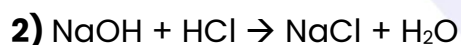


Model answer lesson 5 chapter 2

| Question | Answer | Question | Answer |
|----------|-------------|----------|-------------|
| 1 | D | 13 | C (Steps ↓) |
| 2 | B (Steps ↓) | 14 | D (Steps ↓) |
| 3 | B (Steps ↓) | 15 | D (Steps ↓) |
| 4 | A (Steps ↓) | 16 | B (Steps ↓) |
| 5 | D (Steps ↓) | 17 | A (Steps ↓) |
| 6 | C (Steps ↓) | 18 | A (Steps ↓) |
| 7 | A (Steps ↓) | 19 | A (Steps ↓) |
| 8 | C (Steps ↓) | 20 | A (Steps ↓) |
| 9 | A (Steps ↓) | 21 | D (Steps ↓) |
| 10 | A (Steps ↓) | 22 | A (Steps ↓) |
| 11 | C (Steps ↓) | 23 | D (Steps ↓) |
| 12 | B (Steps ↓) | | |

Steps:

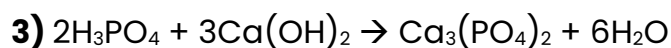


$$\frac{Ma Va}{na} = \frac{\text{no.of moles}}{nb}$$

$$\frac{0.1 \times 1500 \times 10^{-3}}{1} = \frac{\text{no.of moles}}{1}$$

No. of moles of NaOH = 0.15 moles

| Acid (HCl) | Base (NaOH) |
|--------------------------------|------------------|
| Ma = 0.1 M | No. of moles = x |
| Va = 1500 × 10 ⁻³ L | nb = 1 |
| na = 1 | |



$$\frac{Ma Va}{na} = \frac{Mb Vb}{nb}$$

$$\frac{Ma \times 80 \times 10^{-3}}{2} = \frac{0.4 \times 60 \times 10^{-3}}{3}$$

Ma = 0.2M

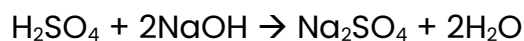
| Acid (H ₃ PO ₄) | Base (Ca(OH) ₂) |
|--|------------------------------|
| Ma = x | Mb = 0.4 M |
| Va = 80 × 10 ⁻³ L | Vb = 60 × 10 ⁻³ L |
| na = 2 | nb = 3 |

4) 1 mole NaOH \rightarrow molar mass $(23+16+1) = 40\text{g}$

X moles $\rightarrow 8\text{g}$

X = 0.2 moles of NaOH

$$\text{Concentration} = \frac{\text{no. of moles}}{\text{volume of solution (L)}} = \frac{0.2}{200 \times 10^{-3}} = 1\text{M}$$



$$\frac{Ma Va}{na} = \frac{Mb Vb}{nb}$$

$$\frac{0.5 \times Va}{1} = \frac{1 \times 30 \times 10^{-3}}{2}$$

$$Va = 0.03\text{L}$$

| Acid (H_2SO_4) | Base (NaOH) |
|----------------------------------|-----------------------------------|
| $Ma = 0.5\text{ M}$ | $Mb = 1\text{ M}$ |
| $Va = x\text{ L}$ | $Vb = 30 \times 10^{-3}\text{ L}$ |
| $na = 1$ | $nb = 2$ |

5) $\text{H}_2\text{SO}_4 + 2\text{NaHCO}_3 \rightarrow \text{Na}_2\text{SO}_4 + 2\text{H}_2\text{CO}_3$

$$\frac{Ma Va}{na} = \frac{\text{no. of moles}}{nb}$$

$$\frac{0.1 \times 7.15 \times 10^{-3}}{1} = \frac{\text{no. of moles}}{2}$$

No. of moles of $\text{NaHCO}_3 = 0.00143\text{ moles}$

1 mole $\text{NaHCO}_3 \rightarrow$ molar mass = 84g

$0.00143\text{ moles} \rightarrow x\text{g}$

$$X = 0.12012\text{g}$$

$$\text{Mass \% of } \text{NaHCO}_3 = \frac{\text{mass of } \text{NaHCO}_3}{\text{total mass}} \times 100$$

$$\text{Mass \% of } \text{NaHCO}_3 = \frac{0.12012}{1} \times 100 = 12.012\%$$

| Acid (H_2SO_4) | Base (NaHCO_3) |
|-------------------------------------|---------------------------|
| $Ma = 0.1\text{ M}$ | No. of moles = x |
| $Va = 7.15 \times 10^{-3}\text{ L}$ | $nb = 2$ |
| $na = 1$ | |

6) $\text{H}_2\text{SO}_4 + 2\text{NaOH} \rightarrow \text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O}$

$$\frac{Ma Va}{na} = \frac{Mb Vb}{nb}$$

| Acid (H_2SO_4) | Base (NaOH) |
|-----------------------------------|-----------------------------------|
| $Ma = 0.1\text{ M}$ | $Mb = x$ |
| $Va = 25 \times 10^{-3}\text{ L}$ | $Vb = 15 \times 10^{-3}\text{ L}$ |
| $na = 1$ | $nb = 2$ |

$$\frac{0.1 \times 25 \times 10^{-3}}{1} = \frac{Mb \times 15 \times 10^{-3}}{2}$$

$$Mb = 0.33M$$

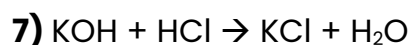
$$\text{Concentration} = \frac{\text{no.of moles}}{\text{volume of solution (L)}}$$

$$0.33 = \frac{x}{450 \times 10^{-3}}, x = 0.1485 \text{ moles of NaOH}$$

$$1 \text{ mole NaOH} \rightarrow \text{molar mass (23+16+1)} = 40g$$

$$0.1485 \text{ moles} \rightarrow xg$$

$$X = 5.94g$$



$$\frac{Ma Va}{na} = \frac{\text{no.of moles}}{nb}$$

$$\frac{0.1 \times 30 \times 10^{-3}}{1} = \frac{\text{no.of moles}}{1}$$

$$\text{No. of moles of KOH} = 0.003 \text{ moles}$$

$$1 \text{ mole KOH} \rightarrow \text{molar mass (39+16+1)} = 56g$$

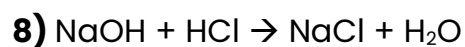
$$0.003 \text{ moles} \rightarrow xg$$

$$X = 0.168g$$

$$\% \text{ of purity} = \frac{\text{mass of pure KOH}}{\text{total mass of impure sample}} \times 100$$

$$\% \text{ of purity} = \frac{0.168}{0.3} \times 100 = 56\%$$

| Acid (HCl) | Base (KOH) |
|------------------------------|------------------|
| Ma = 0.1 M | No. of moles = x |
| Va = 30 × 10 ⁻³ L | nb = 1 |
| na = 1 | |



$$\frac{Ma Va}{na} = \frac{\text{no.of moles}}{nb}$$

$$\frac{0.1 \times 10 \times 10^{-3}}{1} = \frac{\text{no.of moles}}{1}$$

| Acid (HCl) | Base (NaOH) |
|------------------------------|------------------|
| Ma = 0.1 M | No. of moles = x |
| Va = 10 × 10 ⁻³ L | nb = 1 |
| na = 1 | |

No. of moles of NaOH = 0.001 moles

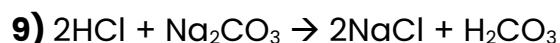
1 mole NaOH \rightarrow molar mass (23+16+1) = 40g

0.001 moles \rightarrow xg

X = 0.04g

$$\text{Mass \% of NaOH} = \frac{\text{mass of NaOH}}{\text{total mass}} \times 100$$

$$\text{Mass \% of NaOH} = \frac{0.04}{0.1} \times 100 = 40\%$$



$$\frac{Ma Va}{na} = \frac{\text{no.of moles}}{nb}$$

$$\frac{0.05 \times 20 \times 10^{-3}}{2} = \frac{\text{no.of moles}}{1}$$

No. of moles of Na_2CO_3 = 0.0005 moles

1 mole $\text{Na}_2\text{CO}_3 \rightarrow$ molar mass $(23 \times 2) + 12 + (16 \times 3) = 106\text{g}$

0.0005 moles \rightarrow xg

X = 0.053g

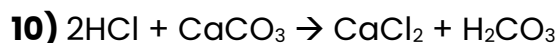
Mass of NaCl = Mass of mixture – mass of Na_2CO_3

Mass of NaCl = 0.4 – 0.053 = 0.347g

$$\text{Mass \% of NaCl} = \frac{\text{mass of NaCl}}{\text{total mass of mixture}} \times 100$$

$$\text{Mass \% of NaCl} = \frac{0.347}{0.4} \times 100 = 86.75\%$$

| Acid (HCl) | Base (Na_2CO_3) |
|----------------------------|-----------------------------------|
| Ma = 0.05 M | No. of moles = x |
| Va = 20×10^{-3} L | nb = 1 |
| na = 2 | |



$$\frac{Ma Va}{na} = \frac{\text{no.of moles}}{nb}$$

$$\frac{0.8 \times 15 \times 10^{-3}}{2} = \frac{\text{no.of moles}}{1}$$

| Acid (HCl) | Base (CaCO_3) |
|----------------------------|--------------------------|
| Ma = 0.8 M | No. of moles = x |
| Va = 15×10^{-3} L | nb = 1 |
| na = 2 | |

No. of moles of $\text{CaCO}_3 = 0.006$ moles

1 mole $\text{CaCO}_3 \rightarrow$ molar mass $40+12+(16 \times 3) = 100\text{g}$

$0.006\text{moles} \rightarrow \text{Xg}$

$\text{X} = 0.6\text{g}$

$$\text{Mass \% of } \text{CaCO}_3 = \frac{\text{mass of } \text{CaCO}_3}{\text{total mass of mixture}} \times 100$$

$$\text{Mass \% of } \text{CaCO}_3 = \frac{0.6}{1.5} \times 100 = 40\%$$

11) $\text{KCl} + \text{AgNO}_3 \rightarrow \text{AgCl} + \text{KNO}_3$

*Molar mass of $\text{AgCl} = 108 + 35.5 = 143.5\text{g}$

$\text{AgCl} \rightarrow \text{Cl}$

$6.7\text{g} \rightarrow \text{Xg}$

$143.5\text{g} \rightarrow 35.5\text{g}$

$\text{X} = 1.65 \text{ g of Cl}$

$$\text{Mass \% of Cl} = \frac{\text{mass of Cl}}{\text{total mass}} \times 100$$

$$\text{Mass \% of Cl} = \frac{1.65}{3.4} \times 100 = 48.5\%$$

12) $\text{K}_2\text{SO}_4 + \text{BaCl}_2 \rightarrow \text{BaSO}_4 + 2\text{KCl}$

*Molar mass of $\text{K}_2\text{SO}_4 = (39 \times 2) + 32 + (16 \times 4) = 174\text{g}$

*Molar mass of $\text{BaSO}_4 = 137 + 32 + (16 \times 4) = 233\text{g}$

$\text{K}_2\text{SO}_4 \rightarrow \text{BaSO}_4$

$\text{Xg} \rightarrow 4.66\text{g}$

$174\text{g} \rightarrow 233\text{g}$

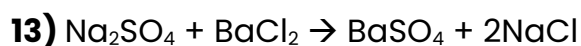
$\text{X} = 3.48 \text{ g of } \text{K}_2\text{SO}_4$

Mass of impurities = Mass of impure sample – mass of K_2SO_4

Mass of impurities = $4 - 3.48 = 0.52g$

$$\% \text{ of impurities} = \frac{\text{mass of impurities}}{\text{total mass of mixture}} \times 100$$

$$\% \text{ of impurities} = \frac{0.52}{4} \times 100 = 13\%$$



*Molar mass of $BaCl_2 = 137 + (35.5 \times 2) = 208g$

*Molar mass of $BaSO_4 = 137 + 32 + (16 \times 4) = 233g$



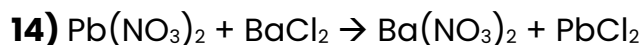
xg $\rightarrow 2.734g$

208g $\rightarrow 233g$

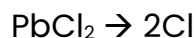
X = 2.44 g of $BaCl_2$

$$\% \text{ of } BaCl_2 = \frac{\text{mass of } BaCl_2}{\text{total mass}} \times 100$$

$$\% \text{ of } BaCl_2 = \frac{2.44}{3.725} \times 100 = 65.5\%$$



*Molar mass of $PbCl_2 = 207 + (35.5 \times 2) = 278g$



1g $\rightarrow xg$

278g $\rightarrow 2 \times 35.5g$

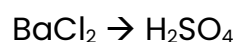
X = 0.255 g of Cl

$$\text{Mass \% of Cl} = \frac{\text{mass of Cl}}{\text{total mass}} \times 100$$

$$\text{Mass \% of Cl} = \frac{0.255}{2} \times 100 = 12.75\%$$

15) *Molar mass of $\text{BaCl}_2 = 137 + (35.5 \times 2) = 208\text{g}$

*Molar mass of $\text{H}_2\text{SO}_4 = (1 \times 2) + 32 + (16 \times 4) = 98\text{g}$



$$0.5\text{g} \rightarrow x\text{g}$$

$$208\text{g} \rightarrow 98\text{g}$$

$$X = 0.235 \text{ g of } \text{H}_2\text{SO}_4$$

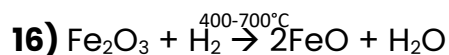
$$1 \text{ mole } \text{H}_2\text{SO}_4 \rightarrow 98\text{g}$$

$$X \text{ moles} \rightarrow 0.235\text{g}$$

$$X = 0.00239 \text{ moles}$$

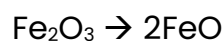
$$\text{Concentration} = \frac{\text{no. of moles}}{\text{volume of solution (L)}}$$

$$1 = \frac{0.00239}{x}, x = 0.00239 \text{ L} = 2.39 \text{ ml} = 2.4 \text{ ml}$$



*Molar mass of $\text{FeO} = 55.8 + 16 = 71.8\text{g}$

*Molar mass of $\text{Fe}_2\text{O}_3 = (2 \times 55.8) + (16 \times 3) = 159.6\text{g}$



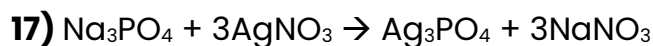
$$x\text{g} \rightarrow 0.58\text{g}$$

$$159.6\text{g} \rightarrow 2 \times 71.8\text{g}$$

$$X = 0.64 \text{ g of } \text{Fe}_2\text{O}_3$$

$$\text{Mass \% of } \text{Fe}_2\text{O}_3 = \frac{\text{mass of } \text{Fe}_2\text{O}_3}{\text{total mass}} \times 100$$

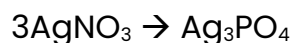
$$\text{Mass \% of Fe}_2\text{O}_3 = \frac{0.64}{0.7} \times 100 = 91.4\% = 92\%$$



Yellow ppt. soluble in ammonia solution $\rightarrow \text{Ag}_3\text{PO}_4$

*Molar mass of $\text{AgNO}_3 = 108 + 14 + (16 \times 3) = 170\text{g}$

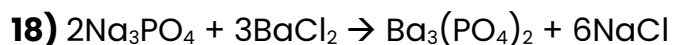
*Molar mass of $\text{Ag}_3\text{PO}_4 = (108 \times 3) + 31 + (16 \times 4) = 419\text{g}$



xg $\rightarrow 2.25\text{g}$

$3 \times 170\text{g} \rightarrow 419\text{g}$

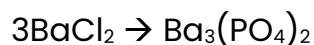
$X = 2.738\text{ g of AgNO}_3$



White ppt. soluble in dil. HCl $\rightarrow \text{Ba}_3(\text{PO}_4)_2$, therefore name of anion is phosphate

*Molar mass of $\text{BaCl}_2 = 137 + (35.5 \times 2) = 208\text{g}$

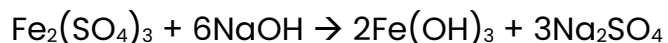
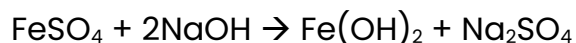
*Molar mass of $\text{Ba}_3(\text{PO}_4)_2 = (137 \times 3) + ((31 + (16 \times 4)) \times 2) = 601\text{g}$



xg $\rightarrow 1.21\text{g}$

$3 \times 208\text{g} \rightarrow 601\text{g}$

$X = 1.256\text{ g of BaCl}_2$



1 mole of Fe_3O_4 gives 1 mole of each of FeSO_4 and $\text{Fe}_2(\text{SO}_4)_3$

0.1 moles of Fe_3O_4 gives 0.1 moles of each of FeSO_4 and $\text{Fe}_2(\text{SO}_4)_3$

$\text{FeSO}_4 \rightarrow \text{Fe}(\text{OH})_2$ (0.1 moles of FeSO_4 gives 0.1 moles of $\text{Fe}(\text{OH})_2$)

1 mole $\text{Fe}(\text{OH})_2 \rightarrow 90\text{g}$

0.1 moles $\rightarrow x\text{g}$

$x = 9\text{g}$

$\text{Fe}_2(\text{SO}_4)_3 \rightarrow 2\text{Fe}(\text{OH})_3$ (0.1 moles of $\text{Fe}_2(\text{SO}_4)_3$ gives 0.2 moles of $\text{Fe}(\text{OH})_3$)

1 mole $\text{Fe}(\text{OH})_3 \rightarrow 107\text{g}$

0.2 moles $\rightarrow x\text{g}$

$x = 21.4\text{g}$

Total mass of precipitates = Mass of $\text{Fe}(\text{OH})_2$ + Mass of $\text{Fe}(\text{OH})_3$

Total mass of precipitates = $9 + 21.4 = 30.4\text{g}$

20) $\text{AgNO}_3 + \text{NaCl} \rightarrow \text{NaNO}_3 + \text{AgCl}$

*Molar mass of $\text{AgCl} = 108 + 35.5 = 143.5\text{g}$

$\text{AgCl} \rightarrow \text{Cl}$

$3.52\text{g} \rightarrow x\text{g}$

$143.5\text{g} \rightarrow 35.5\text{g}$

$x = 0.87\text{ g of Cl}$

Mass % of $\text{Cl} = \frac{\text{mass of Cl}}{\text{total mass}} \times 100$

Mass % of $\text{Cl} = \frac{0.87}{4} \times 100 = 21.75\%$

21) $\text{H}_2\text{SO}_4 + 2\text{NaNO}_3 \rightarrow \text{Na}_2\text{SO}_4 + 2\text{HNO}_3$

1 mole $\text{H}_2\text{SO}_4 \rightarrow 98\text{g}$

0.125 moles $\rightarrow x\text{g}$

$x = 12.25\text{g}$

$\text{H}_2\text{SO}_4 \rightarrow 2\text{HNO}_3$

12.25g $\rightarrow x\text{g}$

98g $\rightarrow 2 \times 63\text{g}$

$x = 15.75\text{ g of HNO}_3$

1 mole $\text{HNO}_3 \rightarrow 63\text{g}$

$x\text{ moles} \rightarrow 15.75\text{g}$

$x = 0.25\text{ moles}$

$\text{HNO}_3 + \text{NaOH} \rightarrow \text{NaNO}_3 + \text{H}_2\text{O}$

$$\frac{\text{no. of moles}}{na} = \frac{Mb Vb}{nb}$$

$$\frac{0.25}{1} = \frac{Mb \times 200 \times 10^{-3}}{1}$$

$Mb = 1.25\text{M}$

| Acid (HNO_3) | Base (NaOH) |
|-------------------------|------------------------------------|
| No. of moles = 0.25 | $Mb = x$ |
| $na = 1$ | $Vb = 200 \times 10^{-3}\text{ L}$ |
| | $nb = 1$ |

22) $\text{MnCl}_x \cdot 4\text{H}_2\text{O} \rightarrow \text{MnCl}_x + 4\text{H}_2\text{O}$

Mass of water = Mass of hydrated sample – mass of anhydrous sample

Mass of water = $6.6 - 4.2 = 2.4\text{g}$

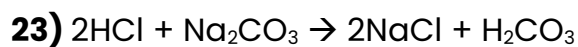
$\text{MnCl}_x \rightarrow 4\text{H}_2\text{O}$

4.2g $\rightarrow 2.4\text{g}$

$(55 + 35.5x)\text{g} \rightarrow 4 \times 18\text{g}$

$x = 2$

$\text{Mn}_{25} \rightarrow \text{Ar}_{18}, 4s^2, 3d^5$



$$\frac{M_a V_a}{n_a} = \frac{M_b V_b}{n_b}$$

$$\frac{0.1 \times 25 \times 10^{-3}}{2} = \frac{M_b \times 25 \times 10^{-3}}{1}$$

$$M_b = 0.05\text{M}$$

$$\text{Concentration} = \frac{\text{no. of moles}}{\text{volume of solution (L)}}$$

$$0.05 = \frac{x}{1}, x = 0.05 \text{ moles of } \text{Na}_2\text{CO}_3$$

$$\text{*Molar mass of } \text{Na}_2\text{CO}_3 = (23 \times 2) + 12 + (16 \times 3) = 106\text{g}$$

$$1 \text{ mole } \text{Na}_2\text{CO}_3 \rightarrow 106\text{g}$$

$$0.05 \text{ moles} \rightarrow x\text{g}$$

$$x = 5.3\text{g}$$

$$\text{Mass of water} = \text{Mass of hydrated sample} - \text{mass of anhydrous sample}$$

$$\text{Mass of water} = 14.3 - 5.3 = 9\text{g}$$

$$\text{Mass \% of water} = \frac{\text{mass of water}}{\text{total mass of hydrated sample}} \times 100$$

$$\text{Mass \% of water} = \frac{9}{14.3} \times 100 = 62.93\%$$

| Acid (HCl) | Base (Na ₂ CO ₃) |
|--|--|
| M _a = 0.1 M | M _b = x |
| V _a = 25 × 10 ⁻³ L | V _b = 25 × 10 ⁻³ L |
| n _a = 2 | n _b = 1 |

