

CHAPTER 3 ATOMS AND MOLECULES
CBSE Class 9 – Chemistry

PAGE No 128

Solution: 01

International Union of Pure and Applied Chemistry

Solution: 02

(a) Law of conservation of mass – Antoine Lavoisier

(b) Law of constant proportions – Joseph Proust

Solution: 03

(a) Law of conservation of mass.

(b) Law of constant proportions.

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Solution: 04

John Dalton

Solution: 05

Atoms can neither be created nor destroyed.

Solution: 06

The elements consist of atoms having fixed mass, and that the number and kind of atoms of each element in a given compound is fixed.

Solution: 07

Kanad ; 'parmanu'.

Solution: 08

Law of Conservation of mass and law of constant proportions.

Solution: 09

Law of constant proportions.

Solution: 10

Law of Conservation of mass.

Solution: 11

Atoms are the building blocks of matter.

Solution: 12

The size of an atom indicated by its radius which is called 'atomic radius'.

Solution: 13

The radius of an atom is usually expressed in 'nanometers'.

Solution: 14

1 nanometer = 10^{-9} m

Solution: 15

'nm' represents nanometer.

Solution: 16

Because they are very very small.

Solution: 17

False ; it is Co

Solution: 18

The molecular mass of a substance is the relative mass of its molecule as compared with the mass of a Carbon-12 atom taken as 12 units.

Solution: 19

This means that a molecule of oxygen is 32 times heavier than $1/12$ of a Carbon-12 atom.

Solution: 20

(a) 1:8

(b) Conservation of mass

Solution: 21

(a) Carbon is used as a standard for atomic mass scale.

(b) Atom with 6 neutrons and 6 protons in its nucleus so that its mass number is 12.

(c) Mass = 12 u

Solution: 22

The major drawback of Dalton's atomic theory is that atoms were thought to be indivisible. But, it is not true since atoms are divisible.

Solution: 23

No, the statement is not valid because atoms can be divided into subatomic particles called electrons, protons and neutrons.

Solution: 24

Yes, 'THE SCANNING TUNNELLING MICROSCOPE' enables people to see atoms. This microscope can produce computer generated images of the surface of elements which show the individual atoms. The atoms show up as blurred images.

Solution: 25

The symbol of element is the "first letter" or "first letter and another letter" of the English name or Latin name of the element.

For example, symbol of Hydrogen is "H" and symbol of Calcium is "Ca".

Solution 26

(a) Ca, Mg

(b) Cu, Hg

Solution 27

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

Solution 28

Sodium – Na

Potassium – K

Iron – Fe

Copper – Cu

Mercury – Hg

Silver – Ag

Solution 29

Hg – Mercury

Pb – Lead

Au – Gold

Ag – Silver

Sn – Tin

Solution 30

The number of atoms present in one molecule of an element is called atomicity of that element.

For example, atomicity of sodium is 1 and that of nitrogen is 2.

Solution 31

(a) Oxygen = 2

(b) Ozone = 3

- (c) Neon = 1
- (d) Sulphur = 8
- (e) Phosphorus = 4
- (f) Sodium = 1

Solution 32

A chemical formula represents the composition of a molecule of the substance in terms of the symbols of the elements present in the molecule. It is also known as molecular formula.

Chemical formula of element – H₂ for hydrogen

Chemical formula of compound – H₂O for water

Solution 33

(a). Water- H₂O; Elements present are Hydrogen and Oxygen.

(b). Ammonia- NH₃; Elements present are Nitrogen and Hydrogen.

(c). Methane-CH₄; Elements present are Carbon and Hydrogen.

(d). Sulphur dioxide-SO₂; Elements present are Sulphur and Oxygen.

(e). Ethanol-C₂H₅OH; Elements present are carbon, hydrogen and oxygen.

Solution 34

2N represents two separate atoms of nitrogen and N₂ represents one molecule of nitrogen.

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Solution 35

- (a) O- one atom of oxygen
- (b) 2O- two separate atoms of oxygen
- (c) O₂-one molecule of oxygen
- (d) 3O₂-three molecules of oxygen

Solution: 36

H₂ represents two atoms of hydrogen, one atom of sulphur and four atoms of oxygen.

Solution 37

- (a) Oxygen gas occurs as a diatomic molecule in nature.
- (b) Noble gases occur as monoatomic gases in nature.

Solution: 38

2H represents two separate atoms of hydrogen and H₂ represents one molecule

of hydrogen.

Solution 39

- (a) N – one atom of nitrogen
- (b) 2N – two separate atoms of nitrogen
- (c) N₂ – one molecule of nitrogen
- (d) 2N₂ – two molecules of nitrogen

Solution: 40

Significance of formula of a substance-

1. Formula represents the name of the substance.
2. Formula represents one molecule of a substance.
3. Formula gives the number of atoms of each element present in one molecule.
4. Formula also represents one mole of molecules of the substance.

Solution: 41

Significance of the formula H₂O-

1. H₂O represents water.
2. It represents one molecule of water.
3. H₂O also represents 6.022 x 10²³ molecules of water.
4. It represents 18gm of water.

Solution 42

Molecular formula of glucose = C₆H₁₂O₆

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

Solution 43

(a).Molecular mass of Hydrogen (H₂) = 2 x H = 2 x 1 u = 2 u

(b).Molecular mass of oxygen (O₂) = 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 (NH₃) = 1 x N + 3 x H = 14 + 3 = 17 u

(e).Molecular mass of carbon dioxide (CO₂) = 1 x C + 2 x O = 12 + 32 = 44 u

Solution 44

(a). Molecular mass of methane (CH₄) = 12 + 4 = 16 u

(b). Molecular mass of ethane (C₂H₆) = 2 x 12 + 6 x 1 = 30 u

(c). Molecular mass of ethane (C₂H₄) = 2 x 12 + 4 x 1 = 28 u

(d). Molecular mass of ethyne (C_2H_2) = $2 \times 12 + 2 \times 1 = 26 \text{ u}$

Solution 45

(a) Molecular mass of Methanol(CH_3OH) =
 $1 \times C + 3 \times H + 1 \times O + 1 \times H = (12+3+16+1)u = 32u$

(b) Molecular mass of Ethanol (C_2H_5OH) = $2 \times C + 5 \times H + 1 \times O + 1 \times H$
 $= (24 + 5 + 16 + 1) = 46u$

Solution: 46

Molecular mass of ethanoic acid (CH_3COOH)
 $= 1 \times C + 3 \times H + 1 \times C + 2 \times O + 1 \times H = 12+3+12+32+1 = 60u$

Solution: 47

Molecular mass of Nitric acid (HNO_3) = $1 \times H + 1 \times N + 3 \times O$
 $= (1 + 14 + 48) u = 63 u$

Solution: 48

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

Solution: 49

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

Solution: 50

(a).Molecular mass of hydrogen sulphide (H_2S) = $2 \times H + 1 \times S$
 $= (2+32) u = 34u$

(b). Molecular mass of Carbon disulphide (CS_2) = $1 \times C + 2 \times S = (12+2 \times 32) u = 76 u$

Solution: 51

Law of conservation of mass by LAVOISIER states that: "Mass can neither be created nor be destroyed in a chemical reaction". So, in a chemical reaction, the total mass of reactants must be equal to the total mass of products.

For example: When calcium carbonate is heated, a chemical reaction takes place to form calcium oxide and calcium carbonate. If 100 gms of calcium carbonate is decomposed completely, then 56 gms of calcium oxide and 44 gms of carbon dioxide are formed.

In the above example: the total mass of products = 56 gms (CaO) + 44gms (CO_2) = 100 gms.

As total mass of products is equal to the total mass of reactant so, the law of conservation of mass is satisfied.

Solution: 52

Law of constant proportion given by PROUST states that “A chemical compound always consists of the same elements combined together in the same proportion by mass.”

For example: If we decompose 100 gms of pure water by passing electricity through it, then 11 gms of hydrogen and 89 gms of oxygen are obtained. Now, if we repeat this experiment by taking pure water from different sources (like river, sea, well, etc.), the same masses of hydrogen and oxygen elements are obtained in each case. They are always combined together in the same constant proportion of 11:89 or 1:8 by mass. And this is the law of constant proportions.

Solution: 53

[a]. Postulates of Dalton’s atomic theory:

- a) All the matter is made up of very small particles called ‘atoms’.
- b) Atoms cannot be divided.
- c) Atoms can neither be created nor be destroyed.
- d) Atoms are of various kinds. There are as many kinds of atoms as are elements.
- e) All the atoms of a given element are identical in every respect, having the same mass, size and chemical properties.
- f) Atoms of different elements differ in mass, size and chemical properties.
- g) The ‘number’ and ‘kind’ of atoms in a given compound is fixed.
- h) During chemical combination, atoms of different elements combine in small whole numbers to form compounds.
- i) Atoms of the same elements can combine in more than one ratio to form more than one compound.

[b]. The postulate “The elements consists of atoms and that atoms can neither be created nor destroyed” can be used to explain the law of conservation of mass.

[c]. The postulate “The elements consist of atoms having fixed mass, and that the number and kind of atoms of each element in a given compound is fixed” can be used to explain the law of constant proportions.

Solution: 54

(a).Significance of symbol of element –

- i. It represents name of the element.
- ii. It represents one atom of the element.
- iii. It represents a definite mass of the element.
- iv. It represents one mole of atoms of the element.

For example – C represents one atom of the element Carbon. It also represents 12 gms of Carbon.

(b). Significance of symbol H –

- i. It represents Hydrogen element.
- ii. It represents one atom of Hydrogen element.
- iii. It represents one mole of Hydrogen atoms.
- iv. It represents 2 gms of Hydrogen.

Solution: 55

a) An atom is the smallest particle of an element that can take part in a chemical reaction. They usually exist in combination with the atoms of same element or another element.

b) A molecule is an electrically neutral group of two or more atoms chemically bonded together.

For example- Ozone gas has three oxygen atoms combined together, so ozone exists in the form of O₃ molecule.

c) The molecule of an element contains two or more similar atoms chemically bonded together.

For example- A molecule of hydrogen element consists of 2 hydrogen atoms combined together.

Whereas the molecule of compound contains two or more different type of atoms chemically bonded together.

For example- The molecule of hydrogen chloride(HCl) contains two different type of atoms, i.e. H and Cl.

Solution: 56

(a) One atomic mass unit is defined as exactly one-twelfth the mass of an atom of carbon-12. Its symbol is 'u'.

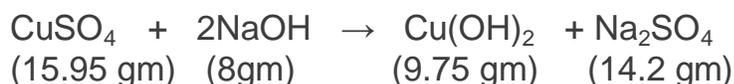
(b) The atomic mass of an element is the relative mass of its atom as compared with the mass of a carbon-12 atom taken as 12 units.

(c) It means that one atom of oxygen is 16 times heavier than 1/12 of a C-12 atom.

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Solution: 75

According to question-



Clearly, in this case

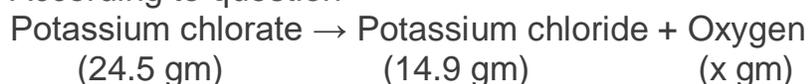
total mass of reactants = (15.95 gm + 8 gm) = 23.95 gm

total mass of products = (9.75 gm + 14.2 gm) = 23.95 gm

Hence, Law of conservation of mass is valid here.

Solution: 76

According to question-



Let, x gm of oxygen is formed

Then, according to law of conservation of mass-

$$24.5 \text{ gm} = 14.9 \text{ gm} + x \text{ gm}$$

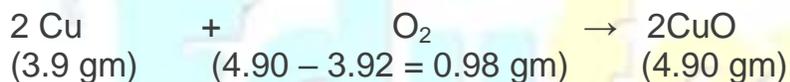
$$\text{So, } x = (24.5 - 14.9) \text{ gm} = 9.6 \text{ gm.}$$

Thus, 9.6 gm of oxygen is formed in the reaction

Solution: 77

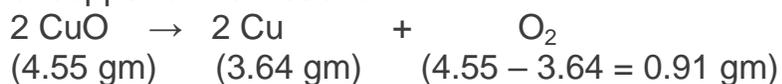
According to question-

Reaction 1-



$$\frac{3.92}{3.92} = 1, \frac{0.98}{3.92} = 0.25, \frac{4.90}{3.92} = 1.25$$

So, 1 equivalent of Cu reacts with 0.25 equivalent of O₂ to form 1.25 equivalent of copper oxide Reaction 2 –



$$\frac{4.55}{3.64} = 1.25, \frac{3.64}{3.64} = 1, \frac{0.91}{3.64} = 0.25$$

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.

Solution: 78

According to question –



3x 2x x

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

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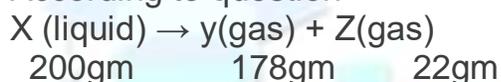
Solution: 79

When 5 gm of calcium is burnt in 2 gm 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.

Solution: 80

According to question-



(a) Liquid X – Water

Gas Y – Oxygen

Gas Z – Hydrogen

(b) mass of Z / mass of Y = 22gm / 178 gm = 1:8

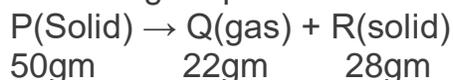
(c) Law of constant proportion is illustrated by this example.

(d) Two sources of liquid X – Sea, Well

(e) Gas Y (oxygen) is necessary for breathing.

Solution: 81

According to question-



(a) Solid P – Calcium Carbonate (CaCO₃)

Gas Q – Carbon dioxide (CO₂)

Solid R – Calcium oxide (CaO)

(b) Total mass of Q and R = $22\text{gm} + 28\text{gm} = 50\text{gm}$

(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.

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Solution: 01

Ions

Solution: 02

(a). Anions ; (b). Cations

Solution: 03

The formula mass of an ionic compound is the relative mass of its 'formula unit' as compared with the mass of a Carbon-12 atom taken as 12 units.

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Solution: 04

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

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

Solution: 05

(a) False

(b) True

Solution: 06

(a). Calcium oxide – CaO

(b). Magnesium hydroxide – $\text{Mg}(\text{OH})_2$

Solution: 07

Valency of element Z = 3

Valency of oxygen = 2

So, formula of oxide of element = Z_2O_3

Solution: 08

Its Na^+ , the sodium ion.

Solution: 09

Its Cl^- , the chloride ion.

Solution: 10

- (a) Anion
- (b) Cation
- (c) Ion
- (d) Electrons ; protons
- (e) Protons ; electrons

Solution: 11

Water is made up of Hydrogen and oxygen.

Valency of hydrogen is +1 ; Valency of oxygen is -2.

Chemical formula of water is H_2O .

Solution: 12

Symbols: H N

Valencies: +1 -3

So, chemical formula of ammonia is NH_3 .

Solution: 13

Symbols: S O

Valencies: +4 -2

Chemical formula of sulphur dioxide is SO_2 .

Solution: 14

According to question-

Symbols: C S

Valencies: +4 -2

Name and formula of the resulting compound is Carbon disulphide; CS_2 .

Solution: 15

As the valency of element X is 4 and that of Y is 1, so the resulting formula is XY_4 .

Solution: 16

When the valency shown by B is 4, then

Symbols: B O

Valencies: +4 -2

The resulting compound is BO_2

When the valency shown by B is 6, then

Symbols: B O

Valencies: +6 -2

The resulting compound is BO_3

Solution: 17

Symbols: X Y

Valencies: 3 2

Thus, the resulting compound is X_2Y_3

Solution: 18

Symbols: Mg HCO_3

Valencies: +2 -1

Thus, the resulting compound is $\text{Mg}(\text{HCO}_3)_2$

Solution: 19

(a). Bromide of element-

As valency of bromine is -1 and that of element X is +2 so, the resulting compound is XBr_2 .

(b). Oxide of element-

As valency of oxygen is -2 and that of element is +2 so, the resulting compound is XO .

Solution: 20

(a) Sodium oxide

Symbols: Na O

Valencies: +1 -2

Thus, the formula of sodium oxide is Na_2O .

(b) Calcium carbonate

Symbols: Ca CO_3

Valencies: +2 -2

Thus, the resulting compound is CaCO_3

Solution: 21

(a).Molecular mass of $\text{Na}_2\text{O} = (2 \times \text{Na}) + (1 \times \text{O}) = (2 \times 23) + (1 \times 16) = 62\text{u}$

(b). Molecular Mass of $\text{Al}_2\text{O}_3 = (2 \times \text{Al}) + (3 \times \text{O}) = (2 \times 27) + (3 \times 16) = 102\text{u}$

Solution: 22

- (a). CuSO_4 : Copper sulphate; Cu^{+2} and SO_4^{-2}
- (b). $(\text{NH}_4)_2\text{SO}_4$: Ammonium sulphate; NH_4^+ and SO_4^{-2} .
- (c). Na_2O : Sodium oxide; Na^+ and O^{-2}
- (d). Na_2CO_3 : Sodium carbonate; Na^+ and CO_3^{-2} .
- (e). CaCl_2 : Calcium chloride; Ca^{+2} and Cl^- .

Solution: 23

- (a). CH_3COONa : Na^+ (cation) and CH_3COO^- (anion)
- (b). NaCl : Na^+ (cation) and Cl^- (anion)
- (c). H_2 : It is a covalent molecule. So, cation and anion are not present.
- (d). NH_4NO_3 : NH_4^+ (cation) and NO_3^- (anion)

Solution: 24

- (a) Element: Ca F
Valencies: +2 -1

Thus, the resulting compound is CaF_2

- (b) Element: H S
Valencies: +1 -2

Thus, the resulting compound is H_2S .

- (c) Element: N H
Valencies: -3 +1

Thus, the resulting compound is NH_3

- (d) Element: C Cl
Valencies: +4 -1

Thus, the resulting compound is CCl_4

- (e) Element: Na O
Valencies: +1 -2

Thus, the resulting compound is Na_2O

- (f) Element: C O
Valencies: +4 -2

Thus, the resulting compound is CO_2

Solution: 25

i. Ionic compounds- The compounds which are formed by combination of metals and non-metals are called ionic compounds. For ex: CaCl_2 and CaCO_3 .

ii. Molecular compounds- These compounds are formed by the combination between two non-metal elements. For ex. HCl and H_2S .

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Solution: 26

(a) An ion is a positively or negatively charged atom (or group of atoms). An ion is formed by the loss or gain of an electrons contains an unequal number of protons and electrons.

Example – (1) Sodium ion, Na^+ , formed by loss of one electron.

(2) Chloride ion, Cl^- , formed by gain of one electron.

- (b) i. Sodium phosphate – Na_3PO_4
 ii. Ammonium sulphate – $(\text{NH}_4)_2\text{SO}_4$
 iii. Calcium Hydroxide – $\text{Ca}(\text{OH})_2$
 iv. Lead bromide – PbBr_2

Solution: 27

(a) A cation is formed by the loss of one or more electrons by an atom. For ex. Magnesium loses 2 electron to form Mg^{+2} .

An anion is formed by the gain of one or more electrons by an atom. For Ex. Chlorine loses one electron to form Cl^- .

- (b) (i). Na_2S
 (ii). $\text{Cu}(\text{NO}_3)_2$

Solution: 28

(i).



The reason for positive charge on sodium is the loss of electron.

(ii).



The reason for negative charge on chlorine is the gain of electron.

Solution: 29

(a). Simple ions: Br⁻ and Na⁺; Compound ions: NH₄⁺ and Al³⁺

(b). (i). YCl₄ (ii). YO₂ (iii). Y (SO₄)₂ (iv). Y (CO₃)₂ (v). Y (NO₃)₄

Solution: 30

(a). The simplest combination of ions that produces an electrically neutral unit, is called 'formula unit' of the ionic compound.

Formula unit of sodium chloride – NaCl

Formula unit of magnesium chloride – MgCl₂

(b).

(i). Formula Mass of Calcium chloride (CaCl₂) = 1xCa + 2xCl = (40+71) u = 111 u

(ii). Formula Mass of Sodium carbonate (Na₂CO₃) = 2xNa + 1xC + 3xO = (2x23 + 1x12 + 3x16) u = 106 u

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Solution: 46

(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 AC₅.

Solution: 47

Valency of X –

(i). In H₂X: -2

(ii). In CX₂ : -2

(iii). In XO₂ : +4

(iv). In XO₃ : +6

Solution: 48

Let the valency of X be y, then

$$2 \times (+3) + 3 \times y = 0$$

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.

Solution: 49

According to formula M₂CO₃, valency of M is +1.

(a). formula of iodide = MI (as valency of iodine is -1)

(b). formula of nitride = M_3N (as valency of nitrogen is -3)

(c). formula of phosphate = M_3PO_4

Solution: 50

(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).

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Solution: 1

A mole

Solution: 2

1 mole

Solution: 3

Solution: 4

One mole of atoms(6.022×10^{23} atoms)

Solution: 5

6.022×10^{23}

Solution: 6

Avogadro number

Solution: 7

Given mass of oxygen = 12g

Molar mass of oxygen = 32g

No. of moles = Given mass / Molar mass = $12\text{g} / 32\text{g} = 0.375$

Solution: 8

No. of moles = $3.6\text{g} / 18\text{g} = 0.2$ mole

Solution: 9

Mass of 0.2 moles of oxygen atoms = $0.2 \times 16 = 3.2\text{g}$

Solution: 10

Mass of 2 moles of nitrogen atoms = $2 \times 14 = 28\text{g}$

Solution: 11

Given mass of $\text{CaCO}_3 = 10\text{g}$

Molar mass of $\text{CaCO}_3 = 1 \times \text{Ca} + 1 \times \text{C} + 3 \times \text{O} = (40+12+48)\text{gm} = 100\text{gm}$

So, no. of moles of $\text{CaCO}_3 = \text{Given mass} / \text{Molar mass} = 10/100 = 0.1$ moles

Solution: 12

(a) 6.022×10^{23} atoms

(b) One mole

(c) Avogadro's Number

Solution 13

One mole of $\text{O}_2 = 32\text{gm}$

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

Solution 14

One mole of ammonia contains = 6.022×10^{23} molecules of ammonia

So, 1.5 moles of ammonia contains = $1.5 \times 6.022 \times 10^{23}$ molecules

= 9.033×10^{23} molecules of ammonia

Solution 15

Given mass of $\text{CaCO}_3 = 10\text{g}$

Molar mass of $\text{CaCO}_3 = 1 \times \text{Ca} + 1 \times \text{C} + 3 \times \text{O} = (40+12+48)\text{gm} = 100\text{ gm}$

So, no of moles of $\text{CaCO}_3 = \text{Given mass} / \text{Molar mass} = 10/100 = 0.1$ moles

Solution: 16

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

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

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

$$= 0.0199 \text{ moles of } O_2$$

Solution: 17

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

$$= 4.648 \times 10^{-23} \text{ grams of } N_2$$

Solution: 18

1 mole of sodium weighs = 23 gm

So, 1 gm of sodium will have = $1/23$ moles of sodium

Therefore, 34.5 gm of sodium will have = $34.5/23 = 1.5$ moles of sodium.

Solution: 19

1 mole of Zn = 65gm of zinc = 6.022×10^{23} atoms of zinc

Given mass of zinc = 10gm

No. of moles of zinc = $10/65 = 0.15$ moles of zinc

Total no. of atoms in 0.15 moles = $0.15 \times 6.022 \times 10^{23}$ atoms of Zn

$$= 9.264 \times 10^{22} \text{ atoms of Zn}$$

Solution: 20

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

Solution: 21

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

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

Page No 173**Solution: 22**

1 mole of hydrogen has = 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.

Solution: 23

6.022×10^{23} atoms of phosphorus has = 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

Solution: 24

Given mass of CHCl_3 = 0.0239 g

Molar mass of CHCl_3 = $1 \times \text{C} + 1 \times \text{H} + 3 \times \text{Cl} = 119.5$ g

No. of moles = Given mass/ Molar mass

No. of moles = $0.0239/119.5 = 0.0002$

So, no. of molecules present in 0.0239 g of chloroform = $0.0002 \times 6.022 \times 10^{23}$

= 12.044×10^{19} molecules

Solution: 25

1 mole of Na_2CO_3 = 106g

So, 5 x mole of Na_2CO_3 = $5 \times 106\text{g} = 530\text{g}$

Solution: 26

32 g of oxygen (1 mole of oxygen) has = 6.022×10^{23} molecules of oxygen

So, 4 g of oxygen will have = $6.022 \times 10^{23} \times 4/32 = 7.528 \times 10^{22}$ molecules of oxygen

Solution: 27

Molar mass of glucose = 180 g

180 g of glucose has = 1 mol

So, 100 g of glucose will have = $1 \times 100/180 = 0.55$ moles

Solution: 28

1 mole of H_2S weighs = 34g

So, 0.17 mole of H_2S will weight = $34 \times 0.17 \text{ g} = 5.78 \text{ g}$

Solution: 29

Molar mass of CO_2 = 44G

Molar mass of H_2O = 18G

Mass of 5 mole of CO_2 = $5 \times 44G = 220G$

So, 5 mole of H_2O and 5 mole of CO_2 do not have same mass

And the difference in their masses = $220g - 90g = 130g$

Solution: 30

240g of calcium has $240/40 = 6$ moles

240g of magnesium has = $240/24 = 10$ moles

So, required mole ratio = $6:10 = 3:5$

Solution: 31

(a) A group 6.022×10^{23} particles (atoms molecules or ions) of a substance is called a mole of that substance. One mole represent of a substance equal to its 'GRAM ATOMIC MASS' or 'GRAM MOLECULAR MASS' and 6.022×10^{23} no. of particles of the substance.

(b) 1.5 moles of Na_2SO_3 has 3 moles of Na, 1.5 moles of S and 4.5 moles of O.

Thus, mass of sodium = $3 \times 23g = 69g$

Mass of sulphur = $1.5 \times 32 = 48g$

Mass of oxygen = $4.5 \times 16g = 72g$

Solution: 32

(a) A mole of carbon atoms means a carbon sample weighing 12g and containing 6.022×10^{23}

(b) 1 mole of aluminum weighing 27g has = 6.022×10^{23} atoms of Al

So, 1g of Al = 0.22×10^{23} atoms of Al

Hence, 50g of Al will have = $50 \times 0.22 \times 10^{23}$ atoms of Al

= 11×10^{23} atoms of Al

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

So, 1g of Fe has = 0.10×10^{23} atoms of Fe

Hence, 50g of Fe will have = $50 \times 0.10 \times 10^{23}$ atoms of Fe = 5×10^{23} atoms of Fe

Thus, 50g of Al has more no. of atoms as compared to 50g of Fe.

Solution: 33

(a) The amount of substance whose mass in grams is numerically equal to its atomic mass, is called gram atomic mass of oxygen is 16g.

(b) Moles of oxygen atom are

(i) Al_2O_3 : 3 mole

(ii) CO_2 : 2 mole

(iii) Cl_2O_7 : 7 mole

(iv) H_2SO_4 : 4 mole

(v) $\text{Al}_2(\text{SO}_4)_3$: 12 MOLE

Solution: 34

(a) The amount of substance whose mass in grams is numerically equal to its molecular mass is called gram molecular mass of oxygen is 32g.

(b) Given mass of sulphur = 100g

Molar mass of S_8 = 32×8 = 256g

No. of moles = Given mass/Molar mass = $100/256$ = 0.39 moles.

Solution: 35

(a) The molar mass of the substance is the mass of 1 mole of that substance. Molar mass is generally expressed.

(b) (i) Molar mass of ozone (O_3) = 3×16 = 48g/ mole

(ii) Molar mass of Ethanoic acid (CH_3COOH) = $2 \times \text{C} + 4 \times \text{H} + 2 \times \text{O}$
 = $(24 + 4 + 32) \text{u} = 60 \text{g/mole}$

Page No 174

Solution: 43

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

64g 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

32g 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 = $x \times 64/32 = 2x$ molecules

Solution: 44

Mass of one molecules 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 = 28u

The substance is nitrogen with molecular mass 28 u

Solution: 45

Molar mass of SO_2 = $(32 + 2 \times 16)$ g = 64g

Molar mass of oxygen (O_2) = 32G

Given mass of SO_2 = 10g = Given mass of oxygen (O_2)

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

(a) No. of moles of SO_2 = $10\text{g}/64\text{g} = 0.15$

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

(b) No. of moles of O_2 = $10\text{g}/32\text{g} = 0.31$

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.

Solution: 46

Given mass of nitrogen = 56g

Molar mass of nitrogen = 14g

No. of moles of nitrogen = $56\text{g}/14\text{g} = 4$ moles

Equal number of moles of all the substances 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 = $4 \times 16\text{g} = 64\text{g}$

Solution: 47

Given mass of water = 1.8 g

Molar mass of water = 18g

No. of moles of water = $1.8\text{g}/18\text{g} = 0.1$ 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 = $0.1 \times 28\text{g} = 2.8\text{g}$

Solution: 48

32g of S = 1 mole,

So, 1g 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.

16g of oxygen = $1/16$ mole

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

So, $1/16$ mole of oxygen will contain = $x \times 32/16 = 2x$ atoms

Solution: 49

Given mass of carbon = 6g

Molar mass of carbon = 12g

No. of moles of carbon = $6\text{g}/12\text{g} = 0.5$ 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 moles of magnesium = $0.5 \times 24\text{g} = 12\text{g}$

Solution: 50

(i) Mass of 1 g of element X = $2 \times 10^{-23}\text{g}$

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

Molar mass of the element X = mass of 1 mole of element = 12 u

(ii) Element X is CARBON.