

Chemical Compound Formulas Chemistry Questions with Solutions

Q1: The formula of a metal chloride is MCl_2 . What will be the formula of its nitrate?

- a) MNO_3
- b) $M(NO_3)_2$
- c) $M(NO_3)_3$
- d) M_2NO_3

Answer: b) $M(NO_3)_2$

Explanation: The valency of chloride ions is -1. The chemical formula MCl_2 shows that the valency of the metal is +2. The valency of the nitrate ion (NO_3^-) is -1.

The correct formula for its nitrate can be obtained by the criss-cross method. Each ion's numerical valency value can be crossed over to form the subscript of another ion.

The metal nitrate has the formula $M(NO_3)_2$.

Q2: A divalent metal M forms a salt of its sulphate in a hydrated form. A 0.10 mol of metal sulphate requires 9 g of water to form the hydrated salt. What is the correct formula for the hydrated salt?

- a) $MSO_4 \cdot H_2O$
- b) $M(SO_4)_2 \cdot 3H_2O$
- c) $MSO_4 \cdot 5H_2O$
- d) $M_2SO_4 \cdot H_2O$

Answer: c) $MSO_4 \cdot 5H_2O$

Explanation: Let the formula of the hydrated salt is $MSO_4 \cdot xH_2O$, where x is the moles of H_2O .

We know that, 18g of H_2O = 1 mole

So, 9g of H_2O = 0.5 moles

According to the given data, a 0.10 mol of metal sulphate combines with 9g of H_2O (0.5 moles).

This shows 1 mol of metal sulphate will combine with 5 moles of H_2O .

The correct formula for the salt is $MSO_4 \cdot 5H_2O$.

Q3. Write the general rules for writing chemical formulas.

Answer:

The rules that you have to follow while writing a chemical formula are as follows:

- The valencies or charges on the ion must balance.
- When a compound contains a metal and a nonmetal, the metal's name or symbol comes first. Magnesium oxide (MgO), sodium chloride (NaCl), iron sulfide (FeS), zinc oxide (ZnO), and so on, where oxygen, chlorine, and sulfur are nonmetals and are written on the right, whereas magnesium, sodium, iron, and zinc are metals and are written on the left.
- The number of ions present in a compound created using polyatomic ions is expressed by enclosing the formula of an ion in a bracket and writing the number of ions outside the bracket. $\text{Ca}(\text{OH})_2$ is an example. The bracket is not required if the number of polyatomic ions is one. For instance, KOH.

Q4. Give the compound names represented by the following formulas.

1. NaNO_3
2. Al_2O_3
3. HCl
4. $\text{Mg}(\text{OH})_2$
5. CaCO_3

Answer:

The positive atom or ion appears first in a formula, followed by the name of the negative ion.

1. Sodium nitrate
2. Aluminium oxide
3. Hydrogen chloride
4. Magnesium hydroxide
5. Calcium carbonate

Q5. How many atoms are present in the following compounds or ions?

1. NaHCO_3
2. SO_3^{2-}

Answer:

1. In NaHCO_3 , six atoms are present in total. Amongst the six, one is sodium and one is hydrogen, one is carbon and three are oxygen atoms.
2. In SO_3^{2-} , four atoms are present in total. Amongst the four, one is sulphur and three are oxygen atoms.

Q6. A metal M forms a volatile chloride with a vapour density of 94.8. What will be the formula of the metal chloride if it contains 74.75% of chlorine?

- a) MCl_2
- b) MCl
- c) MCl_4
- d) M_2Cl

Answer: c) MCl_4

Explanation : Let the formula be MCl_x , where x is the number of chlorine atoms.

$$\begin{aligned}\text{Molecular weight of the volatile compound} &= 2 \times \text{Vapour density} \\ &= 2 \times 94.8 \\ &= 189.6 \text{ u}\end{aligned}$$

$$\begin{aligned}\text{Mass of chlorine(in compound)} &= \text{Gram weight of the compound} \times \% \text{ chlorine in the compound} \\ &= 189.6 \times (74.75/100) \\ &= 141.7 \text{ g}\end{aligned}$$

$$\text{Weight of one chlorine atom} = 35.5 \text{ g}$$

$$\begin{aligned}\text{Number of Chlorine atoms, } x &= \text{Mass of chlorine/ Weight of one chlorine atom} \\ &= (141.7 \text{ g}) / (35.5 \text{ g}) \\ &= 4\end{aligned}$$

The correct formula for the metal chloride is MCl_4 .

Q7: Calculate the formula unit mass of CaCO_3 .

Answer:

$$\begin{aligned}\text{Formula unit mass} &= \text{Atomic mass of Ca} + \text{Atomic mass of C} + (3 \times \text{Atomic mass of oxygen}) \\ &= 40 + 12 + (3 \times 16) \\ &= 100 \text{ u.}\end{aligned}$$

Q8 : A metal M forms two chlorides of the form MCl_2 and MCl_4 respectively. To which group can the metal be placed?

Answer:

The chemical formula MCl_2 and MCl_4 reveal the oxidation state of metal as +2 and +4 respectively. These oxidation states are common for Group 14 (Carbon family) of the periodic table. The general valence-shell electronic configuration of Group 14 elements is ns^2np^2 . They can lose all the four valence electrons to give +4 or two p-electrons to give +2 oxidation states.

Thus, the metal belongs to Group 14 of the modern periodic table.

Q9: The chloride of the element X has the molecular formula XCl . Which of the following will be present in the same group as X?

- a) Mg
- b) Al
- c) Zn
- d) Na

Answer: d) Na

Explanation: The chloride ion exists as Cl^- showing a charge of -1 . A chemical formula of a compound is overall neutral. This causes metal to exhibit $+1$ oxidation state. Such oxidation state(charge) is shown by Alkali metals. The only alkali metal present here is Na(Sodium).

Q10: Match the chemical names in column 1 with their respective chemical formulas in column 2.

Column 1	Column 2
a) Ammonium Hydroxide	i) SiO_2
b) Zinc sulfate	ii) $\text{Zn}(\text{CH}_3\text{COO})_2$
c) Silicon dioxide	iii) $\text{K}_2\text{Cr}_2\text{O}_7$
d) Potassium Dichromate	iv) NH_4OH
e) Zinc acetate	v) ZnSO_4

Answer: a-iv), b-v), c-i), d-iii),e-ii)

Q-11: How many grams of oxygen are present in one mole of magnesium carbonate MgCO_3 ?
(Atomic mass of O = 16 u)

Answer:

1 mole of MgCO_3 contains 3 atoms of oxygen.

1 atom of oxygen has a mass = 16g.

Thus, 3 atoms will have mass = 3×16
= 48 g

Q-12: What is the chemical formula of pyrosulfuric acid?

Answer: Pyrosulfuric acid is also known as disulfuric acid or oleum. Its chemical formula is $\text{H}_2\text{S}_2\text{O}_7$.

Q-13: A compound with molecular formula $\text{Cr}_2(\text{SO}_4)_3$ would be called:

- a) Chromium sulfite
- b) Chromium(II) sulphate
- c) Chromium(III) sulfite
- d) Chromium(III) sulphate

Answer: d) Chromium(III) sulphate

Explanation: The positive radical is chromium ion(Cr^{3+}) and the negative radical is sulphate ion (SO_4^{2-}). While writing the chemical name, the positive radical name is followed by negative radical eliminating ion in the final chemical name.

The correct name will be Chromium(III) sulphate.

Q-14: A hydrocarbon contains 75% of carbon. Then its molecular formula is
(Given: Atomic mass of C=12 u , Atomic mass of H= 1u)

Answer:

Let the mass of hydrocarbon be 100g

Mass of Carbon = 75g

Mass of Hydrogen = $100 - 75 = 25\text{g}$

Calculate moles for each element:

Mole is the ratio of an element mass to its molar mass.

Moles of Carbon = $75/12 = 6.25\text{g}$

Moles of Hydrogen = $25/1 = 25\text{g}$

Divide the moles with the simplest number(6.25) to get the simple mole ratio of elements.

Simple mole ratio of C:H = 1:4

Hence the molecular formula will be CH_4 .

Q-15: List the three main types of chemical formulas.

Answer:

The three types of chemical formulas are:

1. Empirical Formula
2. Structural Formula

3. Molecular Formula

Practise Questions on Chemical Compound Formulas

Q1. What do you understand by the term chemical formula?

Answer: A chemical formula is the way of representing the chemical name of the compound using chemical symbols, numbers, parenthesis, plus and minus symbols. It basically tells the proportion of each atom in a particular molecule or compound.

Q2. Write down the formulae of the following

- a) Copper nitrate
- b) Calcium chloride
- c) Sodium sulfide
- d) Magnesium hydroxide

Answer:

- a) $\text{Cu}(\text{NO}_3)_2$
- b) CaCl_2
- c) Na_2S
- d) $\text{Mg}(\text{OH})_2$

Q3. If the formula of the metal sulphite is MSO_3 , give the formulae of its

- a) Hydrogen phosphate
- b) Nitrate

Answer:

The chemical formula MSO_3 , contains metal in +2 oxidation state. While writing the formula, always keep in mind the compound is overall neutral, that is, the sum of charges on each ion is equal to zero.

- a) The radical hydrogen phosphate is HPO_4^{2-} . The formula of its hydrogen phosphate is MHPO_4
- b) The radical nitrate is NO_3^- . The formula of its nitrate is $\text{M}(\text{NO}_3)_2$.

Q4. Give the name of the elements present in the following compounds.

- a) Baking soda
- b) Slaked lime
- c) Milk of Magnesia

Answer:

- a) The chemical formula of baking soda is NaHCO_3 . The element names are: Sodium, Hydrogen, carbon and oxygen.
- b) The chemical formula of slaked lime is Ca(OH)_2 . The element names are: Calcium, Hydrogen and oxygen.
- c) The chemical formula of milk of magnesia is Mg(OH)_2 . The element names are: Magnesium, Hydrogen and oxygen.

Q5. Calculate the formula unit mass of sulphuric acid.

Answer: The formula unit mass is equal to the sum of the masses of the atoms in the formula unit.

The chemical formula of sulphuric acid is H_2SO_4 .

The formula unit mass = $2(1) + 32 + 4(16)$
= 98 u

