

Exercise 1C

Fill in the blanks

- Dalton used symbol _____ for oxygen _____ for hydrogen.
- Symbol represents _____ atom(s) of an element.
- Symbolic expression for a molecule is called _____.
- Sodium chloride has two radicals. Sodium is a _____ radical, while chloride is a _____ radical.
- Valency of Phosphorous in PCl_3 is _____, in PCl_5 is _____.
- Valency of iron in FeCl_2 is _____ and in FeCl_3 it is _____.
- Formula of iron (III) carbonate is _____.

Solution:

- Dalton used symbol **[O]** for oxygen, **[H]** for hydrogen.
- Symbol represents **gram** atom(s) of an element.
- Symbolic expression for a molecule is called **molecular formula**.
- Sodium chloride has two radicals. Sodium is a **basic** radical, while chloride is an **acid** radical.
- Valency of Phosphorous in PCl_3 is **3**, in PCl_5 is **5**.
- Valency of iron in FeCl_2 is **2** and in FeCl_3 it is **3**.
- Formula of iron (III) carbonate is **$\text{Fe}_2[\text{CO}_3]_3$** .

2. Complete the following table

Acid Radical → Basic radical ↓	Chloride	Nitrate	Sulphate	Carbonate	Hydroxide	Phosphate
Magnesium	MgCl_2	$\text{Mg}(\text{NO})_2$	MgSO_4	MgCO_3	$\text{Mg}(\text{OH})_2$	$\text{Mg}_3(\text{PO}_4)_2$
Sodium						
Zinc						
Silver						
Ammonium						
Calcium						
Iron (II)						
Potassium						

Solution:

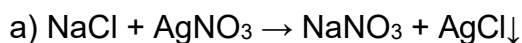
Acid Radical → Basic radical ↓	Chloride	Nitrate	Sulphate	Carbonate	Hydroxide	Phosphate
Magnesium	MgCl_2	$\text{Mg}(\text{NO})_2$	MgSO_4	MgCO_3	$\text{Mg}(\text{OH})_2$	$\text{Mg}_3(\text{PO}_4)_2$
Sodium	NaCl	NaNO_3	Na_2SO_4	Na_2CO_3	NaOH	Na_3PO_4
Zinc	ZnCl_2	ZnNO_3	ZnSO_4	ZnCO_3	$\text{Zn}(\text{OH})_2$	$\text{Zn}_3(\text{PO}_4)_2$
Silver	AgCl	AgNO_3	Ag_2SO_4	AgCO_3	AgOH	Ag_3PO_4
Ammonium	NH_4Cl	NH_4NO_3	$(\text{NH}_4)_2\text{SO}_4$	$(\text{NH}_4)_2\text{CO}_3$	NH_4OH	$(\text{NH}_4)_3(\text{PO}_4)_2$
Calcium	CaCl_2	CaNO_3	CaSO_4	CaCO_3	$\text{Ca}(\text{OH})_2$	$\text{Ca}_3(\text{PO}_4)_2$

Iron (II)	FeCl ₂	Fe(NO ₃) ₂	FeSO ₄	FeCO ₃	Fe(OH) ₂	Fe ₃ (PO ₄) ₂
Potassium	KCl	KNO ₃	K ₂ SO ₄	K ₂ CO ₃	KOH	K ₃ PO ₄

3. Sodium chloride reacts with silver nitrate to produce silver chloride and sodium nitrate

- Write the equation
- Check whether it is balanced, if not balance it.
- Find the weights of reactants and products.
- State the law that this equation satisfies?

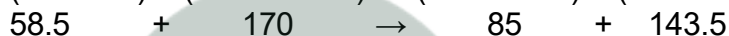
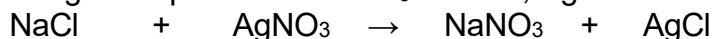
Solution:



b) It is a balanced equation

c) Weights of reactants: NaCl - 58.44, AgNO₃ - 169.87

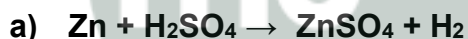
Weights of products: NaNO₃ - 84.99, AgCl - 143.32



Thus, 228.5 g of reactants \rightarrow 228.5 g of products

d) This equation states law of conservation of mass where mass is neither created nor destroyed.

4. What information does the following chemical equations convey?



Solution:

a) This equation shows the result of a chemical change. When one molecule of zinc and one molecule of sulphuric acid reacts, it results in the production of one molecule of zinc sulphate and one molecule of hydrogen.

b) This equation shows reaction of Magnesium with HCl which gives magnesium chloride and liberated Hydrogen gas.

5. a) What are poly-atomic ions? Give two examples

b) Name the fundamental law involved in every equation

Solution:

a) A charged ion that consists of two or more covalently bounded atoms are called as polyatomic ions. Eg: CaCO₃, MgSO₄

b) Fundamental law involved in every equation is “the law of conservation of mass”.

6. What is the valency of?

a) Fluorine in CaF₂

- b) Sulphur in SF₆
- c) Phosphorous in PH₃
- d) Carbon in CH₄
- e) Nitrogen in the following compound
 - i) N₂O₃ ii) N₂O₅ iii) NO₂ iv) NO
- f) Manganese in MnO₂
- g) Copper in Cu₂O
- h) Magnesium in Mg₃N₂

Solution:

- a) Valency of fluorine in CaF₂ is -1
- b) Valency of sulphur in SF₆ is -6
- c) Valency of phosphorus in PH₃ is +3
- d) Valency of carbon in CH₄ is +4
- e) Valency of nitrogen in the given compounds:
 - i) N₂O₃ = +3
 - ii) N₂O₅ = +5
 - iii) NO₂ = +4
 - iv) NO = +2

7. Why should an equation be balanced? Explain with the help of simple equation.

Solution:

An equation should be balanced to make it comply with the law of conservation of matter which states that matter is neither created nor destroyed in the course of a chemical reaction. An unbalanced equation either deletes or adds extra atoms in the equation.

e.g. $\text{KNO}_3 \rightarrow \text{KNO}_2 + \text{O}_2$

In this equation number of atoms in left and right side are not equal hence the balanced equation will be written as.

$2\text{KNO}_3 \rightarrow 2\text{KNO}_2 + \text{O}_2$

8. Write the balanced chemical equations of the following word equations

- a) Sodium hydroxide + Sulphuric acid → Sodium Sulphate + Water
- b) Potassium bicarbonate + Sulphuric acid → Potassium Sulphate + Carbon di oxide + Water
- c) Iron + Sulphuric acid → Ferrous sulphate + Hydrogen
- d) Chlorine + Sulphur di oxide + Water → Sulphuric acid + Hydrogen Chloride
- e) Silver Nitrate → Silver + Nitrogen di oxide + Oxygen
- f) Copper + Nitric acid → Copper nitrate + Nitric oxide + water
- g) Ammonia + Oxygen → Nitric oxide + Water
- h) Barium chloride + Sulphuric acid → Barium Sulphate + Hydrochloric acid
- i) Zinc sulphide + Oxygen → Zinc oxide + Sulphur dioxide
- j) Aluminium carbide + Water → Aluminium hydroxide + methane
- k) Iron Pyrites + Oxygen → Ferric oxide + Sulphur di oxide
- l) Potassium permanganate + Hydrochloric acid → Potassium chloride + Manganese

chloride + chlorine + Water

m) Aluminium sulphate + Sodium hydroxide → Sodium sulphate + Sodium meta aluminate + Water

n) Aluminium + Sodium hydroxide + Water → Sodium meta aluminate + Hydrogen

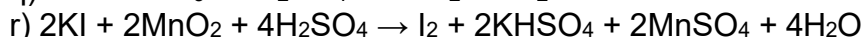
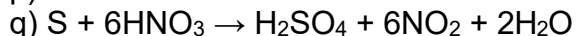
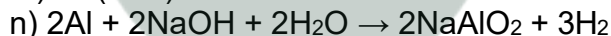
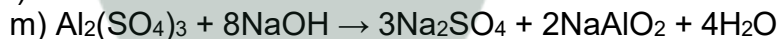
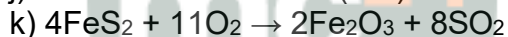
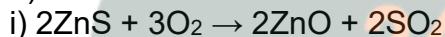
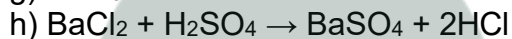
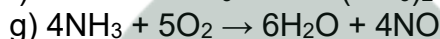
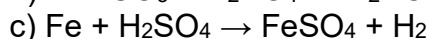
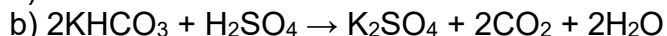
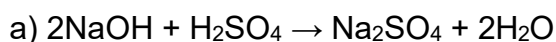
o) Potassium dichromate + Sulphuric acid → Potassium sulphate + Chromium sulphate + Water + Oxygen

p) Potassium dichromate + Hydrochloric acid → Potassium chloride + Chromium chloride + Water + Chlorine

q) Sulphur + Nitric acid → Sulphuric acid + Nitrogen dioxide + Water

r) Sodium chloride + Manganese dioxide + Sulphuric acid → Sodium hydrogen sulphate + Manganese sulphate + Water + Chlorine

Solution:



9. a) Define atomic mass unit

b) Calculate the molecular mass of the following

i) $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$ ii) $(\text{NH}_4)_2\text{CO}_3$ iii) $(\text{NH}_2)_2\text{CO}$ iv) Mg_3N_2

Give atomic mass of Na = 23, H = 1, O = 16, C = 12, N = 14, Mg = 24, S = 32

Solution:

a) The atomic mass unit (amu) is defined as $1/12^{\text{th}}$ of the mass of an atom of carbon

$$1 \text{ a.m.u.} = 1.67 \times 10^{-24} \text{g} = 1.67 \times 10^{-27} \text{kg}$$

$$1 \text{ gm mass} = 6.02 \times 10^{23} \text{ a.m.u. and } 1 \text{ kg mass} = 6.02 \times 10^{26} \text{ a.m.u.}$$

b) i) The relative molecular mass of $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$

$$= 63.5 + 32 + (16 \times 4) + 5(2 + 16)$$

$$= 159.5 + 90$$

$$= 249.5$$

ii) The relative molecular mass of $(\text{NH}_4)_2\text{CO}_3 = \text{N}_2\text{H}_8\text{CO}_3$
 $= 14 \times 2 + 1 \times 8 + 12 + 3 \times 16$
 $= 28 + 8 + 12 + 48$
 $= 96$

iii) The relative molecular mass of $(\text{NH}_2)_2\text{CO} = \text{N}_2\text{H}_4\text{CO}$
 $= 2 \times 14 + 1 \times 4 + 12 + 16$
 $= 28 + 4 + 12 + 16$
 $= 60$

iv) The relative molecular mass of Mg_3N_2
 $= 3 \times 24 + 2 \times 14$
 $= 72 + 28$
 $= 100$

10. Choose the correct answer from the options given below

a) Modern atomic symbols are based on the methods proposed by

(i) Bohr (ii) Dalton (iii) Berzelius (iv) Alchemist

b) The number of carbon atoms in a hydrogen carbonate radical is

(i) one (ii) two (iii) three (iv) four

c) The formula of Iron(III) Sulphate is

(i) Fe_3SO_4 (ii) $\text{Fe}(\text{SO}_3)_3$ (iii) $\text{Fe}(\text{SO}_4)_3$ (iv) FeSO_4

d) In water, the hydrogen-to-oxygen mass ratio is

(i) 1:8 (ii) 1:16 (iii) 1:32 (iv) 1:64

(e) The formula of sodium carbonate is Na₂CO₃ and that of calcium hydrogen carbonate is

(i) CaHCO_3 (ii) $\text{Ca}(\text{HCO}_3)_2$ (iii) CaHCO_3 (iv) $\text{Ca}(\text{HCO}_3)_3$

Solution:

a) Answer is (iii) Berzelius

b) Answer is (i) One

c) Answer is (iii) $\text{Fe}_2(\text{SO}_4)_3$

d) Answer is (i) 1: 8

e) Answer is (ii) $\text{Ca}(\text{HCO}_3)_2$

11. Correct the following statements

(a) A molecular formula represents an element

(b) Molecular formula of water is H_2O_2

(c) A molecule of Sulphur is monoatomic

(d) CO and Co both represent cobalt

(e) Formula of Iron(III) oxide is FeO

Solution:

- a) Molecular formula represents molecule of an element or a compound.
b) Molecular formula of water is H_2O
c) A molecule of Sulphur is diatomic
d) CO represents carbon monoxide and Co represent cobalt
e) Formula of Iron(III) oxide is Fe_2O_3

12. Calculate the relative molecular masses of:

(a) $CHCl_3$

(b) $(NH_4)_2Cr_2O_7$

(c) $CuSO_4 \cdot 5H_2O$

(d) $(NH_4)_2SO_4$

(e) CH_3COONa

(f) Potassium chlorate

(g) Ammonium chloroplatinate $(NH_4)_2PtCl_6$

[At. mass: C = 12, H = 1, O = 16, Cl = 35.5, N = 14, Cu = 63.5, S = 32, Na = 23, K = 39, Pt = 195, Ca = 40, P = 31, Mg = 24]

Solution:

(a) Relative molecular mass of $CHCl_3$

$$= 12 + 1 + (3 \times 35.5)$$

$$= 12 + 1 + 106.5$$

$$= 119.5$$

(b) Relative molecular mass of $(NH_4)_2Cr_2O_7$

$$= (14 \times 2) + (1 \times 8) + (52 \times 2) + (16 \times 7)$$

$$= 28 + 8 + 104 + 112$$

$$= 252$$

(c) Relative molecular mass of $CuSO_4 \cdot 5H_2O$

$$= 63.5 + 32 + (16 \times 4) + 5(2 + 16)$$

$$= 159.5 + 90$$

$$= 249.5$$

(d) Relative molecular mass of $(NH_4)_2SO_4$

$$= (2 \times 14) + (8 \times 1) + 32 + (4 \times 16)$$

$$= 28 + 8 + 32 + 64$$

$$= 132$$

(e) Relative molecular mass of CH_3COONa

$$= (12 \times 2) + (1 \times 3) + (16 \times 2) + 23$$

$$= 24 + 3 + 32 + 23$$

$$= 82$$

(f) Potassium chlorate ($KClO_3$)

$$= 39.1 + 35.5 + 16 \times 3$$

$$= 39.1 + 35.5 + 48$$

$$= 122.6$$

(g) Ammonium chloroplatinate $(\text{NH}_4)_2\text{PtCl}_6$
 $= (14 \times 2) + (1 \times 8) + 195.08 + (35.5 \times 6)$
 $= 28 + 8 + 195.08 + 213$
 $= 444.08$

13. Give the empirical formula of:

(a) Benzene (C_6H_6) (b) Glucose ($\text{C}_6\text{H}_{12}\text{O}_6$) (c) Acetylene (C_2H_2) (d) Acetic acid (CH_3COOH)

Solution:

- (a) Benzene - CH
(b) Glucose - CH_2O
(c) Acetylene - CH
(d) Acetic acid - CH_2O

14. Find the percentage mass of water in Epsom salt $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$.

Solution:

Relative molecular mass of $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$
 $= 24 + 32 + (16 \times 4) + 7(2 + 16)$
 $= 24 + 32 + 64 + 126$
 $= 246$

26 g of Epsom salt contains 126 g of water of crystallisation.

So, 100 g of Epsom salt contains $(100 \times 126/246)$ g of water

Thus, percentage mass of H_2O in $\text{MgSO}_4 \cdot 7\text{H}_2\text{O} = 51.2$

15. Calculate the percentage of phosphorus in:

(a) Calcium hydrogen phosphate $\text{Ca}(\text{H}_2\text{PO}_4)_2$

(b) Calcium phosphate $\text{Ca}_3(\text{PO}_4)_2$

Solution:

(a) Relative molecular mass of $\text{Ca}(\text{H}_2\text{PO}_4)_2$
 $= 40.07 + (1 \times 4) + (30.9 \times 2) + (16 \times 8)$
 $= 40.07 + 4 + 61.8 + 128$
 $= 233.87$

Now, 233.87 g of $\text{Ca}(\text{H}_2\text{PO}_4)_2$ contains 61.8 g of P

So, 100 g $\text{Ca}(\text{H}_2\text{PO}_4)_2$ contains

$$(100 \times 61.8)/233.87 = 26.42 \text{ g}$$

Thus, the percentage of phosphorus in $\text{Ca}(\text{H}_2\text{PO}_4)_2$ is 26.42%

(b) Relative molecular mass of $\text{Ca}_3(\text{PO}_4)_2$

$$= (40.07 \times 3) + (30.9 \times 2) + (16 \times 8)$$
$$= 120.21 + 61.8 + 128$$
$$= 310.01$$

Now, 310.01 g of $\text{Ca}_3(\text{PO}_4)_2$ contains 61.8 g of P

So, 100 g $\text{Ca}_3(\text{PO}_4)_2$ contains

$$(100 \times 61.8)/310.01 = 19.93 \text{ g}$$

Thus, the percentage of phosphorous in $\text{Ca}_3(\text{PO}_4)_2$ is 19.93%

16. Calculate the percentage composition of each element in Potassium chlorate, KClO_3 .

Solution:

Relative molecular mass of KClO_3

$$= 39.09 + 35.5 + (3 \times 16)$$

$$= 122.59 \text{ g}$$

So, 122.59 g of KClO_3 contains 39.09 g of K

Hence, 100 g of KClO_3 contains

$$= (100 \times 39.09)/122.59$$

$$= 31.9 \text{ g}$$

Also, 122.59 g of KClO_3 contains 35.5 g of Cl

Hence, 100 g of KClO_3 contains

$$= (100 \times 35.5)/122.59$$

$$= 28.9 \text{ g}$$

And, 122.59 g of KClO_3 contains 48 g of O

Hence, 100 g of KClO_3 contains

$$= (100 \times 48)/122.59$$

$$= 39.1 \text{ g}$$

Therefore, the percentage composition of K, Cl and O in KClO_3 are 31.9%, 28.9% and 39.1% respectively.

17. Urea is a very important nitrogenous fertilizer. Its formula is $\text{CH}_4\text{N}_2\text{O}$. Calculate the percentage of carbon in urea. (C = 12, O = 16, N = 14 and H = 1)

Solution:

Element	No of atoms	Atomic mass	Total
N	2	14	28
C	1	12	12
H	4	1	4
O	1	16	16

$$\Rightarrow 12 + 16 + 28 + 4 = 60$$

Hence, relative molecular mass of urea = 60

Thus,

Percentage of carbon = Weight of carbon/Total weight of urea $\times 100$

$$= 12/60 \times 100$$

$$= 20\%$$