CLASS-IX 'B'

CHEMISTRY

CHAPTER-1

THE LANGUAGE OF CHEMISTRY

Exercise :1 (B)

1.What is a chemical equation? Why it is necessary to balance it.

Solution:A chemical equation is a symbolic representation of a chemical reaction. Here we use symbols and formulas of the substance involved in the reaction.
According to law of conservation of mass, "matter can neither be created nor be destroyed in a chemical reaction. This is possible only, if total number of atoms on the reactants side is equals to total number of atoms on products side. Thus, a chemical reaction should be always balanced.

2.State the information conveyed by the following equation.
$Zn(s) + 2HCl(aq) \longrightarrow ZnCl_2(aq) + H_2$

Solution: This chemical equation shows 'single displacement reaction', in which a non-metal is displaced by a metal. Here, non-metal is hydrogen which is evolved as gas. It is displaced by the metal zinc.In the given equation - $Zn(s) + 2HCl(aq) \longrightarrow ZnCl_2(aq) + H_2(g)$, Zinc (Zn) is a reductant metal that displaces hydrogen (H_2) from aqueous solution of Hydrochloric acid (HCl).

3. Write the limitation of reaction given in question 2.

Solution:
HCl will be the limiting reagent in the reaction and Zn will be excess reagent.

4.Write chemical equations for the following equations and balance them.

a) Carbon + Oxygen $\longrightarrow$ Carbon-di-oxide
b) Nitrogen + Oxygen $\longrightarrow$ Nitrogen monoxide
c) Calcium + Nitrogen $\longrightarrow$ Calcium nitride
d) Calcium oxide + carbon dioxide $\rightarrow$ Calcium carbonate
e) Magnesium + Sulphuric acid $\longrightarrow$ Magnesium sulphate + Hydrogen

Solution:

a) $2C + O_2 \longrightarrow CO_2$
b) $N_2 + O_2 \longrightarrow 2NO$
c) $3Ca(s) + N_2(g) \rightarrow Ca_3N_2$
d) $CaO + CO_2 \longrightarrow CaCO3$
e) $Mg(s) + H2SO4(aq) \rightarrow MgSO4(aq) + H2(g)$

5. Balance the following equations

a) $Fe + H_2O \longrightarrow Fe_3O_4 + H_2$
b) $Ca + N_2 \longrightarrow Ca_3N_2$
c) $Zn + KOH \longrightarrow K_2ZnO_2 + H_2$
d) $Fe_2O_3 + CO \rightarrow Fe + CO_2$
e) $PbO + NH_3 \rightarrow Pb + H_2O + N_2$
f) $Pb_3O4 \longrightarrow PbO + O_2$
g) $PbS + O_2 \longrightarrow PbO + O_2$
h) $S + H_2SO_4 \rightarrow SO_2 + H_2O$
i) $S + HNO_3 \longrightarrow H_2SO_4 + NO_2 + H_2O$
j) $MnO_2 + HCl \rightarrow MnCl_2 + H_2O + SO_2$
k) $C + H_2SO_4 \longrightarrow CO_2 + H_2O + SO_2$
l) $KOH + Cl_2 \longrightarrow KCl + KClO + H_2O$
m) $NO_2 + H_2O \longrightarrow HNO_2 + HNO_3$
n) $Pb_3O_4 + HCl \rightarrow PbCl_2 + H2O + Cl_2$
o) $H_2O + Cl_2 \longrightarrow HCl + O_2$
p) $NaHCO_3 \longrightarrow Na_2CO_3 + H_2O + CO_2$
q) $HNO_3 + H_2S \rightarrow NO_2 + H_2O + S$
r) $P + HNO_3 \longrightarrow NO_2 + H_2O + H_3PO4$
s) $Zn + HNO_3 \longrightarrow Zn(NO)_3 + H_2O + NO_2$

Solution:-

1. $3Fe + 4H_2O \rightarrow Fe_3O_4 + 4H_2$
2. $3Ca + N_2 \rightarrow Ca_3N_2$
3. $Zn + 2KOH \rightarrow K_2ZnO_2 + H_2$
4. $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$
5. $3PbO + 2NH_3 \rightarrow 3Pb + 3H_2O + N_2$
6. $2Pb_3O_4 \rightarrow 6PbO + O_2$
7. $2PbS + 3O_2 \rightarrow 2PbO + 2SO_2$
8. $S + 2H_2SO_4 \rightarrow 3SO_2 + 2H_2O$
9. $S + 6HNO_3 \rightarrow H_2SO_4 + 6NO_2 + 2H_2O$
10. $MnO_2 + 4HCl \rightarrow MnCl_2 + 2H_2O + Cl_2$
11. $C + 2H_2SO_4 \rightarrow CO_2 + H_2O + SO_2$
12. $2KOH + Cl_2 \rightarrow KCl + KClO + H_2O$
13. $2NO_2 + H_2O \rightarrow HNO_2 + HNO_3$
14. $Pb_3O_4 + 8HCl \rightarrow 3PbCl_2 + 4H_2O + Cl_2$
15. $2H_2O + 2Cl_2 \rightarrow 4HCl + O_2$
16. $2NaHCO_3 \rightarrow Na_2CO_3 + H_2O + CO_2$
17. $2HNO_3 + H_2S \rightarrow 2NO_2 + 2H_2O + S$
18. $P + 5HNO_3 \rightarrow 5NO_2 + H_2O + H_3PO_4$

EXERCISE-1 (C)

1. Fill in the blanks

a) Dalton used symbol_____for oxygen_____for hydrogen.
b) Symbol represents_____atom(s) of an element.
c) Symbolic expression for a molecule is called_____.
d) Sodium chloride has two radicals. Sodium is a_____radical, while chloride is a_____radical.
e) Valency of Phoshorous in PCl_3 is_____, in PCl_5 is_____.
f) Valency of iron in FeCl2 is_____and in FeCl3 it is_____.
g) Formula of iron (III) carbonate is_____.

Solution:

a) Dalton used symbol **[O]** for oxygen,**[H]** for hydrogen.
b) Symbol represents **gram** atom(s) of an element.
c) Symbolic expression for a molecule is called **molecular formula**.
d) Sodium chloride has two radicals. Sodium is a **basic** radical, while chloride is an **acid** radical.
e) Valency of Phosphorous in PCl3 is **3** , in PCl5 is **5**,
f) Valency of iron in FeCl2 is **2** and in FeCl3 it is **3**.
g) Formula of iron (III) carbonate is **$Fe_2(CO_3)_3$**.

2.Complete the following table

Acid Radical → / Basic radical ↓	**Chloride**	**Nitrate**	**Sulphate**	**Carbonate**	**Hydroxide**	**Phosphate**
Magnessium	**$MgCl_2$**	**$Mg(NO_3)_2$**	**$MgSO_4$**	**$MgCO_3$**	**$Mg(OH)_2$**	**$Mg_3(PO_4)_2$**
Sodium						
Zinc						
Silver						
Ammonium						
Calcium						
Iron(II)						
Potassium						

Solution:

Acid Radicals / Basic Radicals	Chloride	Nitrate	Sulphate	Carbonate	Hydroxide	Phosphate
Magnesium	$MgCl_2$	$Mg(NO_3)_2$	$MgSO_4$	$MgCO_3$	$Mg(OH)_2$	$Mg_3(PO_4)_2$
Sodium	NaCl	$NaNO_3$	Na_2SO_4	Na_2CO_3	NaOH	Na_3PO_4
Zinc	$ZnCl_2$	$Zn(NO_3)_2$	$Zn(SO_4)_2$	$ZnCO_3$	$Zn(OH)_2$	$Zn_3(PO_4)_2$
Silver	AgCl	$AgNO_3$	Ag_2SO_4	$AgCO_3$	AgOH	Ag_3PO_4
Ammonium	NH_4Cl	NH_4NO_3	$(NH_4)_2SO_4$	$(NH_4)_2CO_3$	NH_4OH	$(NH_4)_3PO_4$
Calcium	$CaCl_2$	$CaCO_3$	$CaSO_4$	$CaCO_3$	$Ca(OH)_2$	$Ca_3(PO_4)_2$
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_2SO_4	K_2CO_3	KOH	K_3PO_4

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

a) Write the equation

b) Check whether it is balanced, if not balance it.

c) Find the weights of reactants and products.

d) State the law that this equation satisfies?

Solution:

a. $NaCl + AgNO_3 \rightarrow NaNO_3 + AgCl\downarrow$

b.It is a balanced equation.

c.Weights of reactants: NaCl - 58.44, AgNO3 - 169.87
Weights of products: $NaNO_3$ - 84.99, AgCl - 143.32
$NaCl + AgNO_3 \rightarrow NaNO_3 + AgCl$
$(23+35.5) + (108+14+48) \rightarrow (23+14+48) + (108+35.5)$
$58.5 + 170 \rightarrow 85 + 143.5$
$228.5\ g \rightarrow 228.5\ g$

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?

a) $\mathbf{Zn + H_2SO_4 \longrightarrow ZnSO_4 + H_2}$

b) $\mathbf{Mg + 2Hcl \longrightarrow MgCl_2 + H_2}$

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. Ex: $CaCO_3$, $MgSO_4$

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

6.What is the valency of?

a)Fluorine in CaF_2

b)Sulphur in SF_6

c) Phosphorous in PH_3

d) Carbon in CH_4

e) Nitrogen in the following compound

(i) N_2O_3 (ii) N_2O_5 (iii) NO_2 (iv) NO

f) Manganese in MnO_2

g) Copper in Cu_2O

h) Magnesium in Mg_3N_2

Solution:

a)Valency of fluorine in CaF_2 is -1.

b)Valency of sulphur in SF_6 is -6.

c)Valency of phosphorus in PH_3 is +3.

d)Valency of carbon in CH_4 is +4.

e) Valency of nitrogen in the given compounds:-

i) 3 ii)5 iii)2 iv)2

f) Valency of Manganese in MnO_2 is 2

g) Valency of Copper in Cu_2O is 1.

h) Valency of Magnesium in Mg_3N_2 is 2

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

Solution:

An equation should n 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 if a chemical reaction. An unbalanced equation either delets ort adds extra atoms in the equation.

e.g. $KNO_3 \rightarrow KNO_2 + O_2$

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

$2KNO_3 \rightarrow 2KNO_2 + O_2$

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 (FeS_2) + Oxygen ⟶ Ferriic 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) Potassium iodide + manganese dioxide + sulphuric acid ⟶ Potassium hydrogen sulphate + manganese sulphate+ water+ iodine

OR

r) Sodium Chloride + manganese dioxide + sulphuric acid ⟶ Sodium hydrogen sulphate + manganese sulphate+ water+ iodine

Solution:

(a) $2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$

(b) $2KHCO_3 + H_2SO_4 \rightarrow K_2SO_4 + 2CO_2 + 2H_2O$

(c) $Fe + H_2SO_4 \rightarrow Fe(SO_4) + H_2$

(d) $Cl_2 + SO_2 + 2H_2O \rightarrow H_2SO_4 + 2HCl$

(e) $2AgNO_3 \rightarrow 2Ag + 2NO_2 + O_2$

(f) $3Cu + 8HNO_3 \rightarrow 3Cu(NO_3)_2 + 2NO + 4H_2O$

(g) $4NH_3 + 5O_2 \xrightarrow{Pt,\ 800^oC} 6H_2O + 4NO\ ? + Heat$

(h) $BaCl_2 + H_2SO_4 \rightarrow BaSO_4 + 2HCl$

(i) $2ZnS + 3O_2 \rightarrow 2ZnO + 2SO_2$

(j) $Al_4C_3 + 12H_2O \rightarrow 4Al(OH)_3 + 3CH_4$

(k) $4FeS_2 + 11O_2 \rightarrow 2Fe_2O_3 + 8SO_2$

(l) $2KMnO_4 + HCl \rightarrow 2KCl + 2MnCl_2 + 5Cl_2 + 8H_2O$

(m) $Al_2(SO_4)_3 + 8NaOH \rightarrow 3Na_2SO_4 + 2NaAlO_2 + 4H_2O$

(n) $2Al + 2NaOH + 2H_2O \rightarrow 2NaAlO_2 + 3H_2$

(o) $2K_2Cr_2O_7 + 8H_2SO_4 \rightarrow 2K_2SO_4 + 2Cr_2(SO_4)_3 + 8H_2O + 3O_2$

(p) $K_2Cr_2O_7 + 14HCl \rightarrow 2KCl + 2CrCl_3 + 7H_2O + 3Cl_2$

(q) $S + 6HNO_3 \rightarrow H_2SO_4 + 6NO_2 + 2H_2O$

(r) $2KI + 2MnO_2 + 4H_2SO_4 \rightarrow I_2 + 2KHSO_4 + 2MnSO_4 + 4H_2O$

OR (r) $2NaCl + MnO_2 + 2H_2SO_4 \longrightarrow 2NaHSO_4 + MnSO_4 + 2H_2O + Cl_2$

9.a) Define atomic mass unit

b) Calculate the molecular mass of the following

i) Na2So4.10H2O ii) (NH4)2 CO3 iii) (NH2)2CO iv) Mg3N2

Give atomic mass of Na=23, H=1, 0=16 C=12, N=14, Mg=24, S=32

Solution:

(a) The atomic mass unit (amu) is defined as 1/12th of the mass of an atom of carbon.

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

1 gm mass = 6.02×10^{23} a.m.u. and 1 kg mass = 6.02×10^{26} a.m.u.

(b)

1) The relative molecular mass of = $CuSO_4.5H_2O$

= 63.5 + 32 + (16 x 4) + 5 (2 + 16)

= 159.5 + 90

= 249.5 2.

2) The relative molecular mass of - $(NH_4)_2CO_3 = N_2H_8CO_3$

= 14 x 2+1 x 8+ 12 +3 x 16

=28+8+12+48= 96 .

3) The relative molecular mass of - $(NH_2)_2CO = N_2H_4CO$
= 2 x 14+1 x 4+12+16
= 28 + 4 + 12 + 16 = 60

The relative molecular mass of = Mg_3N_2
= 3 x 24 + 2 x 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 d) Alchemist
b)The number of carbon atoms in a hydrogen carbonate radical is
(i)one (ii)two (iii) Three (iv) Four

(b)The formula of iron(III)sulphate is
(i) Fe_3SO_4
ii) $Fe(SO_4)_3$
iii)$Fe_2(SO_4)_3$
(iv)$FeSO_4$

(c) In water, the hydrogen-to-oxygen mass ratio is
(i)1:8
(ii) 1:16
(iii) 1:32
(iv) 1:64

(d)The formula of sodium carbonate is Na, CO,and that of calcium hydrogen carbonate is
(i)$CaHCO_3$
(ii) $Ca(HCO_3)_2$
(iii) Ca,HCO_3
(iv)$Ca(HCO)_3$

Solution:

a) Answer is (iii) Berzelius
b) Answer is (i) One
c) Answer is (iii) $Fe_2(SO_4)_3$
d) Answer is (i)1: 8
e) Answer is (ii) $Ca(HCO_3)_2$

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)$CHCI_3$
(b)$(NH_4)_2Cr_2O_7$
(c)$CuSO_4.5H_2O$
(d)$(NH_4)_2SO_4$
(e)CH_3COONa
(f) Potassium chlorate
(g) Ammonium chloroplatinate$(NH_4)_2PtCl_6$
[At.mass:C=12,H=1,0=16,Cl=35.5,N=14,Cu=63-5,S=32,Na=23,K=39,Pt=195,Ca=40,P=31,Mg=24]

Solution:

1. Relative molecular mass of $CHCI_3$
   = 12 + 1 + (3 x 35.5)
   = 12 + 1 + 106.5
   = 119.5 2.
2. Relative molecular mass of $(NH_4)_2$ Cr_2O_7
   =(14 x 2)+(1x8)+(52 x 2)+(16x 7)
   = 28 + 8 + 104 + 112 = 252
3. Relative molecular mass of CuSO4. $5H_2O$
   = 63.5 + 32 + (16 x 4) + 5(2 + 16)
   = 159.5 + 90
   = 249.5 4.
4. Relative molecular mass of $(NH_4)_2SO_4$
   =(2 x 14)+(8x 1)+32 +(4 x 16)
   =28+8+32+64
   = 132

5. Relative molecular mass of CH_3COONa
   =(12 x 2)+(1x3)+(16 x 2)+23
   =24+3+32+23
   = 82
6. Potassium chlorate ($KClO_3$) =39.1+35.5+16 x 3
   = 39.1+ 35.5 + 48
   = 122.6
7. Ammonium chloroplatinate $(NH_4)_2PtC1_6$
   =(14 x 2)+(1 x8)+195.08+(35.5 x 6)
   = 28+ 8 +195.08 + 213
   = 444.08

13. Give the empirical formula of:
(a)Benzene(C_6H_6) (b)Glucose($C_6H_{12}0_6$)
(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 $MgSO_4.7H_2O$.

Solution:

Relative molecular mass of $MgSO_4.7H_2O$
=24 + 32 + (16 x 4) + 7(2 + 16)
=24+32+64+126 =246
26 g of Epsom salt contains 126 g of water of crystallisation.
Hence, 100 g of Epsom salt contains 100 x 126/246
The % of H_2O in $MgSO_4.7H_2O$.= 51.2%

15. Calculate the percentage of phosphorus in:
(a)Calcium hydrogen phosphate $Ca(H_2PO_4)_2$
(b)Calcium phosphate $Ca_3(PO_4)_2$

Solution:

(a) Relative molecular mass of $Ca(H_2PO_4)_2$

$= 40.07 + (1 \times 4) + (30.9 \times 2) + (16 \times 8)$

$= 40.07 + 4 + 61.8 + 128$

$= 233.87$

233.87 g $Ca(H_2PO_4)_2$ contains 61.8 g P

So, 100 g $Ca(H_2PO_4)_2$ contains

$$\frac{100 \times 61.8}{233.87} = 26.42\,g$$

The % of P in $Ca(H_2PO_4)_2$ is 26.42%.

(b) Relative molecular mass of $Ca_3(PO_4)_2$

$= (40.07 \times 3) + (30.9 \times 2) + (16 \times 8)$

$= 120.21 + 61.8 + 128$

$= 310.01$

310.01 g $Ca_3(PO_4)_2$ contains 61.8 g P

So, 100 g $Ca(H_2PO_4)_2$ contains

(IMAGE)

The % of P in $Ca(H_2PO_4)_2$ is 19.93%.

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

Solution:

Relative molecular mass of $KClO_3$

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

$= 122.59$ g

122.59 g $KClO_3$ contains 39.09 g K
Hence, 100 g $KClO_3$ contains

$$= \frac{100 \times 39.09}{122.59} = 31.9\text{g}$$

122.59 g $KClO_3$ contains 35.5 g Cl
Hence, 100 g $KClO_3$ contains

$$= \frac{100 \times 35.5}{122.59} = 28.9\text{g}$$

122.59 g $KClO_3$ contains 48 g O
Hence, 100 g $KClO_3$ contains

$$= \frac{100 \times 48}{122.59} = 39.1\text{g}$$

The percentages 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 CON,H4.Calculate the percentage of carbon in urea. (C=12,0=16,N=14 and H=1)

Solution:

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

[12 + 16 + 28 + = 60g]
Hence, relative molecular mass of urea = 60

Percentage of carbon = weight of carbon/ Total weight of urea x100

$$= \frac{12 \times 100}{60}$$

= 20or 20%