Intext Exercise 1

Question 1:
In a reaction, 5.3g of sodium carbonate reacted with 6g of ethanoic acid. The products were 2.2g of carbon dioxide, 0.9g water and 8.2g of sodium ethanoate. Show that these observations are in agreement with the law of conservation of mass.

Sodium carbonate + ethanoic acid → sodium ethanoate + carbon dioxide + water

Solution 1:
In the given reaction, sodium carbonate reacts with ethanoic acid to produce sodium ethanoate, carbon dioxide, and water.

Sodium carbonate	+	Ethanoic acid	$\longrightarrow$	Sodium ethanoate	+	Carbon dioxide	+	Water

$$Na_2CO_3 + CH_3COOH \longrightarrow CH_3COONa + CO_2 + H_2O$$

Mass of sodium carbonate = 5.3 g (Given)
Mass of ethanoic acid = 6 g (Given)
Mass of sodium ethanoate = 8.2 g (Given)
Mass of carbon dioxide = 2.2 g (Given)
Mass of water = 0.9 g (Given)
Now, total mass before the reaction = (5.3 + 6) g
= 11.3 g
And, total mass after the reaction = (8.2 + 2.2 + 0.9) g
= 11.3 g
∴Total mass before the reaction = Total mass after the reaction
Hence, the given observations are in agreement with the law of conservation of mass.

Question 2:
Hydrogen and oxygen combine in the ratio of 1:8 by mass to form water. What mass of oxygen gas would be required to react completely with 3 g of hydrogen gas?

Solution 2:
It is given that the ratio of hydrogen and oxygen by mass to form water is 1:8.
Then, the mass of oxygen gas required to react completely with 1 g of hydrogen gas is 8 g.
Therefore, the mass of oxygen gas required to react completely with 3 g of hydrogen gas is 8 × 3 g = 24 g.

Question 3:
Which postulate of Dalton's atomic theory is the result of the law of conservation of mass?

Solution 3:
The postulate of Dalton's atomic theory which is a result of the law of conservation of mass is:

Atoms are indivisible particles, which can neither be created nor destroyed in a chemical reaction.

Question 4:
Which postulate of Dalton's atomic theory can explain the law of definite proportions?

Solution 4:
The postulate of Dalton's atomic theory which can explain the law of definite proportion is: The relative number and kind of atoms in a given compound remains constant.

Intext Exercise 2

Question 1:
Define atomic mass unit.

Solution 1:
Mass unit equal to exactly one-twelfth $\left(\frac{1}{12^{th}}\right)$ the mass of one atom of carbon-12 is called one atomic mass unit. It is written as 'u'.

Question 2:
Why is it not possible to see an atom with naked eyes?

Solution 2:
The size of an atom is so small that it is not possible to see it with naked eyes. Also, the atom of an element does not exist independently.

Intext Exercise 3

Question 1:
Write down the formulae of
(i) sodium oxide
(ii) aluminium chloride
(iii) sodium suphide
(iv) magnesium hydroxide

Solution 1:
(i) Sodium oxide $\rightarrow Na_2O$
(ii) Aluminium chloride $\rightarrow AlCl_3$
(iii) Sodium suphide $\rightarrow Na_2S$
(iv) Magnesium hydroxide $\rightarrow Mg(OH)_2$

Question 2:
Write down the names of compounds represented by the following formulae:
(i) $Al_2(SO_4)_3$

(ii) $CaCl_2$
(iii) K_2SO_4
(iv) KNO_3
(v) $CaCO_3$

Solution 2:
(i) $Al_2(SO_4)_3$ → Aluminium sulphate
(ii) $CaCl_2$ → Calcium chloride
(iii) K_2SO_4 → Potassium sulphate
(iv) KNO_3 → Potassium nitrate
(v) $CaCO_3$ → Calcium carbonate

Question 3:
What is meant by the term chemical formula?

Solution 3:
The chemical formula of a compound means the symbolic representation of the composition of a compound. From the chemical formula of a compound, we can know the number and kinds of atoms of different elements that constitute the compound. For example, from the chemical formula CO_2 of carbon dioxide, we come to know that one carbon atom and two oxygen atoms are chemically bonded together to form one molecule of the compound, carbon dioxide.

Question 4:
How many atoms are present in a
(i) H_2S molecule and
(ii) PO_4^{3-} ion?

Solution 4:
(i) In an H_2S molecule, three atoms are present; two of hydrogen and one of sulphur.
(ii) In a PO_4^{3-} ion, five atoms are present; one of phosphorus and four of oxygen.

Intext Exercise 4

Question 1:
Calculate the molecular masses of H_2, O_2, Cl_2, CO_2, CH_4, C_2H_6, C_2H_4, NH_3, CH_3OH.

Solution 1:
Molecular mass of H_2 = 2 × Atomic mass of H
= 2 × 1
= 2 u
Molecular mass of O_2 = 2 × Atomic mass of O
= 2 × 16
= 32 u

Molecular mass of Cl_2 = 2 × Atomic mass of Cl
= 2 × 35.5
= 71 u
Molecular mass of CO_2 = Atomic mass of C + 2 × Atomic mass of O
= 12 + 2 × 16
= 44 u
Molecular mass of CH_4 = Atomic mass of C + 4 × Atomic mass of H
= 12 + 4 × 1
= 16 u
Molecular mass of C_2H_6 = 2 × Atomic mass of C + 6 × Atomic mass of H
= 2 × 12 + 6 × 1
= 30 u
Molecular mass of C_2H_4 = 2 × Atomic mass of C + 4 × Atomic mass of H
= 2 × 12 + 4 × 1
= 28 u
Molecular mass of NH_3 = Atomic mass of N + 3 × Atomic mass of H
= 14 + 3 × 1
= 17 u
Molecular mass of CH_3OH = Atomic mass of C + 4 × Atomic mass of H + Atomic mass of O
= 12 + 4 × 1 + 16
= 32 u

Question 2:
Calculate the formula unit masses of ZnO, Na_2O, K_2CO_3, given atomic masses of Zn = 65 u, Na = 23 u, K = 39 u, C = 12 u, and O = 16 u.

Solution 2:
Formula unit mass of ZnO = Atomic mass of Zn + Atomic mass of O
= 65 + 16
= 81 u
Formula unit mass of Na_2O = 2 × Atomic mass of Na + Atomic mass of O
= 2 × 23 + 16
= 62 u
Formula unit mass of K_2CO_3 = 2 × Atomic mass of K + Atomic mass of C + 3 × Atomic mass of O
= 2 × 39 + 12 + 3 × 16
= 138 u

Intext Exercise 5

Question 1:
If one mole of carbon atoms weighs 12 gram, what is the mass (in gram) of 1 atom of carbon?

Solution 1:

One mole of carbon atoms weighs 12 g (Given)

i.e., mass of 1 mole of carbon atoms = 12 g

Then, mass of 6.022×10^{23} number of carbon atoms = 12 g

Therefore, mass of 1 atom of carbon $=\frac{12}{6.022\times10^{23}}g$

$=1.9926\times10^{-23}g$

Question 2:

Which has more number of atoms, 100 grams of sodium or 100 grams of iron (given, atomic mass of Na = 23 u, Fe = 56 u)?

Solution 2:

Atomic mass of Na = 23 u (Given)

Then, gram atomic mass of Na = 23 g

Now, 23 g of Na contains = 6.022×10^{23} number of atoms

Thus, 100 g of Na contains $=\frac{6.022\times10^{23}}{23}\times100$ number of atoms

= 2.6182×10^{24} number of atoms

Again, atomic mass of Fe = 56 u(Given)

Then, gram atomic mass of Fe = 56 g

Now, 56 g of Fe contains = 6.022×10^{23} number of atoms

Thus, 100 g of Fe contains $=\frac{6.022\times10^{23}}{56}\times100$ number of atoms

$=1.0753\times10^{24}$ number of atoms

Therefore, 100 grams of sodium contain more number of atoms than 100 grams of iron.

NCERT Exercise

Question 1:

A 0.24 g sample of compound of oxygen and boron was found by analysis to contain 0.096 g of boron and 0.144 g of oxygen. Calculate the percentage composition of the compound by weight.

Solution 1:

Mass of boron = 0.096 g (Given)

Mass of oxygen = 0.144 g (Given)

Mass of sample = 0.24 g (Given)

Thus, percentage of boron by weight in the compound $=\frac{0.096}{0.24}\times100\%$

= 40%

And, percentage of oxygen by weight in the compound $=\frac{0.144}{0.24}\times100\%$

= 60%

Question 2:
When 3.0 g of carbon is burnt in 8.00 g oxygen, 11.00 g of carbon dioxide is produced. What mass of carbon dioxide will be formed when 3.00 g of carbon is burnt in 50.00 g of oxygen? Which law of chemical combinations will govern your answer?

Solution 2:
Carbon + Oxygen $\longrightarrow$ Carbon dioxide
3 g of carbon reacts with 8 g of oxygen to produce 11 g of carbon dioxide.
If 3 g of carbon is burnt in 50 g of oxygen, then 3 g of carbon will react with 8 g of oxygen.
The remaining 42 g of oxygen will be left un-reactive.
In this case also, only 11 g of carbon dioxide will be formed.
The above answer is governed by the law of constant proportions.

Question 3:
What are polyatomic ions? Give examples?

Solution 3:
A polyatomic ion is a group of atoms carrying a charge (positive or negative). For example, ammonium ion $\left(NH_4^+\right)$, hydroxide ion (OH^-), carbonate ion , $\left(CO_3^{2-}\right)$ sulphate ion $\left(SO_4^{2-}\right)$.

Question 4:
Write the chemical formulae of the following:
(a) Magnesium chloride
(b) Calcium oxide
(c) Copper nitrate
(d) Aluminium chloride
(e) Calcium carbonate

Solution 4:
(a) Magnesium chloride → $MgCl_2$
(b) Calcium oxide → CaO
(c) Copper nitrate → $Cu\ (NO_3)_2$
(d) Aluminium chloride → $AlCl_3$
(e) Calcium carbonate → $CaCO_3$

Question 5:
Give the names of the elements present in the following compounds:
(a) Quick lime
(b) Hydrogen bromide
(c) Baking powder
(d) Potassium sulphate

Solution 5:

Compound	Chemical formula	Elements present
Quick lime	CaO	Calcium, oxygen
Hydrogen bromide	HBr	Hydrogen, bromine
Baking powder	$NaHCO_3$	Sodium, hydrogen, carbon, oxygen
Potassium sulphate	K_2SO_4	Potassium, sulphur, oxygen

Question 6:

Calculate the molar mass of the following substances:

(a) Ethyne, C_2H_2

(b) Sulphur molecule, S_8

(c) Phosphorus molecule, P_4 (atomic mass of phosphorus = 31)

(d) Hydrochloric acid, HCl

(e) Nitric acid, HNO_3

Solution 6:

(a) Molar mass of ethyne, $C_2H_2 = 2 \times 12 + 2 \times 1 = 28$ g

(b) Molar mass of sulphur molecule, $S_8 = 8 \times 32 = 256$ g

(c) Molar mass of phosphorus molecule, $P_4 = 4 \times 31 = 124$ g

(d) Molar mass of hydrochloric acid, HCl = 1 + 35.5 = 36.5 g

(e) Molar mass of nitric acid, $HNO_3 = 1 + 14 + 3 \times 16 = 63$ g

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Question 7:

What is the mass of:

(a) 1 mole of nitrogen atoms?

(b) 4 moles of aluminium atoms (Atomic mass of aluminium = 27)?

(c) 10 moles of sodium sulphite (Na_2SO_3)?

Solution 7:

(a) The mass of 1 mole of nitrogen atoms is 14 g.

(b) The mass of 4 moles of aluminium atoms is (4×27) g = 108 g

(c) The mass of 10 moles of sodium sulphite (Na_2SO_3) is

$10 \times [2 \times 23 + 32 + 3 \times 16]$ g = 10×126 g = 1260 g

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Question 8:

Convert into mole.

(a) 12 g of oxygen gas

(b) 20 g of water

(c) 22 g of carbon dioxide

Solution 8:

(a) 32 g of oxygen gas = 1 mole

Then, 12 g of oxygen gas = $\frac{12}{32}$ mole = 0.375 mole

(b) 18 g of water = 1 mole

Then, 20 g of water = $\frac{20}{18}$ mole = 1.11 moles (approx)

(c) 44 g of carbon dioxide = 1 mole

Then, 22 g of carbon dioxide = $\frac{22}{44}$ mole = 0.5 mole

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Question 9:

What is the mass of:

(a) 0.2 mole of oxygen atoms?

(b) 0.5 mole of water molecules?

Solution 9:

(a) Mass of one mole of oxygen atoms = 16 g

Then, mass of 0.2 mole of oxygen atoms = 0.2 × 16g = 3.2 g

(b) Mass of one mole of water molecule = 18 g

Then, mass of 0.5 mole of water molecules = 0.5 × 18 g = 9 g

Question 10:

Calculate the number of molecules of sulphur (S_8) present in 16 g of solid sulphur.

Solution 10:

1 mole of solid sulphur (S_8) = 8 × 32 g = 256 g

i.e., 256 g of solid sulphur contains = 6.022×10^{23} molecules

Then, 16 g of solid sulphur contains $= \frac{6.022 \times 10^{23}}{256} \times 16$ molecules

= 3.76×10^{22} molecules (approx)

Question 11:

Calculate the number of aluminium ions present in 0.051 g of aluminium oxide.

(*Hint*: The mass of an ion is the same as that of an atom of the same element.

Atomic mass of Al = 27 u)

Solution 11:

1 mole of aluminium oxide (Al_2O_3) = 2 × 27 + 3 × 16 = 102 g

i.e., 102 g of Al_2O_3 = 6.022×10^{23} molecules of Al_2O_3

Then, 0.051 g of Al_2O_3 contains = $\frac{6.022 \times 10^{23}}{102} \times 0.051$ molecules

= 3.011×10^{20} molecules of Al_2O_3

The number of aluminium ions (Al^{3+}) present in one molecule of aluminium oxide is 2.

Therefore, the number of aluminium ions (Al^{3+}) present in 3.011×10^{20} molecules (0.051 g) of aluminium oxide (Al_2O_3) = $2 \times 3.011 \times 10^{20}$
= 6.022×10^{20}