Chemical Formula in Chemistry Questions with Solutions

Q1. The simplest formula of a substance shows-

a) The actual number of atoms of each element in one molecule of a substance.
b) The elements that make up one molecule of the substance and the simplest whole-number ratio between the atoms.
c) The number of molecules in a sample of the substance.
d) The molecular mass of the substance.

Correct Answer. (b) The elements that make up one molecule of the substance and the simplest whole-number ratio between the atoms.

Q2. A substance of phosphorus (P) and oxygen (O) is found to have a mole ratio of 0.4 moles of P for every mole of O. The simplest formula for this substance is:

a) PO_2
b) $P_{0.4}O$
c) P_5O_2
d) P_2O_5

Correct Answer. (d) P_2O_5

Q3. How many grams of oxygen are in one mole of calcium carbonate, $CaCO_3$?
The atomic mass of O = 16 amu.

a) 3 grams
b) 16 grams
c) 32 grams
d) 48 grams

Correct Answer. (d) 48 grams

Q4. Copper sulphate crystals are actually pentahydrate crystals of copper sulphate. Copper sulphate pentahydrate has the following molecular formula:

a) $CuSO_4.5H_2O$
b) $CuSO_4 + H_2O$
c) $CuSO_4$
d) $CuSO_4 + 5H_2O$

Correct Answer. (a)

Q5. A compound with molecular formula $Fe_2(SO_4)_3$ would be called:

a) ferrous sulfate
b) iron(II) sulfate
c) iron(III) sulfite
d) iron(III) sulfate

Correct Answer. iron(III) sulfate

Q6. What will the formula weight of the compound $Al_2(SO_4)_3.18H_2O$?

Answer. The formula weight of the compound $Al_2(SO_4)_3.18H_2O$ can be calculated as-
$2 \times 27 + [32 + (16 \times 4)] \times 3 + 18 \times 18 = 54 + 288 + 324 = 666$
Therefore, the weight of the compound is 666 g.

Q7. State True or False.
The chemical formula is the same as a chemical structure or molecular formula.

Answer. False.
The formula unit mass is the same as the molecular mass, which is equal to the sum of the masses of the atoms in the formula unit.

Q8. What is the chemical formula of Hyposulfurous acid?

Answer. The chemical formula of Hyposulfurous acid is H_2SO_2.

Q9. What is meant by the term chemical formula?

Answer. A compound's chemical formula is a symbolic representation of its composition and the actual number of atoms in one molecule of a pure substance, which could be an atom or a compound.

Q10. Write down the formula of-
(i) Sodium oxide
(ii) Aluminium chloride
(iii) Sodium sulphide
(iv) Magnesium hydroxide

Answer.
(i) Sodium oxide - Na_2O
(ii) Aluminium chloride - $AlCl_3$
(iii) Sodium sulphide - Na_2S
(iv) Magnesium hydroxide - $Mg(OH)_2$

Q11. State two examples in each case and write their chemical formulae:

a) Molecules having one kind of atoms only.
b) Molecules having two different kinds of atoms.
c) Molecules having three different kinds of atoms.

Answer.

a) Molecules having one kind of atoms only are Oxygen (O_2) and Hydrogen (H_2).
b) Molecules having two different kinds of atoms are Methane (CH_4) and Ethane (C_2H_6).
c) Molecules having three different kinds of atoms are Sodium Carbonate (Na_2CO_3) and Glucose ($C_6H_{12}O_6$).

Q12. Define formula unit mass. Calculate the formula unit mass of NaCl.

Answer. The formula unit mass is the same as the molecular mass, which is equal to the sum of the masses of the atoms in the formula unit.
Formula unit mass of NaCl = (23 + 35.5) = 58.5 u.

Q13. Give the chemical formula for the following compounds and compute the ratio by mass of the combining elements in each one of them.

a) Ammonia
b) Carbon Monoxide
c) Hydrogen chloride
d) Aluminium fluoride
e) Magnesium sulphide

Answer.
The chemical formula

a) Ammonia - NH_3, Ratio by mass - N : H =14 : 3.
b) Carbon Monoxide - CO, Ratio by mass - C : O = 12 : 16 = 3 : 4.
c) Hydrogen chloride - HCl, Ratio by mass - H : Cl = 1 : 35.5
d) Aluminium fluoride - AlF_3, Ratio by mass - Al : F = 27 : (19 × 3) = 27 : 57 = 9 : 19
e) Magnesium sulphide - MgS, Ratio by mass - Mg : S = 24 : 32 = 3 : 4

Q14. An unknown compound is found to contain 40.0% carbon, 6.7% hydrogen, and 53.3% oxygen with a molecular mass of 60.0 g/mol. What is the molecular formula of the unknown compound?

Answer. In 100 g of the unknown compound, the ratio of C : H : O = 3.33 : 6.665 : 3.334
When we divide each elemental ratio by the lowest number, we get an empirical formula of CH_2O. i.e, near enough to whole numbers.

The molecular formula is always a multiple of the empirical formula- $(EF)_n$ = MF.
So 60.0 g mol^{-1} = n × (12.011 + 2 × 1.00794 + 16gmol^{-1}).
Clearly n=2, and the molecular formula is 2×(CH_2O) = $C_2H_4O_2$.
Therefore, the molecular formula of the given compound is $C_2H_4O_2$.

Q15. Find the molecular and empirical formula-
When vapour density = 83
Carbon=57.8%
Oxygen=38.6%
Hydrogen=3.6%

Answer.

Element	R.N of atoms	Simple ratio
C	57.8/12 = 4.8	4.8/2.4 = 2
O	38.6/16 = 2.41	2.4/2.4 = 1
H	3.60/1 = 3.6	3.6/2.4 = 3/2

C:O:H = 2:1:3/2 = 4:2:3
Simple ratio of whole numbers = 4:2:3
Empirical formula is $C_4O_2H_3$
Empirical formula weight = 4 × 12 + 2 × 16 + 3× 1 = 83
Vapour Density = 83
Molecular formula weight = 2 × V.D = 2 × 83 = 166
n= Molecular formula weight / Empirical formula weight = 166/83 = 2
∴ Molecular formula = n × EF
Molecular Formula = 2 × [$C_2H_4O_2$] = $C_8H_6O_4$

Practise Questions on Chemical Formula

Q1. An oxide of lead contains 90.65% Pb, by weight. The empirical formula is:

a) Pb
b) PbO
c) Pb_3O_4
d) Pb_2O_3

Correct Answer. (c) Pb_3O_4

Q2. A molecular formula does not tell about:

a) mass of molecule
b) atomicity of molecule
c) stability of molecule
d) charge on cations and anions

Correct Answer. (c) stability of molecule

Q3. What is the difference between formula mass and molecular mass?

Answer. A molecule's formula mass (formula weight) is the sum of the atomic weights of the atoms in its empirical formula.
A molecule's molecular mass (molecular weight) is its average mass, which is calculated by adding the atomic weights of the atoms in the molecular formula.

Q4. What are the 3 types of chemical formula?

Answer. Chemical formulas are classified into three types: empirical, molecular, and structural. Empirical formulas depict the simplest whole-number ratio of atoms in a compound, whereas molecular formulas depict the number of each type of atom in a molecule and structural formulas depict how the atoms in a molecule are bonded to each other.

Q5. How do you write chemical formulas?

Answer. The chemical formulae for all of the elements that comprise each molecule, with a small number to the bottom right of an element's symbol representing the number of atoms of that element. Water, for example, has the chemical formula H_2O.