3. Atoms and Moleculers

Very Short Answer Type Questions-Pg-128

1. Question

Write the full form of IUPAC.

Answer

IUPAC stands for International Union of Pure and Applied Chemistry. It is a scientific organization which develops nomenclature for chemical compounds.

2. Question

Name the scientist who gave:

(a) law of conservation of mass

(b) law of constant proportions.

Answer

(a) Law of conservation of mass was given by Antoine Lavoisier in 1744. According to this law, “Matter can neither be created nor destroyed in a chemical reaction”.

(b) Law of constant proportions was given by Joseph Proust in 1799. According to this law, “a chemical compound always contains same elements in definite proportion by mass and it does not depend on the source of compound.”

3. Question

Name the law of chemical combination:

(a) which was given by Lavoisier.

(b) which was given by Proust.

Answer

(a) Law of conservation of mass was given by Antoine Lavoisier in 1744. According to this law, “Matter can neither be created nor destroyed in a chemical reaction”.

(b) Law of constant proportions was given by Joseph Proust in 1799. According to this law, “a chemical compound always contains same elements

in definite proportion by mass and it does not depend on the source of compound."

4. Question

Name the scientist who gave atomic theory of matter.

Answer

Atomic theory of matter was given by John Dalton. It was the first complete attempt to describe all the matter in the form of atoms and their properties.

5. Question

Which postulate of Dalton's atomic theory is the result of law of conservation of mass given by Lavoisier?

Answer

According to law of conservation of mass describes that, "Matter can neither be created nor destroyed in a chemical reaction". This law gives result to the postulate of Dalton's atomic theory which states that, "Atoms can neither be created and nor destroyed by physical and chemical changes."

6. Question

Which part of the Dalton's atomic theory came from the law of constant proportions given by Proust?

Answer

According to law of constant proportions describes that, "a chemical compound always contains same elements in definite proportion by mass and it does not depend on the source of compound."

This law gives result to the postulate of Dalton's atomic theory which states that, "When two elements combine to form two or more than two different compounds then the different masses of one element B which combine with fixed mass of the other element bear a simple ratio to one another."

7. Question

Which ancient Indian philosopher suggested that all matter is composed of very small particles? What name was given by him to these particles?

Answer

Maharshi Kanada was ancient Indian scientist and sage who suggested that all matter is composed of very small particles. He named the smallest particles as "Parmanu".

8. Question

Name any two laws of chemical combination.

Answer

Law of conservation of mass was given by Antoine Lavoisier in 1744. According to this law, “Matter can neither be created nor destroyed in a chemical reaction”.

Law of constant proportions was given by Joseph Proust in 1799. According to this law, “a chemical compound always contains same elements in definite proportion by mass and it does not depend on the source of compound.”

9. Question

‘If 100 grams of pure water taken from different sources is decomposed by passing electricity, 11 grams of hydrogen and 89 grams of oxygen are always obtained’. Which chemical law is illustrated by this statement?

Answer

The above statement justifies the Law of constant proportions which was given by Joseph Proust in 1799. According to this law, “a chemical compound always contains same elements in definite proportion by mass and it does not depend on the source of compound.” This suggests that whatever be the source of water, it will always contain 1:8 ratio of Hydrogen and oxygen respectively.

10. Question

‘If 100 grams of calcium carbonate (whether in the form of marble or chalk) are decomposed completely, then 56 grams of calcium oxide and 44 grams of carbon dioxide are obtained’. Which law of chemical combination is illustrated by this statement?

Answer

The above statement justifies the Law of constant proportions which was given by Joseph Proust in 1799. According to this law, “a chemical compound always contains same elements in definite proportion by mass and it does not depend on the source of compound.” This suggests that whatever be the source of water, it will always contain 1:8 ratio of Hydrogen and oxygen respectively.

11. Question

What are the building blocks of matter?

Answer

Matter is made up of indivisible particles known as Atoms. Atoms are the building blocks of matter.

12. Question

How is the size of an atom indicated?

Answer

The size of an atom is indicated by its radius which is called atomic radius (radius of an atom). Atomic radius is measured in nanometre (nm) (1 metre = 109 nanometres or 1nm = 10_9m).

13. Question

Name the unit in which the radius of an atom is usually expressed.

Answer

Atomic radius is measured in nanometre (nm) (1 metre = 109 nanometres or 1nm = 10_9m).

14. Question

Write the relation between nanometer and metre.

Answer

A nanometer is one billionth part of metre. 1 metre = 1/109 nanometres or 1nm = 10_9m).

15. Question

The radius of an oxygen atom is 0.073 nm. What does the symbol 'nm' represent?

Answer

The symbol 'nm' represents Nanometre. A nanometer is one billionth part of metre. 1 metre = 1/109 nanometres or 1nm = 10_9m).

16. Question

Why is it not possible to see an atom even with the most powerful microscope?

Answer

Atoms are the building blocks of the matter. They are very small in size. Hence Why is it not possible to see an atom even with the most powerful microscope.

17. Question

State whether the following statement is true or false:

The symbol of element cobalt is CO.

Answer

False, the symbol of element cobalt is Co.

18. Question

Define 'molecular mass' of a substance.

Answer

The molecular mass of a substance (an element or a compound) can be defined as the average relative mass of a molecule of the substance as compared with mass of an atom of carbon (C-12 isotope) taken as 12 atomic mass unit. The molecular mass of a substance can be determined by adding atomic masses of all the atoms present in the molecule of the substance.

19. Question

What is meant by saying that 'the molecular mass of oxygen is 32'?

Answer

The symbol of oxygen is O_2 which means it contains two atoms of oxygen. The molecular mass of one atom of oxygen is 16.

Hence the molecular mass of O_2 is 32.

20. Question

Fill in the following blanks with suitable words:

(a) In water, the proportion of oxygen and hydrogen is …….. by mass.

(b) In a chemical reaction, the sum of the masses of the reactants and the products remains unchanged. This is called ……. .

Answer

(a) 8:1, whatever be the source of water, it will always contain 1:8 ratio of Hydrogen and oxygen respectively.

(b) Law of conservation of mass.

Short Answer Type Questions-Pg-129

21 A. Question

Name the element used as a standard for atomic mass scale.

Answer

Carbon is the element used as a standard for atomic mass scale.

21 B. Question

Which particular atom of the above element is used for this purpose?

Answer

C-12 atom is used for this purpose.

21 C. Question

What value has been given to the mass of this reference atom?

Answer

12 atomic mass unit (amu) is the mass of this reference atom.

22. Question

Give one major drawback of Dalton's atomic theory of matter.

Answer

According to one of the main postulate of Dalton's atomic theory, atoms were being considered as indivisible. But according to the modern theory, it is now known that that atoms can be further divided into still smaller/subatomic particles called electrons, protons and neutrons.

23. Question

Dalton's atomic theory says that atoms are indivisible. Is this statement still valid? Give reasons for your answer.

Answer

According to one of the main postulate of Dalton's atomic theory, atoms were being considered as indivisible. But according to the modern theory, it is now known that that atoms can be further divided into still smaller/subatomic particles called electrons, protons and neutrons.

24. Question

Is it possible to see atoms these days? Explain your answer.

Answer

To see atoms of different elements a special type of microscope called Scanning Tunnelling microscope [STM] is used. It is an electron microscope for imaging surfaces at the atomic level. It produces 3D images of the sample.

25. Question

What is meant by the symbol of an element? Explain with examples.

Answer

Symbol may be defined as the abbreviation/Sign used for the name of an element. The symbol of an element is generally either the first letter or the first two letters or the first and the third letters of the name of the element.

For examples- Oxygen has symbol O, Aluminum has symbol Al.

26 A. Question

Give two symbols which have been derived from the “Latin names” of the elements.

Answer

(a) Aluminum- Al and Barium- Ba

26 B. Question

Give two symbols which have been derived from the “Latin names” of the elements.

Answer

Iron(ferrum)- Fe and Copper(cuprum)- Cu.

27. Question

Give the names and symbols of five familiar substances which you think are elements.

Answer

Hydrogen- H, Helium-He, Lithium- Li , Beryllium-Be, Boron-B

28. Question

Stat the chemical symbols for the following elements:

Sodium, Potassium, Iron, Copper, Mercury, Silver

Answer

Sodium- Na; Potassium- K; Iron- Fe; copper- Cu; Mercury- Hg; Silver- Ag.

29. Question

Name the elements represented by the following symbols:

Hg, Pb, Au, Ag, Sn

Answer

Hg- Mercury; Pb- Lead; Au- Gold; Ag- Silver; Sn-Tin

30. Question

What is meant by atomicity? Explain with two examples.

Answer

The number of atoms which constitutes a molecule of an element or a compound is known as atomicity of the element. For example -The atomicity of the noble gases is 1, that of hydrogen, nitrogen, oxygen etc. is 2 each and of

ozone is 3. Thus, noble gases, hydrogen and ozone are respectively monoatomic, diatomic and triatomic molecules.

31. Question

What is the atomicity of the following?

(a) Oxygen

(b) Ozone

(c) Neon

(d) Sulphur

(e) Phosphorus

(f) Sodium

Answer

(a) Oxygen -2

(b) Ozone-3

(c) Neon-1

(d) Sulphur-8

(e) Phosphorus-4

(f) Sodium-1

32. Question

What is meant by a chemical formula? Write the formulae of one element and one compound.

Answer

The chemical formula of a compound describes the composition of the molecules of the compound in terms of the symbols of elements and the number of atoms of each element present in one molecule of the compound. In the chemical formula of a compound, the elements present are denoted by their symbols and the number of atoms of each element are shown by writing their number as subscripts to the symbols of the respective elements.

Formula of a compound- Water-H20

Formula of an element-Sodium- Na.

33. Question

Write the formulae of the following compounds. Also name the elements present in them.

(a) Water

(b) Ammonia

(c) Methane

(d) Sulphur dioxide

(e) Ethanol.

Answer

(a) Water- H2O; As conveyed by the formula, elements present are hydrogen and oxygen.

(b) Ammonia-NH3; As conveyed by the formula, elements present are nitrogen and hydrogen.

(c) Methane-Ch4; As conveyed by the formula, elements present are carbon and hydrogen.

(d) Sulphur dioxide-SO2; As conveyed by the formula, elements present are sulphur and oxygen.

(e) Ethanol-C2H5OH; As conveyed by the formula, elements present are carbon, hydrogen and oxygen.

34. Question

Explain the difference between 2N and N2.

Answer

Both 2N and N2 are the forms of nitrogen. 2N denotes two separate atoms of nitrogen whereas N2 denotes one molecule of nitrogen gas.

35. Question

What do the following abbreviation stand for?

(a) O (b) 2O (c) O_2 (d) $3O_2$

Answer

(a) O - one atom of oxygen

(b) 2O - two separate atoms of oxygen

(c) O_2 - one molecule of oxygen gas

(d) $3O_2$ - three molecules of oxygen

36. Question

What do the symbols, H_2, S and O_4 mean in the formula H_2SO_4?

Answer

The above compound is Sulphuric acid (H_2SO_4). According to chemical formula of H_2SO_4, H_2 denotes two atoms of hydrogen, S denotes one atom of sulphur and O_4 denotes four atoms of oxygen.

37 A. Question

In what form does oxygen gas occur in nature?

Answer

Atoms of the majority of elements (except noble gases) are chemically very reactive and does not exist in the free state (as a single atom). Oxygen gas is diatomic and hence its molecular formula is O_2.

37 B. Question

In what form do noble gases occur in nature?

Answer

The atoms of only a few elements are chemically unreactive which are called noble gases (such as helium, neon, argon etc.). They exist in the free state (as single atom).

38. Question

What is the difference between 2H and H_2?

Answer

Both 2H and H_2 are the forms of hydrogen. 2H denotes two separate atoms of hydrogen whereas H_2 denotes one molecule of hydrogen gas.

39. Question

What do the following denote?

(i) N (ii) 2N (iii) N_2 (iv) $2N_2$

Answer

All of the above options are the forms of nitrogen.

(i) N denotes one atom of nitrogen.

(ii) 2N denotes two separate atoms of nitrogen

(iii) N_2 denotes one molecule of nitrogen gas.

(iv) $2N_2$ denotes two molecules of nitrogen gas.

40. Question

What is the significance of the formula of a substance?

Answer

With the help of molecular formula of a compound, we can calculate its percentage composition by mass. First, we calculate the molecular mass of the compound. From this we can find out mass of one mole of the compound, which is equal to its gram molecular mass.

41. Question

What is the significance of the formula H_2O?

Answer

H_2O formula implies :-1. One molecule of water consists of two atoms of hydrogen and one atom of oxygen.2. hydrogen and oxygen combine together in the ratio 1:8.

42. Question

The molecular formula of glucose is $C_6H_{12}O_6$. Calculate its molecular mass. (Atomic masses: C = 12 u; H = 1 u; O = 16 u)

Answer

Molecular formula of glucose is C6H12O6

Molecular mass of glucose = (6xC) + (12xH) + (6xO) = 72 + 12 + 96 = 180u.

43. Question

Calculate the molecular masses of the following:

(a) Hydrogen, H_2

(b) Oxygen, O_2

(c) Chlorine, Cl_2

(d) Ammonia, NH_3

(e) Carbon dioxide, CO_2

(Atomic masses: H = 1 u; O = 16 u; Cl = 35.5 u; N = 14 u; C = 12 u)

Answer

(a) Molecular mass of Hydrogen (H_2) = 2 x H = 2 x 1 u = 2 u

(b) Molecular mass of oxygen (O_2) = 2 x O = 2 x 16 u = 32 u

(c) Molecular mass of chlorine (Cl2) = 2 x Cl = 2 x 35.5 = 71 u

(d) Molecular mass of Ammonia (NH_3) = 1 x N + 3 x H = 14 + 3 = 17 u

(e) Molecular mass of carbon dioxide (CO_2) = 1 x C + 2 x O = 12 + 32 = 44 u

44. Question

Calculate the molecular masses of the following compounds:

(a) Methane, CH_4

(b) Ethane, $C_2 H_6$

(c) Ethene, $C_2 H_4$

(d) Ethyne, $C_2 H_2$

(Atomic masses: C = 12 u; H = 1 u)

Answer

(a). Molecular mass of methane (CH_4) = 12 + 4 = 16 u

(b). Molecular mass of ethane (C_2H_6) = 2 x 12 + 6 x 1 = 30 u

(c). Molecular mass of ethane (C_2H_4) = 2 x 12 + 4 x 1 = 28 u

(d). Molecular mass of ethyne (C_2H_2) = 2 x 12 + 2 x 1 = 26 u

45. Question

Calculate the molecular masses of the following compounds:

(a) Methanol, $CH_3 OH$

(b) Ethanol, $C_2 H_5 OH$

Answer

(a) Molecular mass of Methanol (CH_3OH) = 1 x C + 3xH + 1xO +1xH = (12+3+16+1)u = 32u

(b) Molecular mass of Ethanol (C_2H_5OH) = 2xC + 5xH + 1xO + 1xH = (24 + 5 + 16 + 1) = 46u

46. Question

Calculate the molecular mass of ethanoic acid, $CH_3 COOH$.

(Atomic masses: C = 12 u; H = 1 u; O = 16 u)

Answer

Molecular mass of ethanoic acid (CH_3COOH) = 1xC + 3xH + 1xC + 2xO + 1xH = 12+3+12+32+1 = 60u

47. Question

Calculate the molecular mass of nitric acid, HNO_3. (Atomic masses: H = 1 u; N = 14 u; O = 16 u)

Answer

Molecular mass of Nitric acid (HNO_3) = 1xH + 1xN + 3xO = (1 + 14 + 48) u = 63 u

48. Question

Calculate the molecular mass of chloroform ($CHCl_3$). (Atomic masses: C = 12 u; H = 1 u; Cl = 35.5 u)

Answer

Molecular mass of chloroform ($CHCl_3$) = 1 x C + 1 x H + 3 x Cl = (12 + 1 + 106.5)u = 119.5 u

49. Question

Calculate the molecular mass of hydrogen bromide (HBr). (Atomic masses: H = 1 u; Br = 80 u)

Answer

Molecular mass of hydrogen bromide (HBr) = 1 x H + 1 x Br = (1 + 80) u = 81u

50. Question

Calculate the molecular masses of the following compounds:

(a) Hydrogen sulphide, H_2S

(b) Carbon disulphide, CS_2

Answer

(a) Molecular mass of hydrogen sulphide (H_2S) = 2xH + 1xS = (2+32)u = 34u

(b) Molecular mass of Carbon disulphide (CS_2) = 1xC + 2xS = (12+2 x 32)u = 76 u

Long Answer Type Questions-Pg-130

51. Question

State the law of conservation of mass. Give one example to illustrate this law.

Answer

Law of conservation of mass was given by Antoine Lavoisier in 1744. According to this law, “Matter can neither be created nor destroyed in a

chemical reaction". This law states that mass of an isolated system will remain constant over time. It means that when mass is enclosed in a system and nothing is allowed in or out, its quantity will never change. That is mass will be conserved, and hence this is called Law of Conservation of Mass. This means total mass of products is always equal to the total mass of reactants.

In a chemical reaction, the substances that combine or react are known as reactants and the new substance/substances formed are called product or products. A chemical reaction can be represented in general as follows:

Reactant + Reactant → Product

Example: When calcium oxide is dissolved in water, then calcium hydroxide is formed. The reaction involved in this can be written as:

Calcium oxide + Water → Calcium hydroxide

In this reaction calcium oxide and water are reactants while calcium hydroxide is product.

In this reaction 74 g of calcium hydroxide is obtained when 56 g of calcium oxide reacts with 18 g of water, which is proved by experiment.

Calcium oxide (56 g) + Water (18 g) → Calcium hydroxide (74 g)

{CaO = Ca(40) + O(16) = 56g; H2O = H2(2)+O(16) = 18g; Ca(OH)2 = Ca(40)+O(32)+H(2) = 74g}

Here the total mass of reactants, i.e. calcium oxide and water is equal to 74 g. And the mass of product, i.e. calcium hydroxide is also equal to 74g. This proves that the total mass of reactants is always equal to the total mass of product, which proves the Law of Conservation of Mass.

52. Question

State the law of constant proportions. Give one example to illustrate this law.

Answer

Law of constant proportions was given by Joseph Proust in 1799. According to this law, "a chemical compound always contains same elements in definite proportion by mass and it does not depend on the source of compound." Compounds are formed by the combination of two or more elements. In a compound the ratio of the atoms or element by mass remains always same irrespective of the source of compound. This means a certain compound always formed by the combination of atoms in same ratio by mass. If the ratio of mass of constituent atoms will be altered the new compound is formed.

Example: Water is formed by the combination of hydrogen and oxygen. The ratio of masses of hydrogen and oxygen is always in 1:8 in water irrespective of source of water. Whether you collect the water from a well, river, pond or from anywhere the ratio of their constituent atoms by mass will always same.

53 A. Question

State the various postulates of Dalton's atomic theory of matter.

Answer

Main postulates of Dalton's atomic theory

1). Elements are made of extremely small/ indivisible particles called atoms.

2). Atoms of a given element are identical in size, mass, and other properties.

3). Atoms of different elements differ in size, mass, and other properties.

4). Atoms cannot be subdivided, created, or destroyed.

5). Atoms of different elements combine in simple ratios to form chemical compounds.

6). In chemical reactions, atoms are combined, separated, or rearranged.

53 B. Question

Which postulate of Dalton's atomic theory can explain the law of conservation of mass?

Answer

According to law of conservation of mass which describes that, "Matter can neither be created nor destroyed in a chemical reaction". This law gives result to the postulate of Dalton's atomic theory which states that, "Atoms can neither be created and nor destroyed by physical and chemical changes."

53 C. Question

Which postulate of Dalton's atomic theory can explain the law of constant proportions?

Answer

According to law of constant proportions which describes that, "a chemical compound always contains same elements in definite proportion by mass and it does not depend on the source of compound."

This law gives result to the postulate of Dalton's atomic theory which states that, "When two elements combine to form two or more than two different compounds then the different masses of one element B which combine with fixed mass of the other element bear a simple ratio to one another."

54 A. Question

What is the significance of the symbol of an element? Explain with the help of an example.

Answer

Symbol may be defined as the abbreviation used for the name of an element. The symbol of an element are generally either the first letter or the first two letters of the name of element or the first and the third letters of the name of the element.

For example, the symbol of some elements are the first letter of the name of that element such as Hydrogen- H, Oxygen- O.

Some symbols are derived from the first two letters of the names of the element such as Calcium- Ca, Aluminum- Al.

Some symbol derived from the first and the third letter of the names of the elements such as Arsenic-As

Symbol of many elements are taken from their English name, while symbol of many elements are taken from their Greek or Latin names such as the latin name of sodium is Natrium, hence the symbol is Na.

54 B. Question

Explain the significance of the symbol H.

Answer

Significance of symbol H

- The symbol H refers to the element hydrogen.
- The symbol H refers to one atom of hydrogen.
- The symbol H refers to one mole of hydrogen i.e., 6.022×10^{23} atoms.
- The symbol H refers to 1 gram atomic mass of hydrogen.

55 A. Question

What is an atom? How do atoms usually exist?

Answer

The building blocks of all types of matter is called atoms. An atom is the smallest and indivisible part of an element that can take participate in a chemical reaction. Atoms of majority of the elements are very reactive and do not exist in the free state (as single atom). They exist in combination with the atoms of the same elements or another element.

55 B. Question

What is a molecule? Explain with an example.

Answer

A molecule is the smallest part of an element or compound that has independent existence. A molecule contain one or more than one atoms. The

molecules of elements contain atoms of only one kind. For example Oxygen gas; it contains two atoms of oxygen. Hence it is a molecule.

55 C. Question

What is the difference between the molecule of an element and the molecule of a compound? Give one example of each.

Answer

Molecules of elements: The molecules of an element contain two or more similar atom chemically bonded together, for example oxygen gas has 2 oxygen atoms combined together whereas ozone gas has 3 oxygen atoms combined together, so ozone exists in the form of O3. In contrast to it, molecules of compounds contain two or more different types of atoms chemically bonded together. For example: the molecule sulphur dioxide (SO2) contain one atom of sulphur chemically bonded with two atom of oxygen.

56 A. Question

Define atomic mass unit. What is its symbol?

Answer

'amu' is the symbol of Atomic mass unit, but nowadays it is denoted 1 by 'u'.

56 B. Question

Define atomic mass of an element.

Answer

Atomic mass of an element may be defined as the average relative mass of an atom of the element as compared with mass of an atom of carbon (C-12 isotope) taken as 12 amu

Carbon-12 is considered as unit to calculate atomic mass. Carbon-12 is an isotope of carbon. The relative mass of all atoms are found with respect to C-12.

One atomic mass = 1/12 of the mass of one atom of C-12.

This means atomic mass unit = 1/12th of carbon-12.

56 C. Question

What is meant by saying that 'the atomic mass of oxygen is 16'?

Answer

The atomic mass of oxygen is 16u, this means one atom of oxygen is 16 times heavier than $1/12^{th}$ of carbon atom.

Multiple Choice Questions (MCQs)-Pg-130

57. Question

The atomicities of ozone, sulphur, phosphorus and argon are respectively:

A. 8, 3, 4 and 1

B. 1, 3, 4 and 8

C. 4, 1, 8 and 3

D. 3, 8, 4 and 1

Answer

The atomicity of ozone(O3) is 3, sulphur(S)- 8, phosphorus(P)- 4, Argon(noble gas, Ar)- 1.

58. Question

The symbol of a metal element which is used in making thermometers is:

A. Ag

B. Hg

C. Mg

D. Sg

Answer

Mercury is used in the making of thermometers. Its symbol is Hg.

9. Question

The Latin language name of an element is natrium. The English name of this element is:

A. sodium

B. potassium

C. magnesium

D. sulphur

Answer

Natrium is the latin name of Sodium.

60. Question

The atomic theory of matter was proposed by:

A. John Kennedy

B. Lavoisier

C. Proust

D. John Dalton

Answer

John Dalton gave atomic theory of matter.

61. Question

One of the following elements has an atomicity of 'one'. This element is:

A. helium

B. hydrogen

C. sulphur

D. ozone

Answer

The atomicity of helium is 1. It is a noble gas.

62. Question

The English name of an element is potassium, its Latin name will be:

A. plumbum

B. cuprum

C. kalium

D. natrium

Answer

the latin name of potassium is kalium.

63. Question

The law of conservation of mass was given by:

A. Dalton

B. Proust

C. Lavoisier

D. Berzelius

Answer

The law of conservation of mass was given by Lavoisier.

64. Question

The element having atomicity ‘four’ is most likely to be:

A. argon

B. fluorine

C. phosphorus

D. francium

Answer

The atomicity of phosphorus is 4.

65. Question

If 1.4 g of calcium oxide is formed by the complete decomposition of calcium carbonate, then the amount of calcium carbonate taken and the amount of carbon dioxide formed will be respectively:

A. 2.2 g and 1.1 g

B. 1.1 g and 2.5 g

C. 2.5 g and 1.1 g

D. 5.0 g and 1.1 g

Answer

$CaCO_3$ gets decomposed into calcium oxide(CaO) and carbondioxide(CO_2). According to law of conservation of mass

66. Question

The law of constant proportions was given by:

A. Proust

B. Lavoisier

C. Dalton

D. Berzelius

Answer

The law of constant proportions was given by proust.

67. Question

The law of constant phosphorus, sulphur and krypton, the elements having the lowest and highest atomicities are respectively:

A. sulphur and krypton

B. krypton and ozone

C. phosphorus and sulphur

D. krypton and sulphur

Answer

Krypton has the lowest atomicity and Sulphur has highest atomicity i.e. 8.

68. Question

One nm is equal to:

A. 10^{-9} mm

B. 10^{-7} cm

C. 10^{-9} cm

D. 10^{-6} m

Answer

1nm = 10^{-9} m, whereas 1m = 100cm, hence 1nm = 10^{-7} cm.

69. Question

The scientist who proposed the first letter (or first letter and another letter) of the Latin or English name of an element as its symbol, was:

A. Dalton

B. Proust

C. Lavoisier

D. Berzelius

Answer

Berzelius proposed the first letter (or first letter and another letter) of the Latin or English name of an element as its symbol.

70. Question

The atoms of which of the following pair of elements are most likely to exist in free state?

A. hydrogen and helium

B. argon and carbon

C. neon and nitrogen

D. helium and neon

Answer

helium and neon are noble gases.

71. Question

Which of the following elements has the same molecular mass as its atomic mass?

A. nitrogen

B. neon

C. oxygen

D. chlorine

Answer

Neon has the same molecular mass as its atomic mass.

72. Question

In water, the proportion of oxygen and hydrogen by mass is:

A. 1 : 4

B. 1 : 8

C. 4 : 1

D. 8 : 1

Answer

The proportion of oxygen and hydrogen by mass in water can be calculated as-

(H_2O) = 1xO(16): 2xH(1) = 16:2 = 8:1.

73. Question

In hydrogen peroxide (H_2O_2), the proportion of hydrogen and oxygen by mass is:

A. 1 : 8

B. 1 : 16

C. 8 : 1

D. 16 : 1

Answer

(b); The proportion of hydrogen and oxygen by mass in hydrogen peroxide can be calculated as-

(H_2O_2) = 2xH(1): 2xO(16) = 2:32 = 1:16.

74. Question

The symbols of the elements cobalt, aluminium, helium and sodium respectively written by a student are as follows. Which symbol is the correct one?

A. CO

B. AL

C. He

D. So

Answer

It is the correct symbol of Helium; the correct symbols of cobalt, aluminium, and sodium are Co, Al and Na respectively.

Questions Based on High Order Thinking Skills (HOTS)-Pg-131

75. Question

Copper sulphate reacts with sodium hydroxide to form a blue precipitate of copper hydroxide and sodium sulphate. In an experiment, 15.95 g of copper sulphate reacted with 8.0 g of sodium hydroxide to form 9.75 g of copper hydroxide and 14.2 g of sodium sulphate. Which law of chemical combination is illustrated by this data? Give reason for your choice.

Answer

Here are the equations for copper sulphate solution reacting with sodium hydroxide solution:

copper sulfate + sodium hydroxide → copper hydroxide + sodium sulfate

CuSO4 + 2NaOH → Cu(OH)2 + Na2SO4

(15.95g + 8g → 9.75g + 14.2g)

23.95g = 23.95g

As all the reactants and products remain in the sealed reaction container then it is easy to show that the total mass is unchanged. This data shows the law of

conservation of mass.

76. Question

Potassium chlorate decomposes, on heating, to form potassium chloride and oxygen. When 24.5 g of potassium chlorate is decomposed completely, then 14.9 g of potassium chloride is formed. Calculate the mass of oxygen formed. Which law of chemical combination have you used in solving this problem?

Answer

According to the above question-

Potassium chlorate $\rightarrow$ Potassium chloride + Oxygen
(24.5gm) (14.9gm) (x gm)

According to the law of conservation of mass-

Mass of potassium chloride + mass of oxygen = Mass of potassium chlorate

Mass of oxygen(x) = Mass of potassium chlorate- mass of potassium chloride

X = 24.5g-14.9g

X = 9.6g

Hence mass of oxygen = 9.6 g

77. Question

In an experiment, 4.90 g of copper oxide was obtained form 3.92 g of copper. In another experiment, 4.55 g of copper oxide gave, on reduction, 3.64 g of copper. Show with the help of calculations that these figures verify the law of constant proportions.

Answer

According to question-

Reaction 1-

$2\,Cu + O_2 \rightarrow 2CuO$
(3.92 gm) (4.90-3.92 = 0.98gm) (4.90 gm)

$$\frac{3.92}{3.92} = 1\frac{0.98}{3.92} = 0.25$$

$$\frac{4.90}{3.92} = 1.25$$

So, 1 equivalent of Cu reacts with 0.25 equivalent of O2 to form 1.25 equivalent of copper oxide.

Reaction 2-

$$2\,CuO \rightarrow 2\,Cu + O_2$$

(4.55 gm) (3.64 gm) (4.55-3.64 = 0.91 gm)

$$\frac{4.55}{3.64} = 1.25 \frac{3.64}{3.64} = 1$$

$$\frac{0.91}{3.64} = 0.25$$

Here again, one can see that 1.25 equivalent of CuO decomposed to form 1 equivalent of Cu and 0.25 equivalent of oxygen.

Hence, law of constant proportion is verified.

78. Question

Magnesium and oxygen combine in the ratio of 3 : 2 by mass to form magnesium oxide. What mass of oxygen gas would be required to react completely with 24 h of magnesium?

Answer

According to question-

$$\underset{3x}{Magnesium} + \underset{2x}{Oxygen} \rightarrow \underset{x}{Magnesium\ oxide}$$

i.e. three equivalents of Mg reacts with 2 equivalents of O2 to form 1 equivalent of MgO.

When mass of Mg = 3x = 24 gm

So, x = 8 gm

Then, mass of oxygen required = 2x = 16 gm

79. Question

When 5 g of calcium is burnt in 2 g of oxygen, then 7 g of calcium oxide is produced. What mass of calcium oxide will be produced when 5 g of calcium is burnt in 20 g of oxygen? Which law of chemical combination will govern your answer?

Answer

When 5 gm of calcium is burnt in 2gm of oxygen, then 7 gm of calcium oxide is formed. So, calcium and oxygen combine in the fixed proportion of 5:2 by mass. Now, when 5 gm of calcium is burnt in 20 gm of oxygen, then also 7 gm of calcium oxide will be formed because chemical reactions follows law of constant proportion. As a result, 18 gm of oxygen will be left unreacted.

80. Question

A liquid compound X of molecular mass 18 u can be obtained from a number of natural sources. All the animals and plants need liquid X for their survival. When an electric current is passed through 200 grams of pure liquid X under suitable conditions, then 178 grams of gas Y and 22 grams of gas Z are produced. Gas Y is produced at the positive electrode whereas gas Z is obtained at the negative electrode. Moreover, gas Y supports combustion whereas gas Z burns itself causing explosions.

(a) Name (i) liquid X (ii) gas Y, and (iii) gas Z

(b) What is the ratio to the mass of element Z to the mass of element Y in the liquid X?

(c) Which law of chemical combination is illustrated by this example?

(d) Name two sources of liquid X.

(e) State an important use of Y in our life.

Answer

According to question-

$$\underset{200\text{gm}}{X\,(\text{liquid})} \rightarrow \underset{178\text{gm}}{Y\,(\text{gas})} + \underset{22\text{gm}}{Z\,(\text{gas})}$$

(a) (i) Water (ii) Oxygen (iii) Hydrogen

(b) 1 : 8

(c) Law of Constant proportions

(d) Rivers and Wells

(e) Gas Y (oxygen) is necessary For breathing

81. Question

One of the forms of a naturally occurring solid compound P is usually used for making the floors of houses. On adding a few drops of dilute hydrochloric acid to P, brisk effervescence are produced. When 50 g of reactant P was heated strongly, than 22 g of a gas Q and 28 g of a solid R were produced as products. Gas Q is the same which produced brisk effervescence on adding dilute HCl to P. Gas Q is said to cause global warming whereas solid R is used for white-washing.

(a) What is (i) solid P (ii) gas Q, and (iii) solid R.

(b) What is the total mass of Q and R obtained from 50 g of P?

(c) How does the total mass of Q and R formed compare with the mass of P taken?

(d) What conclusion do you get from the comparison of masses of products and reactant?

(e) Which law of chemical combination is illustrated by the example given in this problem?

Answer

According to question-

$$\underset{50\,gm}{P\,(solid)} \rightarrow \underset{22\,gm}{Q\,(gas)} + \underset{28\,gm}{R\,(solid)}$$

(a) Solid P - Calcium Carbonate ($CaCO_3$)

Gas Q - Carbon dioxide (CO_2)

Solid R - Calcium oxide (CaO)

(b) Total mass of Q and R = 22gm + 28gm = 50gm

(c) Total mass of Q and R (50gm) is equal to mass of reactant (50gm).

(d) The law of conservation of mass is followed, i.e. total mass of product is equal to mass of reactant.

(e) Law of conservation of mass is illustrated by the example.

Very Short Answer Type Questions-Pg-150

1. Question

What do we call those particles which have more or less electrons than the normal atoms?

Answer

Those particles which have more or less electrons than the normal atoms are called Ions.

2. Question

What do we call those particles which have:

(a) more electrons than the normal atoms?

(b) less electrons than the normal atoms?

Answer

(a) Those particles which have more electrons than the normal atoms are called Anions.

(b)Those particles which have less electrons than the normal atoms are called Cations.

3. Question

Define 'formula mass' of a compound.

Answer

Formula mass of an ionic compound is obtained by adding atomic masses of all the atoms in a formula unit of the compound. For example: Formula mass of sodium chloride (NaCl) = Atomic mass of sodium + atomic mass of chlorine = 39 + 35.5 = 74.5

4. Question

What do we call those particles which are formed:

(a) by the gain of electrons by atoms?

(b) by the loss of electrons by atoms?

Answer

(a) Anions are formed by the gain of electrons by atoms

(b) Cations are formed by the loss of electrons by atoms.

5. Question

State whether the following statements are true or false:

(a) A sodium ion has positive charge because it has more protons than a neutral atom

(b) A chloride ion has negative charge because it has more electrons than a neutral atom

Answer

(a) A sodium ion has positive charge because it has more protons than a neutral atom

(b) A chloride ion has negative charge because it has more electrons than a neutral atom

6. Question

Write down the formulae for the following compounds:

(a) Calcium oxide

(b) Magnesium hydroxide

Answer

(a) The formula of Calcium oxide is CaO

(b) The formula of Magnesium hydroxide is Mg(OH)2.

7. Question

An element Z has a valency of 3. What is the formula of oxide of Z?

Answer

Valency of element Z = 3

Valency of oxygen = 2

So, formula of oxide of element = Z_2O_3

8. Question

What is the name of a particle which contains 10 electrons, 11 protons and 12 neutrons?

Answer

The valence electrons present in sodium atom are 11. In the above statement, there is loss of one electron shown which makes it Sodium ion(Cation) denoted by Na^+.

9. Question

Name the particle which has 18 electrons, 18 neutrons and 17 protons in it.

Answer

The valence electrons present in chlorine atom are 17. In the above statement, there is gain of one electron shown which makes it chloride ion(anion) denoted by Cl^-.

10. Question

Fill in the following blanks with suitable words:

(a) The particle which is formed by the gain of electrons by an atom is called ……..

(b) The particle which is formed by the loss of electrons by an atom is called ……..

(c) The particle which is formed by the loss or gain of electrons by an atom is called ……..

(d) A potassium ion has positive change because it contains less …….. than ……..

(e) A sulphide ion has negative charge because it contains less …….. than ……..

Answer

(a) Anion is formed by the acceptance/gain of electrons by an atom.

(b) Cation is formed by donating/loss of electrons by an atom.

(c) ion

(d) electrons; protons

(e) protons; electrons

Short Answer Type Questions-Pg-151

11. Question

Name the elements water is made of. What are the valencies of these elements? Work out the chemical formula for water.

Answer

Water(H2O) is made up of two types of elements known as hydrogen and oxygen.

The valency of hydrogen is 1 as only one valence electron is present in its outermost shell and one is needed. The valency of oxygen is 2 as six valence electrons are present in its outermost shell and two are needed.

So according to the valencies of both the elements present in water, the formula becomes H2O.

12. Question

If the valency of hydrogen is 1 and that of nitrogen is 3, work out the formula for ammonia.

Answer

The valency of hydrogen is 1 and that of nitrogen is 3. So according to the valencies of both the elements present in ammonia, The formula becomes NH3.

13. Question

Work out the formula for sulphur dioxide. (Valencies: S = 4; O = 2)

Answer

The valency of sulphur is 4 and that of oxygen is 2. So according to the valencies of both the elements present in sulphur dioxide, The formula becomes SO4.

14. Question

If the valency of carbon is 4 and that of sulphur is 2, work out the formula of the compound formed by the combination of carbon with sulphur. What is the name of this compound?

Answer

The valency of carbon is 4 and that of sulphur is 2. So according to the valencies of both the elements present, the formula becomes CS2. The name of compound is carbon disulphide.

15. Question

An element X has a valency of 4 whereas another element Y has a valency of 1. What will be the formula of the compound formed between X and Y?

Answer

The valency of X is 4 and that of Y is 1. So according to the valencies of both the elements present, the formula becomes XY4. The name of compound is carbon disulphide.

16. Question

An element B shows valencies of 4 and 6. Write the formulae of its two oxides.

Answer

When element B shows valency of 4 and oxygen has valency of 2. The formula becomes BO2.

When element B shows valency of 6 and oxygen has valency of 2. The formula becomes BO3.

17. Question

An element X of valency 3 combines with another element Y of valency 2. What will be the formula of the compound formed?

Answer

The formula of the compound formed is X2Y3.

18. Question

Work out the formula for magnesium hydrogencarbonate.

Answer

The valency of magnesium is 2 and that of hydrogen carbonate(HCO3) is 1. So according to the valencies of both the elements present in magnesium hydrogencarbonate, the formula becomes $Mg(HCO_3)_2$.

19. Question

An element X has a valency of 2. Write the simplest formula for:

(a) bromide of the element

(b) oxide of the element

Answer

(a) The valency of element X is 2 and that of bromine is -1. So according to the valencies of both the elements, the formula becomes XBr_2.

(b) The valency of element X is 2 and that of oxide is -2. So according to the valencies of both the elements, the formula becomes XO.

20. Question

Work out the formulae for the following compounds:

(a) Sodium oxide

(b) Calcium carbonate

Answer

(a) The valency of sodium is 1 and that of oxide is -2. So according to the valencies of both the elements, the formula becomes Na_2O.

(b) The valency of calcium is 2 and that of carbonate is -2. So according to the valencies of both the elements, the formula becomes $CaCO_3$.

21. Question

Calculate the formulae masses of the following compounds:

(i) Sodium oxide, Na_2O

(ii) Aluminium oxide, Al_2O_3

(Given: Atomic masses: Na = 23 u; O = 16 u; Al = 27 u)

Answer

(a) Molecular mass of Na2O = (2 x Na) + (1 x O) = (2 x 23) + (1 x 16) = 62u

(b) Molecular Mass of Al_2O_3 = (2 x Al) + (3 x O) = (2 x 27) + (3 x 16) = 102u

22. Question

Name the following compounds. Also write the symbols/formulae of the ions present in them:

(a) $CuSO_4$ (b) $(NH_4)_2SO_4$

(c) Na_2O (d) Na_2CO_3

(e) $CaCl_2$

Answer

(a) Copper sulphate; Cu^{2+} and SO_4^{2-}

(b) Ammonium sulphate; NH_4^{2-} *and* SO_4^{2-}

(c) Sodium oxide; Na^+ and O^{2-}

(d) Sodium carbonate; Na^+ and CO_3^{2-}

(e) calcium chloride; Ca^{2+} and Cl^-

23. Question

Write the cations and anions present, if any, in the following:

(a) CH_3COONa (b) NaCl

(c) H_2 (d) NH_4NO_3

Answer

(a) Cation: Na^+; Anion: CH_3COO^-

(b) Cation: Na^+; Anion Cl^-

(c) H_2 is a covalent molecule. It has no cation and anion

(d) Cation: NH_4^+; Anion: NO_3^-

24. Question

Give the formulate of the compounds formed from the following sets of elements:

(a) calcium and fluorine

(b) hydrogen and sulphur

(c) nitrogen and hydrogen

(d) carbon and chlorine

(e) sodium and oxygen

(f) carbon and oxygen

Answer

(a) The valency of calcium is 2 and that of fluorine is -1. So according to the valencies of both the elements, the formula becomes CaF_2.

(b) The valency of hydrogen is 1 and that of sulphur is -2. So according to the valencies of both the elements, the formula becomes H_2S.

(c) The valency of nitrogen is -3 and that of hydrogen is 1. So according to the valencies of both the elements, the formula becomes NH_3.

(d) The valency of carbon is 4 and that of chlorine is -1. So according to the valencies of both the elements, the formula becomes CCl_4.

(e) The valency of sodium is 1 and that of oxygen is -2. So according to the valencies of both the elements, the formula becomes Na_2O.

(f) The valency of carbon is 4 and that of oxygen is -2. So according to the valencies of both the elements, the formula becomes CO_2.

25. Question

What are (i) ionic compounds, and

(ii) molecular compounds? Give two examples of each type of compounds.

Answer

(i) Ionic compounds- The compounds which are formed by the combination of metals and non-metals are called ionic compounds. For example- NaCl, $CaCl_2$.

(i) Molecular Compounds- These compounds are formed by the combination of two non-metal elements. For ex. HCl and H_2SO_4.

Long Answer Type Questions-Pg-152

26 A. Question

What is an ion? How is an ion formed? Explain with the help of two examples of different ions.

Answer

An ion is a charged particle and can be negatively or positively charged.

A negatively charged ion is called an „anion" and the positively charged ion, a „cation". For example, sodium chloride (NaCl). Its constituent particles are positively charged sodium ions (Na^+) and negatively charged chloride ions (Cl^-). Ions may consist of a single charged atom or a group of atoms that have a net charge on them. A group of atoms carrying a charge is known as a polyatomic ion e.g. Calcium oxide (Ca+2 O-2)

26 B. Question

The valencies (or charges) of some of the ions are given below:

Ion	Valency	Ion	Valency
	(Charge)		(Charge)
Sodium ion	1^+	Bromide ion	1^-
Ammonium	1^+	Hydroxide	1^-
ion		ion	
Calcium ion	2+	Sulphate	2-
ion			
Lead ion	2+	Phosphate	3-
Ion			

Using this information, write down the formulate of the following compounds:

(i) Sodium phosphate

(ii) Ammonium sulphate

(iii) Calcium hydroxide

(iv) Lead bromide

Answer

i. Sodium phosphate - Na_3PO_4

ii. Ammonium sulphate - $(NH_4)_2SO_4$

iii. Calcium Hydroxide - $Ca(OH)_2$

iv. Lead bromide - $PbBr_2$

27 A. Question

What is the difference between a cation and an anion? Explain with examples.

Answer

A positively charged ion is known as cation. For example : Sodium ion:Na , Magnesium ion: Mg2 A cation is formed by the loss of one or more electrons by an atom For example : sodium atom, loses one electron to form a sodium ion Na Sodium atom (A cation)

A negatively charged ion is known as anion. Cl- (chloride ion), O-2 (oxide ion) etc. An anions is formed by the gain of one or more electrons by an atom. For example a chlorine atom gains one electron to form a chloride ion Cl-. Chlorine atom Chloride ion (An anion).

27 B. Question

The valencies (or charges) of some of the ions are given below:

Ion Valency (Charge)	Ion Valency (Charge)
Sodium 1+ ion	Nitrate 1- Ion
Copper 2+ ion	Sulphide 2- ion

Using this information, write down the formulae of:

(i) Sodium sulphide

(ii) Copper nitrate

Answer

(i). Na_2S

(ii). Cu $(NO_3)_2$

28. Question

Explain the formation of (i) sodium ion, and (ii) chloride ion, form their respective atoms giving the number of protons and number of electrons in each one of them. What is the reason for positive charge on a sodium ion and a negative charge on a chloride ion?

Answer

Formation of Sodium ion- The atomic number of sodium is 11. The arrangements of electrons in the shells of the sodium atom is in the combination of 2,8,1. The valence electron present in the outermost shell of

sodium atom is 1. The sodium atom can lose one electron to form sodium ion(Na^+). There will be reduction in number of electrons, E=10. Number of protons remain same as 11. Due to the decrease in one electron, there is positive charge on a sodium ion.

Formation of Chloride ion- The atomic number of chlorine is 17. The arrangements of electrons in the shells of the chlorine atom is in the combination of 2,8,7. The valence electron present in the outermost shell of chlorine atom is 1. The chlorine atom can lose one electron to form chlorine ion(Cl^-). There will be increase in number of electrons, E=18. Number of protons remain same as 17. Due to the increase in one electron, there is negative charge on a chloride ion.

29 A. Question

Write the symbols/formulae of two simple ions and two compound ions (or polyatomic ions).

Answer

Symbol of two simple ions$^-$ Na^+, Al^{3+}

Symbol of two compound ions- $NH4^+$, NO_3^{2-}

29 B. Question

An element Y has a valency of 4. Write the formula for its:

(i) chloride

(ii) oxide

(iii) sulphate

(iv) carbonate

(v) nitrate

Answer

(i) The valency of chloride ion is -1. Hence the formula becomes YCl_4

(ii)The valency of oxide ion is -2. Hence the formula becomes YO_2

(iii) The valency of sulphate ion is -4. Hence the formula becomes $Y(SO_4)_2$

(iv) The valency of carbonate ion is -4. Hence the formula becomes $Y(CO_3)_2$

(v) The valency of nitrate ion is -1. Hence the formula becomes $Y(NO_3)_4$

30 A. Question

Define ‘formula unit’ of an ionic compound. What is the formula unit of (i) sodium chloride, and (ii) magnesium chloride?

Answer

Formula unit is defined as the empirical formula of a compound which gives the simplest whole number ratio of atoms of the various elements present in the molecule of the compound.

Formula Unit of Sodium Chloride- NaCl

Formula Unit of Magnesium Chloride- MgCl2.

30 B. Question

Calculate the formula masses of the following compounds:

(i) Calcium chloride

(ii) Sodium carbonate

(Given: Atomic masses: Ca = 40 u; Cl = 35. 5 u; Na = 23 u; C = 12 u; O = 16 u)

Answer

(i) Formula Mass of Calcium chloride ($CaCl_2$) = 1xCa + 2xCl = (40+71) u = 111 u

(ii) Formula Mass of Sodium carbonate (Na_2CO_3) = 2xNa + 1xC + 3xO = (2x23 + 1x12 + 3x16) u = 106 u

Multiple Choice Questions (MCQs)-Pg-152

31. Question

The atomic number of an element X is 13. What will be the number of electrons in its ion X^{3+}?

A. 11

B. 15

B. 16

D. 10

Answer

X^{3+} indicates loss of three electrons. Hence the remaining no. of electrons present are 10.

32. Question

Which of the following represents a correct chemical formula?

A. CaCl

B. Na_3N

C. $NaSO_4$

D. NaS

Answer

according to the valencies of sodium(1) and nitrogen(3).

33. Question

If the number of electrons in an ion Z^{3-} is 10, the atomic number of element Z will be:

A. 7

B. 5

C. 10

D. 8

Answer

as the symbol suggests the gain of three electrons, the atomic number of Z is likely to be 7.

34. Question

The anion of an element has:

A. more electrons than the normal atom

B. less electrons than the normal atom

C. more protons than the normal atom

D. same number of electrons as normal atom

Answer

An anion is formed by the gain of electrons.

35. Question

A particle X has 17 protons, 18 neutrons and 18 electrons. This particle is most likely to be:

A. a cation

B. an anion

C. a molecule

D. a compound

Answer

An anion is formed by the gain of electrons.

36. Question

An element which can exhibit valencies of 2, 4 and 6 can be:

A. Copper

B. iron

C. mercury

D. sulphur

Answer

Sulphur has 2 valence electrons in its outermost shells. Hence it exhibits valencies of 2, 4 and 6.

37. Question

The atomic number of an element E is 16. The number of electrons in ion E^{2-} will be:

A. 16

B. 18

C. 15

D. 14

Answer

as the symbol suggests the gain of two electrons, the atomic number is likely to be 18.

38. Question

The cation of an element has:

A. the same number of electrons as its neutral atom

B. more electrons than a neutral atom

C. less protons than a neutral atom

D. less electrons than a neutral atom

Answer

A cation is formed by the loss of electrons.

39. Question

Two elements X and Y have valencies of 5 and 3, and 3 and 2, respectively. The elements X and Y are most likely to be respectively:

A. copper and sulphur

B. sulphur and iron

C. phosphorus and nitrogen

D. nitrogen and iron

Answer

Nitrogen have 5 electrons in the outermost shell of its atom, hence its valencies are 5 and 3. Iron can lose 2 and 3 electrons from its outermost shell, so its valencies are 2 and 3.

40. Question

The number of electrons in an ion Y^{2+} is 10. The atomic number of element Y is most likely to be:

A. 8

B. 12

C. 10

D. 14

Answer

as the symbol suggests the loss of two electrons, the atomic number is likely to be 12.

41. Question

A particle P has 18 electrons, 20 neutrons and 19 protons. This particle must be:

A. a molecule

B. a binary compound

C. an anion

D. a cation

Answer

The loss of an electron in the above data proves that it is a cation.

42. Question

An ionic compound will be formed by the combination of one of the following pairs of elements. This pair of elements is:

A. chlorine and calcium

B. calcium and sodium

C. sulphur and carbon

D. chlorine and chlorine

Answer

An ionic compound will always formed by the combination of an anion and a cation.

43. Question

Molecular compounds are usually formed by the combination between:

A. a metal and a non-metal

B. two different non-metals

C. two different metals

D. any two gaseous elements

Answer

Molecular compounds are usually formed by the combination between two different non-metals

44. Question

The formula of a compound is X_3Y. The valencies of elements X and Y will be respectively:

A. 1 and 3

B. 3 and 1

C. 2 and 3

D. 3 and 2

Answer

As the formula suggests, the valencies of elements X and Y will be 1 and 3 respectively.

45. Question

The formula of the sulphate of an element X is $X_2(SO_4)_3$. The formula of nitride of element X will be:

A. X_2N

B. XN_2

C. XN

D. X_2N_3

Answer

Nitrogen is trivalent as valency of nitrogen is -3, hence formula of nitride = XN

Questions Based on High Order Thinking Skills (HOTS)-Pg-153

46. Question

An element A forms an oxide A_2O_5.

(a) What is the valency of element A?

(b) What will be the formula of chloride of A?

Answer

(a) Let the valency of element A be y, then 2y + 5(-2) = 0

So, y = valency of element A = 5

(b) As valency of element A is 5 and valency of chlorine is -1,

So, the formula of chloride of A is ACl_5.

47. Question

An element X forms the following compounds with hydrogen, carbon and oxygen:

H_2X, CX_2, XO_2, XO_3

Answer

Valency of X -

(i) In H_2X: -2

(ii) In CX_2: -2

(iii) In XO_2: +4

(iv) In XO_3: +6

48. Question

If the aluminium salt of an anion X is Al_2X_3, what is the valency of X? What will be the formula of the magnesium salt of X?

Answer

Let the valency of X be y, then 2 x (+3) + 3 x y = 0

So, valency of X = y = -2

As valency of Mg is +2 and that of X is -2 so the formula of Magnesium salt of X will be MgX.

49. Question

The formula of carbonate of a metal M is M_2CO_3.

(a) What will be the formula of its iodide?

(b) What will be the formula of its nitride?

(c) What will be the formula of its phosphate?

Answer

According to formula M_2CO_3, the metal M is univalent having valency of +1 and valency of carbonate is -2 i.e. bivalent.

(a) Iodine is univalent as valency of iodine is -1, hence formula of iodide = MI

(b) Nitrogen is trivalent as valency of nitrogen is -3, hence formula of nitride = M_3N

(c) Phosphorus is trivalent as valency of phosphorus is -3, hence formula of phosphate = M_3PO_4

50. Question

The atom of an element X contains 17 protons, 17 electrons and 18 neutrons whereas the atom of an element Y contains 11 protons, 11 electrons and 12 neutrons.

(a) What type of ion will be formed by an atom of element X? Write the symbol of ion formed.

(b) What will be the number of (i) protons (ii) electrons, and (iii) neutrons, in the ion formed from X?

(c) What type of ion will be formed by an atom of element Y? Write the symbol of ion formed.

(d) What will be the number of (i) protons (ii) electrons, and (iii) neutrons, in the ion formed from Y?

(e) What is the atomic mas of (i) X, and (ii) Y?

(f) What could the elements X and Y be?

Answer

(a). Anion will be formed by element X; Symbol: X-

(b) (i). No. of protons in X = 17

(ii) No. of electrons in X = 18

(iii) No. of neutrons in X = 18

(c) Cation will be formed by element Y; Symbol: Y+

(d) (i). No. of protons in Y = 11

(ii) No. of electrons in Y = 10

(iii) No. of neutrons in Y = 12

(e) Atomic mass of X = No. of protons (17) + No. of neutrons (18) = 35 u

Atomic mass of Y = No. of protons (11) + No. of neutrons (12) = 23 u

(f) Element X is Chlorine (Cl).

Element Y is Sodium (Na).

Very Short Answer Type Questions-Pg-172

1. Question

What is a group of 6.022×10^{23} particles known as?

Answer

The group of 6.022×10^{23} particles is known as One mole of a substance.

2. Question

What name is given to the amount of substance containing 6.022×10^{23} particles (atoms, molecules or ions) of a substance?

Answer

A group of 6.022×10^{23} particles (atom, molecules or ions) of a substance is called a mole of that substance.

3. Question

What is the numerical value of Avogadro number?

Answer

The numerical value of Avogadro number is 6.022×10^{23}.

4. Question

How many atoms are present in one gram atomic mass of a substance?

Answer

One gram atomic mass = 6.022×10^{23} atoms.

5. Question

How many molecules are present in one gram molecular mass of a substance?

Answer

One gram molecular mass = 6.022×10^{23} molecules.

6. Question

What name is given to the number 6.022×10^{23}?

Answer

Avagadro's Number is the name given number 6.022×10^{23}

7. Question

Convert 12 g of oxygen gas into moles.

Answer

Given Mass of oxygen gas(O2) = 12g

Molar mass of oxygen gas(O2) = 32g

As we know that, Number of moles = mass of an element/molar mass of an element

Hence, Number of moles = 12g /32g = 0.375.

8. Question

How many moles are 3.6 g of water?

Answer

Given Mass of water(H2O) = 3.6g

Molar mass of water(H2O) = 18g

As we know that, Number of moles = mass of an element/molar mass of an element

Hence, Number of moles = 3.6g / 18g = 0.2 mole.

9. Question

What is the mass of 0.2 mole of oxygen atoms?

Answer

Molar mass of oxygen atom(O) = 16g

Number of moles present = 0.2 mole

As we know that, Number of moles = G mass of an element/molar mass of an element

Hence mass of an element = No. of moles X molar mass of an element.

Mass of oxygen atoms = 0.2×16 = 3.2g

10. Question

Find the mass of 2 moles of oxygen atoms?

Answer

Molar mass of oxygen atom(O) = 16g

Number of moles present = 2 mole

As we know that, Number of moles = G mass of an element/molar mass of an element

Hence mass of an element = No. of moles X molar mass of an element.

Mass of oxygen atoms = 2×16 = 32g

11. Question

Fill in the following blanks:

(a) 1 mole contains ……. atoms, molecules or ions of a substance.

(b) A mole represents an …….. number of particles of a substance.

(c) 60 g of carbon element are ……. moles of carbon atoms.

(d) 0.5 mole of calcium element has a mass of …….. .

(e) 64 g of oxygen gas contains ……. Moles of oxygen atoms.

Answer

(a) 6.022×10^{23}

(b) Avogadro

(c) 5

(d) 20 g

(e) 4

Short Answer Type Questions-Pg-172

12 A. Question

How many atoms are there in exactly 12 g of carbon -12 element? (C = 12 u)

Answer

The number of atoms present in 12g of carbon-12 element = 6.022×10^{23} atoms

12 B. Question

What name is given to this number?

Answer

Avogadro number

12 C. Question

What name is given to the amount of substance containing this number of atoms?

Answer

Mole

13. Question

Calculate the mass of 12.044×10^{25} molecules of oxygen (O_2).

Answer

One mole of O_2 = 32 gm

6.022×10^{23} molecules of O_2 have mass = 32 gm

So, 12.044×10^{25} molecules of O_2 will have mass = 6400 gm = 6.4 Kg

14. Question

What is the number of molecules in 1.5 moles of ammonia?

Answer

1 mole of ammonia contains 6.022×10^{23} molecules.

Therefore, 1.5 mole of ammonia contains = $6.022 \times 10^{23} \times 1.5 = 9.03 \times 1023$ molecules of ammonia

15. Question

How many moles of calcium carbonate ($CaCO_3$) are present in 10 g of the substance? (Ca = 40 u; C = 12 u; O = 16 u)

Answer

Molar mass of calcium carbonate ($CaCO_3$) = 40+12+48 = 100g

Mass of the substance = 10g

As we know that, Number of moles = mass of an element/molar mass of an element

Hence Number of moles = 10/100 = 0.1 mole.

16. Question

How many moles of O_2 are there in 1.20×10^{22} oxygen molecules?

Answer

Since One mole of O_2 contains = 6.022×10^{23} molecules of oxygen

So, 1 molecule of O_2 has = $1/6.022 \times 10^{23}$ moles of O_2

Therefore, 1.2×10^{22} molecules of O2 will have = $1.2 \times 10^{22} / 6.022 \times 10^{23}$ moles of O_2

= 0.0199 moles of O_2

17. Question

If one mole of nitrogen molecules weights 28 g, calculate the mass of one molecule of nitrogen in grams.

Answer

Since 1 mol of nitrogen contains 6.02×10^{23} molecules.

So according to given information, 6.022×10^{23} molecules of N_2 weigh = 28 gm

So, 1 molecule of N_2 will weigh = $28 / 6.022 \times 10^{23}$ grams of N_2

= 4.648×10^{-23} grams of N_2

18. Question

How many moles are there in 34.5 g of sodium? (Atomic mass of Na = 23 u)

Answer

Molar mass of sodium(Na) = 23g

Given Mass of the sodium = 34.5g

As we know that, Number of moles= mass of an element/molar mass of an element

Hence Number of moles = 34.5/23 = 1.5 moles.

19. Question

What is the number of zinc atoms in a piece of zinc weighing 10 g?

(Atomic mass of Zn = 65 u)

Answer

Mole concept provides a relationship between number of particles(atoms) and their mass. Thus it is possible to calculate the number of particles in a given mass.

Molar mass of Zinc(Zn) = 65g

Given Mass of the Zinc = 10g

As we know that, Number of moles = mass of an element/molar mass of an element

Hence Number of moles= 10g/65g = 0.15 moles.

Since 1 mol of zinc contains 6.02×10^{23} atoms

Therefore, 0.15 mol of zinc contains = $6.02 \times 10^{23} \times 0.15$ mol = 9.03×10^{22} atoms of zinc

20. Question

Calculate the mass of 3.011×10^{24} atoms of carbon.

Answer

Mass of 6.022×10^{23} atoms of Carbon = 12 g

So, Mass of 1 Carbon atom = $12/6.022 \times 10^{23}$ g

Hence, mass of 3.011×10^{24} atoms of Carbon = $3.011 \times 10^{24} \times 12 / 6.022 \times 10^{23}$ = 60 g

21. Question

If 6 g of oxygen contains 1 mole of oxygen atoms, calculate the mass of one atom of oxygen.

Answer

6.022×10^{23} atoms of Oxygen weigh = 16g

So, mass of 1 atom of Oxygen = $16/6.022 \times 10^{23} = 2.656 \times 10^{-23}$ g.

22. Question

How many atoms are there in 0.25 mole of hydrogen?

Answer

1 mole of hydrogen contains = 6.022×10^{23} atoms of hydrogen

So, 0.25 moles of hydrogen will have = $6.022 \times 10^{23} \times 0.25 = 1.50 \times 10^{23}$ atoms of hydrogen.

23. Question

Calculate the number of moles in 12.044 × 1025 atoms of phosphorus.

Answer

6.022×10^{23} atoms of phosphorus contains = 1 mole of phosphorus

So, 12.044×10^{25} atoms of phosphorus will have = $12.044 \times 10^{25}/6.022 \times 10^{23} = 200$ moles

24. Question

Calculate the number of moles present in a drop of chloroform ($CHCl_3$) weighing 0.0239 g. (Atomic masses: C = 12 u; H = 1 u; Cl = 35.5 u)

Answer

Molar mass of chloroform ($CHCl_3$) = (12+1+3x35.5) = 119.5g

Given Mass of the chloroform ($CHCl_3$) = 0.0239g

As we know that, Number of moles = mass of an element/molar mass of an element

Hence Number of moles of chloroform ($CHCl_3$) = 0.0239g/119.5g = 0.0002 moles.

25. Question

What is the mass of 5 moles of sodium carbonate (Na_2CO_3)?

(Atomic masses: Na = 23 u; C = 12 u; O = 16 u)

Answer

Molar mass of sodium carbonate (Na_2CO_3) = 2×23+12+3×16 = 106 g

Mass of one mole of sodium carbonate (Na_2CO_3) = 106g

Mass of five moles of sodium carbonate (Na_2CO_3) = 5×106g = 530g.

26. Question

Calculate the number of molecules in 4 g of oxygen.

Answer

Mole concept provides a relationship between number of particles and their mass. Thus it is possible to calculate the number of particles in a given mass.

Molar mass of oxygen(O_2) = 32g

Given mass of the oxygen = 4g

As we know that, Number of moles = Given mass of an element/molar mass of an element

Hence, Number of moles of oxygen = 4g/32g = 0.12 moles

Since 1 mole of oxygen contains 6.022×10^{23} molecules.

Therefore, 0.12 mole of oxygen contains =

$$\frac{6.022 \times 10^{23}}{1\ mole} \times 0.12 mole = 0.72264 \times 10^{23} = 7.2264 \times 10^{22}\ Molecules\ of\ Oxygen$$

27. Question

How many moles are represented by 100 g of glucose, $C_6H_{12}O_6$? (C = 12 u, H = 1 u, O = 16 u)

Answer

Molar mass of glucose, $C_6H_{12}O_6$ = 6×12+12×1+16×6 = 180g

Given Mass of the glucose, $C_6H_{12}O_6$ = 100g

As we know that, Number of moles = mass of an element/molar mass of an element

Hence Number of moles glucose, $C_6H_{12}O_6$ = 100g/180g = 0.55 moles.

28. Question

Calculate the mass in grams of 0.17 mole of hydrogen sulphide, H_2S.

(Atomic masses: H = 1 u, S = 32 u)

Answer

For converting mole into mass in grams and vice-versa, we always need a relationship between mass and mole.

Molar mass of hydrogen sulphide, H_2S = 1×2+32 g /mol = 34g/mol

Therefore, number of grams of hydrogen sulphide, H_2S in 0.17 mol of it = 0.17 mol of oxygen × 34 g /mol = 5.78 g of hydrogen sulphide, H_2S.

29. Question

Show by means of calculations that 5 moles of CO_2 and 5 moles of H_2O do not have the same mass. How much is the difference in their masses?

Answer

One mole of CO_2 weighs (12+2×16)g = 44g

5 moles of CO_2 weighs 5×44g = 220g

One mole of H_2O weighs (1×2+16)g = 18g

5 moles of H_2O weighs 5×18g = 90g

Hence from above calculation, it can be concluded that there is a difference of 130 g between 5 moles of CO_2 and 5 moles of H_2O.

30. Question

Calculate the mole ratio of 240 g calcium and 240 g of magnesium. (Ca = 40 u; Mg = 24 u)

Answer

Molar mass of calcium, Ca = 40g

Given Mass of the calcium = 240g

As we know that, Number of moles = mass of an element/molar mass of an element

Hence Number of moles of Calcium = 240g/40g = 6 moles.

Molar mass of magnesium, Mg = 24g

Given Mass of the magnesium, Mg = 240g

As we know that, Number of moles = mass of an element/molar mass of an element

Hence Number of moles of magnesium = 240g/24g = 10 moles.

From above calculation, the molar ratio can be inferred - 6:10 = 3:5

Long Answer Type Questions-Pg-173

31 A. Question

Define mole. What are the two things that a mole represents?

Answer

Mole is defined as the amount of substance that contains as many specified elementary particles (such as atoms, molecules) as the number of atoms in 12g of carbon-12 isotope. One mole is also defined as the amount of substance which contains Avogadro number (6.023×10^{23}) of particles.

31 B. Question

What weight of each element is present in 1.5 moles of sodium sulphite, Na_2SO_3?

(Atomic masses: Na = 23 u; S = 32 u; O = 16 u)

Answer

1.5 moles of Na_2SO_3 has 1.5×2 = 3 moles of Na

1.5 moles of Na_2SO_3 has 1.5×1 = 1.5 mole of S

1.5 moles of Na_2SO_3 has 1.5×3 = 4.5 moles of O.

As we know that Mass of an element= number of moles x atomic mass

Thus, mass of sodium = 3 × 23 g = 69g

Mass of sulphur = 1.5 × 32 = 48g

Mass of oxygen = 4.5 × 16 g = 72g

32 A. Question

What is meant by 'a mole of carbon atoms'?

Answer

A mole of carbon atoms means a carbon sample measuring 12 g and containing 6.022×10^{23} carbon atoms.

32 B. Question

Which has more atoms, 50 g of aluminium or 50 g of iron? Illustrate your answer with the help of calculations.

(Atomic masses: Al = 27 u; Fe = 56 u)

Answer

Atomic mass of Al = 27u

1 mole of aluminium weighing 27g contains N = 6.022×10^{23} atoms of Al

So, 50g of Al contains = 50 × N(6.022 × 1023)/27 atoms of Al = 11 × 10^{23} atoms of Al

Atomic mass of Fe = 56 u

1 mole of iron weighing 56g contains N = 6.022 × 10^{23} atoms of Fe

So, 50g of Fe contains = 50 × N(6.022 × 10^{23})/56 atoms of Fe = 5 × 10^{23} atoms of Fe

Thus, 50g of Al has more no. of atoms as compared to 50g of Fe. This is because Aluminium has a smaller atomic mass and is lighter.

33 A. Question

Define gram atomic mass of a substance. How much is the gram atomic mass of oxygen?

Answer

The atomic mass of an element expressed in grams is called gram atomic mass. It is determined by taking the atomic weight for an element on the periodic table and expressing it in gram. Weight in grams is numerically equal to the atomic weight of the element.

The gram atomic mass of oxygen is equal to 16.

33 B. Question

How many moles of oxygen atoms are present in one mole of the following compounds?

(i) Al_2O_3 (ii) CO_2 (iii) Cl_2O_7

(iv) H_2SO_4 (v) $Al_2(SO_4)_3$

Answer

Moles of oxygen atom are -

(i). Al_2O_3 : 3 moles

(ii). CO_2 : 2 mole

(iii). Cl_2O_7 : 7 mole

(iv). H_2SO_4 : 4 mole

(v). $Al_2(SO_4)_3$: 12 mole

34 A. Question

Define gram molecular mass of a substance. How much is the gram molecular mass of oxygen?

Answer

Gram molecular mass of a substance is known as the quantity of the substance whose mass expressed in grams is numerically equal to its molecular mass. For example: The molecular mass of CO_2 is 44 u, its gram molecular mass is 44g.

The gram molecular mass of oxygen(O_2) = 2×16g = 32g

34 B. Question

If sulphur exists as S8 molecules, calculate the number of moles in 100 g of sulphur. (S = 32 u)

Answer

Given mass of sulphur, S_8 = 100g

Atomic mass of sulphur, S_8 = 32 × 8 g = 256g

Number of moles = Given mass of the element / Atomic mass of the element

Number of moles = 100/ 256 = 0.39 moles.

35 A. Question

What is meant by the 'molar mass' of a substance? State the unit in which molar mass is usually expressed.

Answer

Molar mass can be defined as the mass of one mole of a substance (may be an element or a compound). For example, One mole of oxygen(O_2) weighs 32.0 g. Thus, Molar mass of one mole molecules of oxygen = 32 g /mol

35 B. Question

Calculate the molar masses of the following substances. Write the results with proper units.

(i) Ozone molecule, O_3

(ii) Ethanoic acid, CH_3COOH

Answer

Molar mass of ozone (O_3) = 3 × gram atomic mass of O = 3 × 16 g = 48 g/ mole

(ii) Molar mass of Ethanoic acid (CH_3COOH) = 2×C + 4×H + 2×O = (24 + 4 + 32)u = 60 g/ mole

Multiple Choice Questions (MCQs)-Pg-173

36. Question

Which of the following pair of elements represents a mole ratio of 1 : 1?

A. 10 g of calcium and 12 g of magnesium

B. 12 g of magnesium and 6 g of carbon

C. 12 g of carbon and 20 g of calcium

D. 20 g of sodium and 20 g of calcium

Answer

Molar mass of magnesium = 24g

Given mass of magnesium = 12g

Number of moles = given mass of the element/ atomic weight of element

Number of moles of magnesium = 12/24 = 0.5 moles

Molar mass of carbon = 12g

Given mass of carbon = 6g

Number of moles = given mass of the element/ atomic weight of element

Number of moles of carbon = 6/12 = 0.5 moles

Hence, 12 g of magnesium and 6 g of carbon represents a mole ratio of 1 : 1

37. Question

Which of the following correctly represents 360 g water?

(i) 2 moles of H_2O

(ii) 20 moles 0f water

(iii) 6.022×10^{23} molecules of water

(iv) 1.2044×10^{25} molecules of water

A. (i)

B. (i) and (iv)

C. (ii) and (iii)

D. (ii) and (iv)

Answer

One mole of water = 18 g

20 moles of water = 360g; it supports option (ii)

38. Question

If 32g of sulphur has x atoms, then the number of atoms in 32g of oxygen will be:

A. x/2

B. 2x

C. x

D. 4x

Answer

Atomic weight of sulphur = 32g

One atom of sulphur weighs 32g

Atomic weight of oxygen is 16g

Hence, 2 atoms of oxygen weighs 32g

39. Question

A student wants to have 3.011×10^{23} atoms each of magnesium and carbon elements. For this purpose, he will have to weigh:

A. 24 g of magnesium and 6 g of carbon

B. 12 g of carbon and 24 g of magnesium

C. 20 g of magnesium and 10 g of carbon

D. 12 g of magnesium and 6 g of carbon

Answer

6.022×10^{23} atoms of magnesium = one mole of magnesium

3.011×10^{23} atoms of magnesium = 0.5 moles of magnesium

Mass of magnesium = atomic weight x number of moles

Mass of magnesium = $24 \times 0.5 = 12$g

Similarly 6.022×10^{23} atoms of carbon = one mole of carbon

3.011×10^{23} atoms of carbon = 0.5 moles of carbon

Mass of carbon = atomic weight × number of moles

Mass of carbon = $12 \times 0.5 = 6$g

40. Question

The ratio of moles of atoms in 12g of magnesium and 16g of sulphur will be:

A. 3 : 4

B. 4 : 3

C. 1 : 1

D. 1 : 2

Answer

Molar mass of magnesium = 24g

Given mass of magnesium = 12g

Number of moles = given mass of the element/ atomic weight of element

Number of moles of magnesium = 12/24 = 0.5 moles

Molar mass of sulphur = 32g

Given mass of sulphur = 16g

Number of moles = given mass of the element/ atomic weight of element

Number of moles of sulphur = 16/32 = 0.5 moles

Hence, 12 g of magnesium and 16 g of sulphur represents a mole ratio of 1 : 1

41. Question

If 12 gram of carbon has x atoms, then the number of atoms in 12 grams of magnesium will be:

A. x

B. 2x

C. x/2

D. 1.5x

Answer

Atomic weight of carbon = 12g

One atom of carbon weighs 12g

Atomic weight of magnesium is 24 g

Hence, 1/2 atom of magnesium weighs 12g

42. Question

Which of the following has the maximum number 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

18 g of CH_4 has the maximum number of atoms.

Questions Based on High Order Thinking Skills (HOTS)-Pg-174

43. Question

If 1 gram of sulphur dioxide contains x molecules, how many molecules will be present in 1 gram of oxygen?

(S = 32 u; O = 16 u)

Answer

1 mole of SO_2 = Mass of S + 2 × Mass of O = 64 grams

64 g of SO_2 = 1 mole

So, 1 g of SO_2 = 1/64 mole

Now since equal moles of all the substances contain equal number of molecules so, 1/64 mole of O_2 will also contain x molecules like SO_2.

32 g of oxygen = 1 mole

So, 1 g of oxygen = 1/32 mole

Now, 1/64 mole of oxygen contains = x molecules

So, 1/32 mole of oxygen will contain = x × 64/32 = 2x molecules

44. Question

The mass of one molecule of a substance is 4.65×10^{-23} g. What is its molecular mass? What could this substance be?

Answer

Mass of one molecule of substance = 4.65×10^{-23} u

So, mass of 1 mole of substance = Mass of 6.022×10^{23} molecules of the substance

$= 4.65 \times 10^{-23} \times 6.022 \times 10^{23}$ u = 28 u

The substance is Nitrogen with molecular mass 28 u.

45. Question

Which contains more molecules, 10 g of sulphur dioxide (SO_2) or 10 g of oxygen (O_2)?

(Atomic masses: S = 32 u; O = 16 u)

Answer

Molar mass of SO_2 = (32 + 2×16) g = 64g

Given mass of SO_2 = 10g

1 mole of substance = 6.023×10^{23} particles of the substance

No. of moles of SO_2 = 10g/64g = 0.15

Total no. of molecules of SO_2 = $0.15 \times 6.022 \times 10^{23} = 0.90 \times 10^{23}$ molecules of SO_2

Molar mass of oxygen (O_2) = 32g

Given mass of oxygen (O_2) = 10g

1 mole of substance = 6.023×10^{23} particles of the substance

No. of moles of O_2 = 10g/32g = 0.31

Total no. of molecules of O_2 = $0.31 \times 6.022 \times 10^{23} = 1.88 \times 10^{23}$ molecules of O_2

Thus, 10g of O_2 contains more no. of molecules.

46. Question

What weight of oxygen gas will contain the same number of molecules as 56 g of nitrogen gas? (O = 16 u; N = 14 u)

Answer

Given mass of nitrogen = 56g

Molar mass of nitrogen = 14g

No. of moles of nitrogen = given mass of the element/ molar mass of the element = 56g/14g = 4 moles

Equal number of moles of all the susbtances contain equal number of molecules.

So, 4 moles of nitrogen and 4 moles of oxygen contains same no. of molecules.

Hence, mass of 4 mole of oxygen = 4 × 16g = 64 g

47. Question

What mass of nitrogen, N_2, will contain the same number of molecules as 1.8 g of water, H_2O? (Atomic masses: N = 14 u; H = 1 u; O = 16 u)

Answer

Given mass of water = 1.8g

Molar mass of water = 18g

No. of moles of water = given mass of the element/ molar mass of the element = 1.8g/18g = 0.1 moles

Equal number of moles of all the substances contain equal number of molecules.

So, 0.1 moles of water and 0.1 moles of nitrogen contains same no. of molecules.

Hence, mass of 0.1 mole of nitrogen = 0.1 × 28 g = 2.8 g.

48. Question

If one gram of sulphur contains x atoms, calculate the number of atoms in one gram of oxygen element. (Atomic masses: S = 32 u; O = 16 u)

Answer

32 g of S = 1 mole

So, 1 g of S = 1/32 mole

Now since equal moles of all the substances contain equal number of atoms so, 1/32 mole of oxygen will also contain x atoms like S.

16 g of oxygen = 1 mole

So, 1 g of oxygen = 1/16 mole

Now, 1/32 mole of oxygen contains = x atoms

So, 1/16 mole of oxygen will contain = x × 32/16 = 2x atoms.

49. Question

How many grams of magnesium will have the same number of atoms as 6 grams of carbon? (Mg = 24 u; C = 12 u)

Answer

Given mass of carbon = 6g

Molar mass of carbon = 12g

No. of moles of carbon = Given mass of element/ Molar mass of element = 6g/12g = 0.5 moles

Equal number of moles of all the substances contain equal number of molecules.

So, 0.5 moles of carbon and 0.5 moles of magnesium contains same no. of molecules.

Hence, mass of 0.5 mole of magnesium = 0.5 × 24g = 12g

50. Question

The mass of one atom of an element X is 2.0×10^{-23} g.

(i) Calculate the atomic mass of element X.

(ii) What could element X be?

Answer

(i) Mass of one atom of element X = 2×10^{-23} g

Mass of 1 mole of atom of element X = $2 \times 10^{-23} \times 6.022 \times 10^{23}$ = 12.044 g

So, atomic mass of the element X = mass of 1 mole of element = 12 u

(ii) Element X is CARBON.