency of cupric = 2

Valency of oxide = 2

By applying crisscross method:



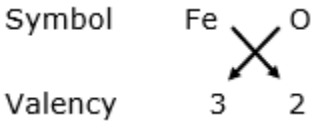

Formula: CuO

**(iii) Ferric oxide:**

Valency of ferric = 3

Valency of oxide = 2

By applying crisscross method:



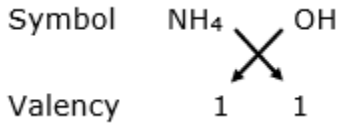

Formula: $Fe_2O_3$

**(iv) Ammonium hydroxide:**

Valency of ammonium = 1

Valency of hydroxide = 1

By applying crisscross method:




Formula: $NH_4OH$

**(v) Calcium carbonate:**

Valency of calcium = 2

Valency of carbonate = 2

By applying crisscross method:

Formula: $CaCO_3$

**(vi) Potassium carbonate:**

Valency of potassium = 1

Valency of carbonate = 2

By applying crisscross method:

Formula: $K_2CO_3$

**Q.18. What rules are to be kept in mind while writing a chemical formula?**

**Answer:** The rules which are to be kept in mind while writing a chemical formula is:

**i.** The valencies or charges on the ion must balance.

**ii.** When a compound consists of a metal and a non-metal, the name or symbol of the metal is written first.

**iii.** For ex: calcium oxide (CaO), sodium chloride (NaCl) where oxygen and chlorine are written on the right whereas calcium and sodium are written on the left.

**iv.** If the valencies of two elements are same, we will simplify the formula.

**v.** In compounds formed with polyatomic ions, the ion is enclosed in a bracket before writing the number to indicate the ratio.

**Q.19 A. What is the mass (in gram) of?**

**1 atom of oxygen**

**Answer:**

**To calculate the mass of 1 atom of oxygen:**

Atomic mass of oxygen = 16

1 mole of atom = $6.022 \times 10^{23}$ (Avogadro's no.)

$$\text{Hence, mass of one oxygen atom} = \frac{\text{Atomic mass of a mole of atom}}{\text{Avogadro's no.}}$$

$$\text{Hence, mass of 1 oxygen atom} = \frac{16}{6.022 \times 10^{23}}$$

Mass of 1 oxygen atom = $2.65 \times 10^{23}$g

**Q.19 B. What is the mass (in gram) of?**

**1 atom of sodium?**

**Answer:**

To calculate the mass of 1 atom of sodium:

Atomic mass of sodium = 23

1 mole of atom = $6.022 \times 10^{23}$ (Avogadro's no.)

$$\text{Hence, mass of one sodium atom} = \frac{\text{Atomic mass of a mole of atom}}{\text{Avogadro's no.}}$$

$$\text{Hence, mass of 1 sodium atom} = \frac{23}{6.022 \times 10^{23}}$$

Mass of 1 oxygen atom = $3.81 \times 10^{23}$g

**Q.20. Which has more number of atoms:**

**100 grams of Magnesium or 100 grams of Aluminium**

**(Given: At mass of Mg=24 u, AL = 27 u)**

**Answer:**

100 grams of magnesium:

1 mole of Mg atom = $6.022 \times 10^{23}$ atoms

This means 24g of Mg has $6.022 \times 10^{23}$ atoms

Then 100 g contains:

$$\text{Number of Mg atoms} = \frac{\text{Given mass}}{\text{Molar mass}} \times 6.022 \times 10^{23}$$

$$\text{Number of Mg atoms} = \frac{100\text{g}}{24\text{u}} \times 6.022 \times 10^{23}$$

Number of Mg atoms = $2.5 \times 10^{24}$ atoms

100 grams of aluminium:

1 mole of Al atom = $6.022 \times 10^{23}$ atoms

This means 27g of Al has $6.022 \times 10^{23}$ atoms

Then 100 g contains:

$$\text{Number of Al atoms} = \frac{\text{Given mass}}{\text{Molar mass}} \times 6.022 \times 10^{23}$$

$$\text{Number of Al atoms} = \frac{100\text{g}}{27\text{u}} \times 6.022 \times 10^{23}$$

Number of Al atoms = $2.2 \times 10^{24}$ atoms

Thus, 100g of magnesium has more atoms.

**Q.21. Calculate the number of molecules of sulphur ($S_8$) present in 64 g of solid sulphur. (Given: At. Mass of S=32 u)**

**Answer:** Given: At. Mass of S = 32 u

Atomic mass of $S_8$ = 8 × 32u = 256u

1 mole of Al atom = $6.022 \times 10^{23}$ atoms

This means 265g of $S_8$ has $6.022 \times 10^{23}$ molecules

Then 64g g contains:

$$\text{Number of } S_8 \text{ molecules} = \frac{\text{Given mass}}{\text{Molar mass}} \times 6.022 \times 10^{23}$$

$$\text{Number of } S_8 \text{ molecules} = \frac{64\text{g}}{256\text{u}} \times 6.022 \times 10^{23}$$

⇒ Number of $S_8$ molecules = $1.5 \times 10^{23}$ molecules

Thus, the number of molecules of sulphur ($S_8$) is $1.5 \times 10^{23}$ molecules.

**Q.22. Calculate the number of aluminium ions present in 0.051 g of aluminium oxide. (Given: At. Mass of AL = 27 u)**

**Answer:** Given: At. Mass of AL = 27 u

Molar mass of aluminium oxide ($Al_2O_3$) = 2 × 27 + 3 × 16 = 54 + 48 = 102g

This means 102g of $Al_2O_3$ has $2 \times 6.022 \times 10^{23}$ molecules

Then 0.051g contains:

$$\text{Number of } Al^{3+} \text{ions} = \frac{\text{Given mass}}{\text{Molar mass}} \times 2 \times 6.022 \times 10^{23}$$

$$\text{Number of } Al^{3+} \text{ions} = \frac{0.051\text{g}}{102\text{g}} \times 6.022 \times 10^{23}$$

⇒ Number of $Al^{3+}$ ions = $6.022 \times 10^{20}$

Thus, 0.051 g of aluminium oxide contains $6.022 \times 10^{20}$ aluminium ions.

**Q.23 A. Calculate the number of moles present in:**

**(i) 92 grams of sodium**

**(ii) 108 grams of aluminium.**

**Answer:**

**(i) 92 grams of sodium:**

Given: Mass of sodium = 92g

Molar mass = 23g/mol

To calculate the number of moles, we apply the formula:

$$\text{Number of moles} = \frac{\text{Mass of sodium}}{\text{Molar mass of sodium}}$$

⇒ Number of moles = 4 mol

Thus, the number of moles in 92 grams of sodium is 4 mol.

**(ii) 108 grams of aluminium:**

Given: Mass of aluminium = 108g

Molar mass = 27g/mol

To calculate the number of moles, we apply the formula:

$$\text{Number of moles} = \frac{\text{Mass of aluminium}}{\text{Molar mass of aluminium}}$$

$$\text{Number of moles} = \frac{108\text{g}}{27\text{g/mol}}$$

⇒ Number of moles = 4 mol

Thus, the number of moles in 108 grams of aluminium is 4 mol.

**Q.23 B. Calculate number of atoms present in:**

**(i) 0.1 mole of sulphur.**

**(ii) 2 moles of phosphors.**

**Answer:**

**(i) 1 mole = $6.022 \times 10^{23}$**

0.1 mole = $0.1 \times 6.022 \times 10^{23} = 6.022 \times 10^{22}$ molecules

1 mole of sulphur ($S_8$) contains = 8 atoms

Hence, no of atoms present = 8 × no. of molecules

⇒ Number of atoms present = $8 \times 6.022 \times 10^{22}$ molecules

⇒ Number of atoms present = $4.8 \times 10^{23}$ atoms

Thus, number of atoms present in 0.1 mole of sulphur is $4.8 \times 10^{23}$ atoms.

**(ii) 1 mole = $6.022 \times 10^{23}$**

2 mole = $2 \times 6.022 \times 10^{23}$ molecules

1 mole of phosphorus ($P_4$) contains = 4 atoms

Hence, no of atoms present = 4 × no. of molecules

⇒ Number of atoms present = $4 \times 2 \times 6.022 \times 10^{23}$ molecules

⇒ Number of atoms present = $4.8 \times 10^{24}$ atoms

Thus, number of atoms present in 2 mole of phosphorus is $4.8 \times 10^{24}$ atoms.

## Comprehensive Exercises (MCQ)

**Q.1. Mass of one atom of oxygen is:**

A. $\frac{16}{6.023 \times 10^{23}} g$

B. $\frac{32}{6.023 \times 10^{23}} g$

C. $\frac{1}{6.023 \times 10^{23}} g$

D. 8 u

**Answer:**

To calculate the mass of 1 atom of oxygen:

Atomic mass of oxygen = 16

1 mole of atom = $6.022 \times 10^{23}$ (Avogadro's no.)

$$\text{Hence, mass of one oxygen atom} = \frac{\text{Atomic mass of a mole of atom}}{\text{Avogadro's no.}}$$

$$\text{Hence, mass of 1 oxygen atom} = \frac{16}{6.022 \times 10^{23}}$$

Mass of 1 oxygen atom = $2.65 \times 10^{23}$g

**Q.2. 3.42 of sucrose is dissolved in 18 g of water in a beaker. The number of oxygen atoms in the solution are:**

**A.** 6.68 x $10^{23}$

**B.** 6.09 x $10^{22}$

**C.** 6.022 x $10^{23}$

**D.** 6.022 x $10^{21}$

**Answer:**

Molar mass of sucrose = $C_{12}H_{22}O_{11}$

= 12× 12 + 1× 22 + 16 × 11 = 342g/mol

$$\text{Number of moles} = \frac{\text{Mass of glucose}}{\text{Molar mass of sucrose}}$$

$$\text{Number of moles} = \frac{3.42\text{g}}{342\text{g/mol}}$$

⇒ Number of moles = 0.01

Sucrose (C12H22O11) contains 11 oxygen atoms

⇒ $11 \times 6.022 \times 10^{23}$

For 0.01 moles of sucrose

⇒ $0.01 \times 11 \times 6.022 \times 10^{23} = 6.6 \times 10^{22}$

Now, Molar mass of water = $H_2O = 2 \times 1 + 16 = 18$g/mol

⇒ Number of moles = 1

Sucrose ($H_2O$) contains 1 oxygen atom = $6.022 \times 10^{23}$

For 1 mole of water = $6.022 \times 10^{23}$

Now, add the both values: $6.6 \times 10^{22} + 6.022 \times 10^{23}$

We get $6.68 \times 10^{23}$ atoms. Hence, the option (a) is correct.

**Q.3. A change in the physical state can be brought about:**

**A.** Only when energy is given to the system

**B.** Only when energy is taken out from the system

**C.** When energy is either given to, or taken out from the system

**D.** without any energy change

**Answer:** A change in the physical state can be brought about only when energy is either given to, or taken out from the system. When the energy is given, it is called endothermic reaction and when energy is released from the system, it is called exothermic reaction.

**Q.4. In a compound such as water, the ratio of the mass of hydrogen to the mass of oxygen is always:**

**A.** 1:8

**B.** 2:8

**C.** 1:16

**D.** 3:16

**Answer:** In water, hydrogen and oxygen are always present in the ratio of 1:8 by mass, whatever the method or source from which water is obtained.

**Q.5. Which of the following postulates of Dalton's atomic theory is challenged by the next generation scientists?**

**A.** All matter is made of very tiny particles called atoms.

**B.** Atoms are indivisible particles, which cannot be created or destroyed in a chemical reaction.

**C.** Atoms of a given element are identical in mass and chemical properties.

**D.** Atoms of a given element are identical in mass and chemical properties.

**Answer:** The postulate of Dalton's atomic theory that "Atoms of a given element are identical in mass and chemical properties" was challenged by the next generation scientists. They have to prove this theory correct at any cost.

**Q.6. Which of the following represents 14 u?**

**A.** Mass of 1 hydrogen atom

**B.** Mass of C-12 atom

**C.** Mass of 0-16 atom

**D.** $1/12^{th}$ of mass of C-12 atom

**Answer:** 1/12th of mass of C-12 atom represents 14u. One atomic mass unit is a mass unit equal to one atom of carbon-12.

**Q.7. The symbols of calcium, carbon and copper are:**

**A.** Ca, C, Co

**B.** Ca, C, Cu

**C.** Ca, C, Cr

**D.** Ca, Cr, Cu

**Answer:**

The symbol of calcium is Ca.

The symbol of carbon is C.

The symbol of copper is Cu.

**Q.8. The unit accepted for taking mass of atom and molecule is:**

**A.** gram

**B.** milligram

**C.** molecular mass unit

**D.** atomic mass unit

**Answer:** The unit accepted for taking mass of atom and molecule is milligram.

**Q.9. Which of the following would weigh the highest?**

**A.** 0.2 mole of sucrose ($C_{12}H_{22}O_{11}$)

**B.** 2 moles of $CO_2$

**C.** 2 moles of $CaCO_3$

**D.** 10 moles of $H_2O$

**Answer:**

**A. 0.2 mole of sucrose ($C_{12}H_{22}O_{11}$):**

Given: Number of moles = 0.2

Molar mass of $C_{12}H_{22}O_{11}$ = 342 g/mol

To find out the mass of sucrose, apply the formula given:

$$\text{Number of moles} = \frac{\text{Mass}}{\text{Molar mass}}$$

$$\Rightarrow 0.2 = \frac{\text{mass}}{342\ \text{g/mol}}$$

⇒ Mass = 0.2 mol × 342g/mol

⇒ Mass = 68.4g

Thus, the mass of sucrose is 68.4 g.

**B. 2 moles of $CO_2$:**

Given: Number of moles = 2

Molar mass of $CO_2$ = 44 g/mol

To find out the mass of sucrose, apply the formula given:

⇒ Mass = 2 mol × 44g/mol

⇒ Mass = 88g

Thus, the mass of $CO_2$ is 88 g.

**C. 2 moles of $CaCO_3$:**

Given: Number of moles = 2

Molar mass of $CaCO_3$ = 40 + 12 + 3× 16 = 100 g/mol

To find out the mass of sucrose, apply the formula given:

$$\text{Number of moles} = \frac{\text{Mass}}{\text{Molar mass}}$$

$$\Rightarrow 2 = \frac{\text{mass}}{100\ \text{g/mol}}$$

⇒ Mass = 2 mol × 100g/mol

⇒ Mass = 200g

Thus, the mass of $CaCO_3$ is 200 g.

**D. 10 moles of H2O:**

Given: Number of moles = 10

Molar mass of $H_2O$ = 18 g/mol

To find out the mass of sucrose, apply the formula given:

$$\text{Number of moles} = \frac{\text{Mass}}{\text{Molar mass}}$$

$$\Rightarrow 10 = \frac{\text{mass}}{18\ \text{g/mol}}$$

⇒ Mass = 10 mol × 18g/mol

⇒ Mass = 180g

Thus, the mass of $H_2O$ is 180 g.

**Hence, the option C is correct which has higher mass.**

**Q.10. Which of the following has maximum numbers of atoms?**

**A.** 18 g of $H_2O$

**B.** 18 g of $O_2$

**C.** 18 g of $CO_2$

**D.** 18 g of $CH_4$

**Answer:** When the mass is same, the number of atoms is inversely proportional to the molecular mass. This means less will be the molecular mass, more will be the number of atoms.

$H_2O$ = 2× 1 + 16 = 18u

$O_2$ = 2× 16 = 32u

$CO_2 = 12 \times 2 \times 16 = 44u$

$CH_4 = 12 + 4 \times 1 = 16u$

Hence, 18 g of $CH_4$ has maximum numbers of atoms.

**Q.11. Which of the following contains maximum number of molecules?**

**A.** 1 g $Co_2$

**B.** 1 g $N_2$

**C.** 1 g $H_2$

**D.** 1 g $CH_4$

**Answer:** When the mass is the same, the number of molecules is inversely proportional to the molecular mass. This means less will be the molecular mass, more will be the number of molecules.

$CO_2 = 12 \times 2 \times 16 = 44u$

$N_2 = 2 \times 14 = 28u$

$H_2 = 2 \times 1 = 2u$

$CH_4 = 12 + 4 \times 1 = 16u$

Hence, 1 g $H_2$ has maximum numbers of molecules.

**Q.12. The molecule having an atomicity of 4 is:**

**A.** Sulphur molecule

**B.** Ozone molecule

**C.** Phosphorus molecule

**D.** Methane molecule

**Answer:**

**Atomicity:** The number of atoms constituting a molecule is known as its atomicity.

**Sulphur molecule ($S_8$):** Atomicity is 8

**Ozone molecule ($O_3$):** Atomicity is 3

**Phosphorus molecule ($P_4$):** Atomicity is 4

**Methane molecule ($CH_4$):** Atomicity is 5

**Thus, option C is correct.**

**Q.13. The molecular formula of aluminium sulphate is:**

**A.** $Al_2(SO_4)_3$

**B.** $ALSO_4$

**C.** $AL_3(SO_4)_2$

**D.** $AL_2(SO_4)_4$

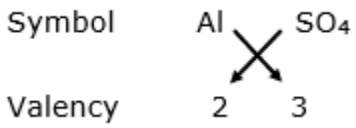
**Answer:**

Aluminium sulphate

Valency of aluminium = 3

Valency of sulphate = 2

By applying crisscross method:




Formula: $Al_2(SO_4)_3$

**Thus, option A is correct.**

**Q.14. The chemical symbol for nitrogen gas is:**

**A.** Ni

**B.** $N_2$

**C.** $N^+$

**D.** N

**Answer:** The chemical symbol of nitrogen gas is $N_2$.

**Q.15. The chemical symbol for sodium is:**

**A.** So

**B.** Sd

**C.** NA

**D.** Na

**Answer:** The chemical symbol of sodium is Na. The symbol of sodium was taken from its Latin name “natrium”.

**Q.16. Which of the following correctly represents 360 g of water?**

**i. 2 moles of $H_2O$**

**ii. 20 moles of water**

**iii. 6.022 x $10^{23}$ molecules of water**

**iv. 1.2044 x $10^{25}$ molecules of water**

**A.** i

**B.** I and iv

**C.** ii and iii

**D.** ii and iv

**Answer:**

20 moles of water:

Given: Number of moles = 20

Atomic mass of $H_2O$ = 2 × 1 + 16 = 18g/mol

To find out the mass of water, apply the formula given:

$$\text{Number of moles} = \frac{\text{Mass}}{\text{Molar mass}}$$

$$\Rightarrow 20 = \frac{\text{mass}}{18\ \text{g/mol}}$$

⇒ Mass = 20 mol × 18g/mol

⇒ Mass = 360 g

1.2044 x $10^{25}$ molecules of water:

1 mole = 6.022 × $10^{23}$

$$1.2044 \times 10^{25}\text{molecules} = \frac{1.2044 \times 10^{23}}{6.022 \times 10^{23}}$$

⇒ 20 moles

Mass of 20 moles of water is 360g.

Thus, option D is correct.

**Q.17. Which of the following statements is true about an atom?**

**A.** Atoms are not able to exist independently

**B.** Atoms are the basic units from which molecules

**C.** Atoms are always neutral in nature

**D.** Atoms aggregate in Large numbers to form the matter that can see, feel or touch.

**Answer:** Atoms are not able to exist independently. They may or may not exist independently. Among all the given options, option A is correct.

**Q.18. One mole of $H_2O$ means:**

**i. 18 g of $H_2O$**

**ii. 6.022 x $10_{23}$ molecules of $H_2O$**

**iii. 180 g of $H_2O$**

**iv. 1.8 of $H_2O$**

**A.** Both i and ii are correct

**B.** Both ii and iii are correct

**C.** Only i is correct

**D.** Both iii and iv are correct

**Answer:**

18 g of $H_2O$:

$$\text{Number of moles} = \frac{\text{Mass}}{\text{Molar mass}}$$

$$\text{Number of moles} = \frac{18\text{g}}{18\ \text{g/mol}}$$

⇒ Number of moles = 1

6.022 x $10^{23}$ molecules of $H_2O$:

We know that 1 mole contains 6.022 x $10^{23}$ molecules.

Thus, option A is correct.

**Q.19. A molecule can be defined as the:**

**A.** A group of two or more atoms that are chemically bonded together.

**B.** A smallest particle of an element or a compound that is capable of an independent existence and shows all the properties of that substance.

**C.** Substance which is formed by the combination of atoms of the same element or of different elements.

**D.** All of these are correct.

**Answer:**

A molecule is:

⇒ A group of two or more atoms that are chemically bonded together.

⇒ A smallest particle of an element or a compound that is capable of an independent existence and shows all the properties of that substance.

⇒ Substance which is formed by the combination of atoms of the same element or of different elements.

Thus, option D is correct.

**Q.20. Which of the following will have maximum mass?**

**A.** 1022 molecules of $H_2O$

**B.** 1022 molecules of $NH_3$

**C.** 2 moles of $NH_3$

**D.** 2 moles of $H_2O$

**Answer:** 2 moles of $H_2O$ has less number of moles as well as less molecular mass among all the given options. Hence, it has maximum mass.

Thus, option D is correct.

## Comprehensive Exercises (T/F)

**Q.1. Write true or false for the following statements:**

**Oxygen molecule exists in the form of three molecules as O2, O3 and O4.**

**Answer:** False

Oxygen molecule do no exists in the form of $O_4$. It exists in two forms which are $O_2$ (oxygen gas) and $O_3$ (ozone).

Hence, the given statement is false.

**Q.2. Write true or false for the following statements:**

**Sodium shows valency of $Na^+$ and $Na^{2+}$.**

**Answer:** False

Na shows valency of $Na^+$ because it has only one electron in the outermost shell. It cannot show the valency of $Na^{2+}$

Hence, the given statement is false.

**Q.3. Write true or false for the following statements:**

**Iron shows valency of $Fe^{2+}$ and $Fe^{3+}$.**

**Answer:** True

Iron shows variable valency. It shows valency of $Fe^{2+}$ and $Fe^{3+}$ simultaneously.

**For example:** In ferrous oxide: $Fe^{2+}$ and in ferric oxide: $Fe^{3+}$

Hence, the given statement is true.

**Q.4. Write true or false for the following statements:**

**The formulae of cupric oxide and cuprous oxide are CuO and $Cu_2O$ respectively.**

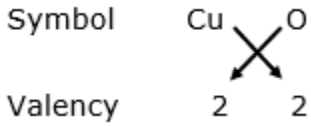
**Answer:** True

Formula for cupric oxide:

Valency of cupric = 2

Valency of oxide = 2

By applying crisscross method:



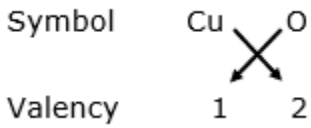

Formula: CuO

Formula for cuprous oxide:

Valency of cuprous = 1

Valency of oxide = 2

By applying crisscross method:




Formula: $Cu_2O$

Hence, the given statement is correct.

**Q.5. Write true or false for the following statements:**

**The elements having one valency are called monovalent.**

**Answer:** True

The elements having one valency are called monovalent. The given statement is correct.

**Q.6. Write true or false for the following statements:**

**A group of atoms carrying a charge are called bivalent ions.**

**Answer:** False

A group of atoms carrying a charge is called polyatomic ion. These are a group of atoms carrying either a negative or positive charge. For example: $SO_3^{2-}$, $OH^-$ etc.

Hence, the given statement is wrong.

**Q.7. Write true or false for the following statements:**

**Atomicity of phosphorus is 5 and that of sulphur is 6.**

**Answer:** False

Atomicity of phosphorus ($P_4$) is 4 and atomicity of sulphur ($S_8$) is 8. Hence, the given statement is wrong.

**Q.8. Write true or false for the following statements:**

**A mole always represents $6.023 \times 10^{22}$ atoms or molecules or ions of a substance.**

**Answer:** False

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

Hence, the given statement is wrong.

**Q.9. Write true or false for the following statements:**

**A mole always represents for gases, 22.4 litres of volume at 0°C and 1 atmospheric pressure which is known as standard temperature and pressure (STP).**

**Answer:** True

A mole always represents for gases, 22.4 litres of volume at 0°C and 1 atmospheric pressure which is known as standard temperature and pressure (STP).

The given statement is correct.

**Q.10. Write true or false for the following statements:**

**Mass of two moles of atoms or molecules is called molar mass.**

**Answer:** False

Molar mass is the mass of one mole of substance. The given statement is wrong.