Moles Calalations

Type 1

Formula mass Calculations

a) $Al_2(SO_4)_3$ = 342.3g
b) $Na_2CO_3 \cdot 10H_2O$ = 286g
c) CH_3COOH = 60g

Type-2

$$\text{Percentage of element in compound} = \frac{\text{total mass of that element}}{\text{Formula mass}} \times 100$$

$$\text{Percentage of water in a hydrated salt} = \frac{\text{total mass of water}}{\text{mass of the hydrated salt}} \times 100$$

Type-3

1 mole CO_3^{2-} = 60g
1 mole H_2O = 18g

Type – 4

Molar mass of CO_2 = $44 g mol^{-1}$

Molar mass of CH_3CH_2OH = $46 g mol^{-1}$

Type - 5

No. of moles = $\frac{mass}{molar\ mass}$

a) Mass of 0.23 mol HNO_3 = 14.5g

b) Mass of 3 mol SO_2 = 192.3g

Type – 6

Molar Volume: Volume of 1 mole any gas at r.t.p is 24 dm^3.

No. of moles = $\frac{Given\ volume\ in\ dm^3}{molar\ volume\ (dm^3)}$

Type – 7

1 mole of any substance contains 6.02×10^{23} particles

number of molecules = No. of moles $\times 6.02 \times 10^{23}$

Calculate number of atoms:

20g of CH_4 $= \frac{20}{16} \times 5 \times 6.02 \times 10^{23}$

Calculate the number of ions

a) 20g $Al_2(SO_4)_3$ $= \frac{20}{342.3} \times 5 \times 6.02 \times 10^{23}$

b) 10g Na_2CO_3 $= \frac{10}{106} \times 3 \times 6.02 \times 10^{23}$

c) 6g $Mg(OH)_2$ $= \frac{6}{58.3} \times 3 \times 6.02 \times 10^{23}$

Calculate number of electrons:

a) 24 dm^3 NO $\frac{24}{24} \times 15 \times 6.02 \times 10^{23}$

b) 2g CO_2 $\frac{2}{44} \times 22 \times 6.02 \times 10^{23}$

Type - 8

Concentration

mol dm^{-3} g dm^{-3}

1.0 NaOH	40
0.01	3 I_2
0.5 H^+	0.5
0.42	40 SO_4^{2-}

No. of moles = concentration $mol\,dm^{-3}$ × volume dm^{-3}

Type-9

Combustion Reaction

$$C_xH_y + \left(x + \frac{y}{4}\right)O_2 \rightarrow xCO_2 + \frac{y}{2}H_2O$$

a) $C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$

$CH_3SH + 3O_2 \rightarrow CO_2 + SO_2 + 2H_2O$

$90\,cm^3$ $3000\,cm^3$

0.00375

$$\begin{array}{r} 3000 \\ -\ 270 \\ \hline 2730 \end{array}$$

Type-10

percentage purity = $\dfrac{\text{mass of the pure substance}}{\text{mass of the substance including impurity}} \times 100$

20g of $NaHCO_3$ (impure) reacts with excess $H_2SO_4(aq)$
$2\,dm^3$ CO_2 is produced. Calculate the percentage purity

Type 11

Titration Calculation

$30\,cm^3$ $0.15\,mol\,dm^{-3}$ H_2SO_4 reacts completely with $20\,cm^3$ $NaOH(aq)$.
Calculate the concent. of NaOH.

$$H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2H_2O$$

$$\frac{30}{1000} \times 0.15$$

$= 4.5 \times 10^{-3}$ $\qquad 9 \times 10^{-3}$ $\qquad = 0.45\,mol/dm^{-3}$

$\frac{20}{1000}$

Type 12

Limiting Reactant

60g of $CaCO_3$ reacts with 40 cm^3 0.5 mol dm^{-3} HNO_3. Calculate the volume of CO_2 produced.

$$CaCO_3 + 2HNO_3 \rightarrow Ca(NO_3)_2 + H_2O + CO_2$$

0.6   0.12

0.02

$\frac{60}{100} = 0.6$

$\frac{40}{1000} \times 0.5 = 0.02$

$0.01 \times 24000 = 240 \text{ cm}^3$

Type-13

Thermal decomposition

Calculate the volume of gas is produced due to the decomposition of 40g

$Ca(NO_3)_2$

$Ca(NO_3)_2 \rightarrow CaO + 2NO_2 + \overset{0.5}{O_2}$

$\frac{40}{164} = 0.2439$ moles $11.7 + 2.9 = 14.6 dm^3$

$Mg(NO_3)_2 \rightarrow MgO + 2NO_2 + \overset{0.5}{O_2}$

20g

$Ba(NO_3)_2 \rightarrow BaO + 2NO_2 + \overset{0.5}{O_2}$

20g

a) total volume of $O_2 \rightarrow$

$\frac{20}{148} = \frac{5}{37} = \boxed{\frac{5}{74}}$

$\frac{5}{74} \times 24 = \underline{\underline{1.62}}$

$\frac{20}{261} = \frac{20}{261} = 0.92$

$\Rightarrow 2.54 \ dm^3$

$6.49 + 3.67$

b) 10.16

Type-14

$$\text{percentage yield} = \frac{\text{experimental value}}{\text{theoritical value}} \times 100$$

30g $CaCO_3$ reacts with excess $HCl_{(aq)}$ to make 4 dm^3 CO_2.

Calculate the percentage yield of the reaction.

$$CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$$

0·3   7·2

$$\frac{30}{100} = 0{\cdot}3$$

$$\frac{4}{7{\cdot}2} \times 100 = 55{\cdot}6\%$$

Type-15

Redox Calculation

$$Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7H_2O$$

$$MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O$$

Reduction: $MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O$

Oxidation: $Fe^{2+} \rightarrow Fe^{3+} + e^-$

Overall : $MnO_4^- + 8H^+ + 5Fe^{2+} \rightarrow Mn^{2+} + 5Fe^{3+} + 4H_2O$

Reduction : $MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O$
Oxidation : $H_2C_2O_4 \rightarrow 2CO_2 + 2H^+ + 2e^-$

Overall : $2MnO_4^- + 16H^+ + 5H_2C_2O_4 \rightarrow 2Mn^{2+} + 8H_2O + 10CO_2 + 10H^+$
$\Rightarrow 2MnO_4^- + 6H^+ + 5H_2C_2O_4 \rightarrow 2Mn^{2+} + 8H_2O + 10CO_2$

Type-16

Relative atomic mass

Average mass of an atom relative to $\frac{1}{12}$ the mass of an atom of C-12.

Relative isotopic mass

Mass of an isotope relative to $\frac{1}{12}$ th the mass of an atom of C-12

Relative molecular mass

The average mass of the molecules relative to $\frac{1}{12}$ the mass of an atom of

Carbon-12.

Example-1

Chlorine has two isotopes

Cl-35 → 75%

Cl-37 → 25%

$$\frac{(35 \times 75) + (37 \times 25)}{75 + 25}$$

$\Rightarrow 35.5$

Example-2

$$\frac{35x + 37(100 - x)}{100} = 35.5$$

$35x - 37x = 3550 - 3700$

$x = 75\%$

Cl-35 = 75%

Cl-37 = 25%

Example-3

Isotope	Relative Isotopic Mass	Percentage Abundance

Mg^{24}	24	79
Mg^{26}	26	11
Mg	24.8	10

$$\frac{(79 \times 24) + (11 \times 26) + (10 \times x)}{100} = 24.3$$

$x = 24.8$