

Gas laws

1. $X: t_1 = 28.3 \text{ sec}$ $RMM = ?$
 $Q_2: t_2 = 20.0 \text{ sec}$ $RMM = 32$
 $T \propto MM$ ✓

$$\frac{T_1}{T_2} = \frac{X}{32}$$

$$\frac{T_1}{T_2}^2 = \frac{X}{32} \quad \checkmark$$

$$\frac{28.3}{20.0}^2 = \frac{X}{32} \quad \checkmark$$

$$X = \frac{28.3^2 \times 32}{400} \quad \checkmark$$

$$X = 64 \quad \checkmark$$

2. (a) The rate of diffusion of a gas is inversely proportional to the square root of its density under the same conditions of temperature and pressure

(b) Rate of gas $V = \frac{1}{5} \times \frac{100 \text{ cm}}{10 \text{ sec}}$

$$= 2 \text{ cm/sec} \quad \checkmark \frac{1}{2}$$

$$\text{Rate of } W = \frac{10 \text{ cm}}{10 \text{ sec}}$$

$$= 1 \text{ cm/sec} \quad \checkmark \frac{1}{2}$$

$$\frac{RV}{RW} = \frac{MW}{MV} = \frac{2}{1} = \frac{MW}{16}$$

$$\frac{2}{1}^2 = \frac{MW}{16}$$

$$\frac{4}{1} = \frac{MW}{16}; = \frac{4 \times 16}{1}$$

$$MW = 64$$

3. (a) The volume of a fixed mass of a gas is directly proportional to its absolute temperature at constant Pressure

(b) Apply combined gas law; $\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$

$$V_1 = 3.5 \times 10^{-2} \text{ m}^3 \quad V_2 = 2.8 \times 10^{-2} \text{ m}^3 \quad \checkmark \frac{1}{2}$$

$$P_1 = 1.0 \times 10^5 \text{ Pa} \quad P_2 = 1.0 \times 10^5 \text{ Pa}$$

$$T_1 = 291 \text{ K} \quad T_2 = ?$$

$$T_2 = \frac{P_2 V_2 T_1}{P_1 V_1}$$

$$T_2 = \frac{1.0 \times 10^5 \text{ Pa} \times 2.8 \times 10^{-2} \text{ m}^3 \times 291 \text{ K}}{1.0 \times 10^5 \text{ Pa} \times 3.5 \times 10^{-2} \text{ m}^3}$$

$$T_2 = 232.8 \text{ K} \quad \checkmark$$

4. $T_{SO_2} = \frac{R.M.N.SO_2}{\checkmark \frac{1}{2}}$

$$TO_2 \quad R.M.MO_2$$

$$SO_2 = 32 + (16 \times 2) = 64 \sqrt{1/2}$$

$$O_2 = (16 \times 2) = 32 \sqrt{1/2}$$

$$\frac{TSO_2}{50} = \frac{64}{32} \sqrt{1/2} = 70.75 \sqrt{1/2}$$

5. a) *The rate of diffusion of a fixed mass of a gas is inversely proportional to the square root of its density at constant temperature and pressure*

$$b) RHCl = \frac{30 \text{ cm}^3}{20 \text{ se}} = 1.5 \text{ cm}^3 \quad \text{see}$$

$$\frac{RHCL}{RSO_2} = \frac{\sqrt{MSO_2}}{\sqrt{MHCL}}$$

$$\frac{(1.5)^2}{(RSO_2)^2} = \frac{\sqrt{64}}{\sqrt{36.5}}$$

$$RSO_2 = \sqrt{2.25 \times 36.5}$$

$$(RSO_2)^2 = \frac{2.25 \times 36.5}{64}$$

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6. a) *Boyles' law For a fixed mass of a gas, volume is inversely proportional to pressure at constant temperature*

b)

$$c) \frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2} \sqrt{1/2} \quad V_2 = \frac{P_1 V_1}{P_2} \times \frac{T_2}{T_1} \sqrt{1/2}$$

$$= \frac{250 \times 273 - 23}{273 + 127} \sqrt{1/2}$$

$$= 156.5 \text{ cm}^3$$

7. a) *RFM of CaCO₃ = 40 + 12 + 48 = 100kg. $\sqrt{1/2}$*

$$\therefore 100 \text{ kg of CaCO}_3 \equiv 22.4 \text{ dm}^3 \text{ of CO}_2(\text{g})$$

$$1000 \text{ kg } \text{''} \text{''} \quad ?$$

$$= \frac{22.4 \times 1000}{100} \sqrt{1/2} = 224 \text{ dm}^3 \sqrt{1/2}$$

8. $T_1 = 23 + 273 = 296$ $T_2 = -25 + 273 = 248$

$$V_1 = 200 \text{ cm}^3 \quad V_2 = ?$$

$$P_1 = 740 \text{ mmHg} \quad P_2 = 780 \text{ mmHg}$$

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

$$\frac{740 \times 200}{296} \sqrt{1} = \frac{780 \times ?}{248} \sqrt{1}$$

$$\therefore x = \frac{740 \times 200 \times 248}{296 \times 780}$$

$$= 158.974 \text{ cm}^3 \sqrt{1} \text{ (penalize } \frac{1}{2} \text{ mark for units)}$$

9. $\frac{Rk}{Rs} = \frac{\sqrt{Ms}}{Mk}$

$$\therefore \frac{12}{7.2} = \frac{\sqrt{x} \sqrt{1/2}}{16}$$

$$X = \frac{12^2}{7.2^2} \times 16 \sqrt{1/2}$$

$$= 44.464 \sqrt{1/2}$$

10. (a) When gases combine they do so in volume which bear a simple ratio to one another and to the product if gaseous under standard temperature and pressure

11. a) Rate of diffusion is whereby proportional to molecular mass of a gas. $\sqrt{1}$

b) $\frac{TCO_2}{TCO} = \frac{MCO_2}{MCO} \sqrt{1/2}$

$$\Rightarrow \frac{200}{T} = \frac{44}{28} = \frac{44}{28} \frac{11}{7} \sqrt{1/2}$$

$$\Rightarrow \frac{200}{T} = \frac{11}{7}$$

$$\Rightarrow \frac{T}{200} = \frac{7}{11}$$

$$\Rightarrow T = 200 \cdot 0.79772 \sqrt{1/2} = 159.5 \text{ Seconds. } \sqrt{1/2}$$

12. a) $Y \sqrt{1}$

b) Z and W $\sqrt{1}$ have same atomic number but different mass number. $\sqrt{1}$

13. (a) Gas P

(b) $\frac{RQ}{RP} = \frac{RMP}{RMMQ}$

$$\frac{18}{54} = \frac{x}{17} \quad 2$$

$$\frac{1^2}{3^2} = \frac{x}{17}$$

$$\frac{1}{9} = \frac{x}{17}$$

$$9x = 17$$

$$x = \frac{17}{9}$$

$$x = 1.88$$

$$Q = It$$

$$= 5 \times 386 = 1930C$$

(b) $Pb^{2+}_{(l)} + 2e \rightarrow Pb_{(s)}$ ($\frac{1}{2}mk$)

$$\text{If } 2 \times 96500C = 207 \quad (\frac{1}{2}mk)$$

$$1930C = \frac{1930 \times 207}{2 \times 96500} \quad (\frac{1}{2} \text{ mk})$$

$$= \frac{399510}{193000C} \quad (\frac{1}{2} \text{ mk})$$

$$= 2.07g \quad (\frac{1}{2} \text{ mk})$$

14. i) Delocalized electrons
 ii) Mobile ions
 iii) Mobile ions

15. $\frac{TNH_3}{TB} = \frac{MNH_3}{MB} \sqrt{\frac{1}{2}}$

$$\frac{TNH_3}{TB} = \frac{17}{34} \sqrt{\frac{1}{2}}$$

$$\frac{TNH_3}{110} = \frac{17}{34} \sqrt{\frac{1}{2}}$$

$$TNH_3 = 110 \times \frac{17}{34} \sqrt{\frac{1}{2}} = 77.78 \text{ seconds} \sqrt{\frac{1}{2}}$$

16. $\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$

$$\frac{1 \times 5}{246} = \frac{2 \times V_2}{400}$$

$$V_2 = \frac{400 \times 1 \times 5}{2 \times 246}$$

$$= 4.065 \text{ dm}^3$$

17. a) $V_1 = 200 \text{ cm}^3$ $V_2 = ?$
 $T_1 = 296 \text{ K}$ $T_2 = 284 \text{ K}$
 $P_1 = 740 \text{ mmHg}$ $P_2 = 780 \text{ mm Hg}$

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

$$V_2 = \frac{P_1 V_1 T_2}{T_1 P_2} = \frac{740 \text{ mm Hg} \times 200 \text{ cm}^3 \times 284 \text{ K}}{296 \text{ K} \times 780 \text{ mm Hg}}$$

$$= 158.97 \text{ cm}^3$$

b) 60 l ✓

18. a) Grahams law states
 Under the same conditions of pressure and temperature, the rate of diffusion of a gas is inversely proportional to the square root of its density

b) $\frac{\text{Time } CO_2}{\text{Time } NO_2} = \frac{\sqrt{M_r CO_2}}{\sqrt{M_r NO_2}}$

Where 100 cm^3 of CO_2 takes 30 seconds

$\therefore 150 \text{ cm}^3$ of CO_2 takes $\frac{30}{100} \times 150$

$$= 45 \text{ seconds} \sqrt{\quad}$$

$$\frac{45^2}{TNO_2} = 0.975$$

$$\frac{45}{TNO_2} = \frac{\sqrt{44}}{46} \quad \text{---} \quad TNO_2 = \frac{45}{0.978}$$

$$TNO_2 = 46 \text{ sec}$$

OR

$$RCO_2 = \frac{\sqrt{M_r NO_2}}{\sqrt{M_r CO_2}}$$



$$\text{But } RCO_2 = \frac{100\text{cm}^3}{30\text{ s}} = 3.33 \text{ cm}^3 \text{ per sec}$$

$$\frac{3.33}{RNO_2} = \frac{\sqrt{46}}{44}$$

$$= 1.0225$$

$$RNO_2 = \frac{3.33}{1.0225}$$

$$= 3.26 \text{ cm}^3 \text{ per second}$$

$$\text{Time for No} = \frac{150 \text{ cm}^3}{3.26 \text{ cm sec}^{-1}} = 46 \text{ secs}$$

1. When a magnesium ribbon is heated in air it combines with oxygen forming magnesium oxide. When potassium manganate (VII) is heated it decomposes giving off oxygen which escapes in air

2. $RFM \text{ of NaOH} = 40$
 $\text{Moles of NaOH} = \frac{8}{40} = 0.2M \checkmark$

Moles of NaOH in 25cm³

$$\frac{25 \times 0.2}{1000} = 0.005 \checkmark$$

Mole ratio 1:2

$$\text{Moles of acid} = \frac{0.005}{2}$$

$$= 0.0025$$

$$\frac{1 \times 0.245}{0.0025} = 98 \checkmark$$

3. No. Of moles of HNO₃ acid

$$\frac{50 \times 2}{1000} = 0.1 \text{ moles}$$

Mole ratio 1:1 \checkmark

$$\text{The KOH will have } 0.1 \text{ moles; } \frac{0.1 \times 100}{50} = 0.2 \text{ moles}$$

$$\text{Then D grams is } 0.2 \times 56$$

$$= 11.2 \text{ g}$$

4. Number of moles of Q = $\frac{960\text{cm}^3 \times 1 \text{ mole}}{24000\text{cm}^3}$
 $= 0.04 \text{ moles}$

Equation:



Mole ratio Na₂SO₃: SO₂ is 1:1

\therefore No. of moles of Na₂SO₃ = 0.04 moles

$$\text{Mass of Na}_2\text{SO}_3 = 126 \text{ gmol}^{-1} \times 0.04$$

$$= 5.04 \text{ g}$$

5. From the equation

- (3x24) litres of chlorine react with iron to produce [(56 x 2) + (35.5 X3)] g of FeCl₃.

325 g of FeCl_3 is produced by 72 litres of Cl_2

Then 0.5g of FeCl_3 is produced by:

$$\frac{0.5 \times 72}{325} = 0.11078 \text{ litres}$$

$$= 110.78 \text{ cm}^3$$

6. $\text{RMM}(\text{CH}_3\text{OOH}) = 60$

Mass of 15cm^3 and $= 1.05 \times 15 = 15.75\text{g}$

Moles in 500cm^3 solution $= \frac{15.75}{60} = 0.2625$

$$\text{Molarity} = \frac{1000 \times 0.2625}{5000} = 0.525\text{M}$$

7. If $24000\text{cm}^3 = 1\text{mole}$

$150\text{cm}^3 = ?$

$$\frac{150 \times 1}{24000} = 0.00625 \text{ moles of } \text{CO}_2$$

Since the ratio of Na_2CO_3 ; O_2 produced is 1:1 the mass of $\text{Na}_2\text{CO}_3 = 0.00625 \times 106 = 0.6625\text{g}$

Na_2CO_3	H_2O
Mass 0.6625g	1.0125g
RFM 106	18
Mole 0.6625 = $\frac{0.00625}{106}$	$\frac{1.0125}{18} = 0.5625$
Ratio $\frac{0.00625}{0.00625} = 1$	$\frac{18}{0.05625} = 9$
$\text{Na}_2\text{CO}_3 \cdot 9\text{H}_2\text{O}$	

8. MgCl_2 $\text{Mg}^{2+}(\text{s}) \cdot 2\text{Cl}^-$

$$\text{R.F.M of } \text{MgCl}_2 = 24 + 71 = 95$$

$$\text{Moles of Mass} = \frac{1.7}{95}$$

$$= 0.01789 \text{ moles}$$

1 mole of $\text{MgCl}_2 = 2 \text{ moles of Cl}^- \text{ ions}$

$$0.01789 \text{ moles of } \text{MgCl}_2 = 0.01789 \times 2 = 0.03478 \text{ moles of Cl}^- \text{ ions}$$

$$1 \text{ mole} = 6.0 \times 10^{23} \text{ ions}$$

$$0.03578 \text{ moles} = \frac{0.03578 \times 6.0 \times 10^{23}}{1}$$

$$= 2.1468 \times 10^{22} \text{ ions of Cl}^-$$

12. Mass of $\text{O}_2 = (4.0 - 2.4) = 1.6\text{g}$

$$\text{Moles of } \text{O}_2 = \frac{1.6}{16} = 0.1$$

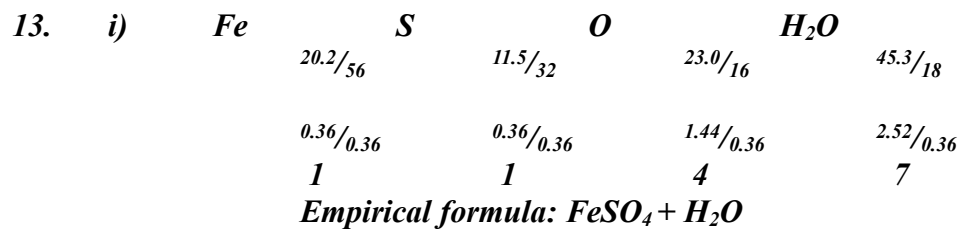
$$\text{If 1 mol } \text{O}_2 \text{ occupies } 24000\text{cm}^3$$

$$0.1 \text{ Mol } \text{O}_2 = 0.1 \times 24000 = 2400\text{cm}^3$$

OR

$$\frac{2\text{mg}}{2(24)} : \frac{\text{O}_2}{24000}$$

$$X = \frac{2.4/2(24)}{2(2.4)} = \frac{x/240000}{2(2.4)} = 1200\text{cm}^3$$



ii) $6.95\text{g} = \frac{6.95}{278} = 0.025$
 $\therefore 0.05 \text{ moles in } 250\text{cm}^3 = 0.025 \times \frac{1000}{250} = 0.1$

14. R.F.M of $PbI_2 = 207 + (127 \times 2) = 461$
 2 moles of Ions produces 1 mole of PbI_2
 Moles of Ions = $\frac{0.1 \times 300}{1000} = 0.03$ mole
 Mole ratio PbI_2 : I = $\frac{0.03}{2} = 0.015$
 Mole of PbI_2 formed = $\frac{0.03}{2} = 0.015$
 Mass of PbI_2 formed = $0.015 \text{ mole} \times 461 = 6.915 \text{ g}$

d(i) Yellow precipitate

15. a) i)
 ii) At 25°C, sodium chloride is in solid form. Ions cannot move. Between 801 and 1413°C sodium chloride is in liquid state, ions are mobile
- b) Both ammonia and water are polar molecules and hydrogen bonds are formed
- c) N _____ H // co-ordinate bond / Dative bond
- d) i) Allotrope
 ii) Add methylbenzene to soot in a beaker. Shake and filter. Warm the filtrate to concentrate it. Allow the concentrate to cool for crystals to form. Filter to obtain crystals of fullerene
 iii) $\frac{720}{12} = 60$

16. Mass of $O_2 = (4.0 - 2.4) = 1.6 \text{ g}$
 Moles of $O_2 = \frac{1.6}{16} = 0.1$

If 1 mol O_2 _____ 24000 cm^3
 0.1 Mol $O_2 = 0.1 \times 24000 = 2400 \text{ cm}^3$

OR

2 mg	:	O_2
$2(24)$		24000
$\frac{2.4}{2(24)}$	$= \frac{x}{24000}$	

$X = \frac{2.4 \times 24000}{2(2.4)} = 1200 \text{ cm}^3$

17. i) C_nH_{2n} , where n = No. of carbon atoms
 ii) 70
 iii) C_5H_{10} , $CH_3CH=CHCH_2CH_3$
 OR $CH_3CH_2CH=CH_2$

18. i)	Fe	S	O	H_2O	
	$\frac{20.2}{56}$	$\frac{11.5}{32}$	$\frac{23.0}{16}$	$\frac{45.3}{18}$	
	$\frac{0.36}{0.36}$	$\frac{0.36}{0.36}$	$\frac{1.44}{0.36}$	$\frac{2.52}{0.36}$	
	1	1	4	7	

Empirical formula: $FeSO_4 + H_2O$

$$\begin{aligned}
 \text{ii) } 6.95\text{g} &= \frac{6.95}{278} = 0.025 \\
 \therefore 0.05 \text{ moles in } 250\text{cm}^3 &= 0.025 \times \frac{1000}{250} = 0.1 \\
 \text{Concentration} &= \frac{6.95}{278} \times \frac{1000}{250} = 0.1
 \end{aligned}$$

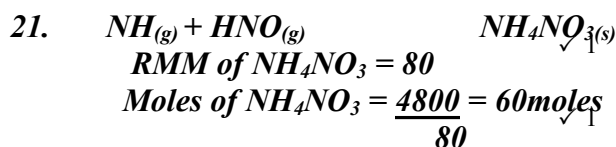
19. a) Zinc is more reactive// higher reduction potential than copper it will react with// get oxidized in preference to iron oxygen to form Zinc Oxide coat which protects iron from rusting
 ii) Sacrificial protection or cathodic protection

$$\begin{aligned}
 20. \text{ Mole of Mg that reacted} &= \frac{\text{Answer in (c) (ii)} \times 2}{1000} \\
 &= \frac{26}{1000} = 0.026 \checkmark^{1/2}
 \end{aligned}$$

$$\begin{aligned}
 \text{Mass of Mg in the alloy} &= 0.026 \times 24 \\
 &= 0.624\text{g} \checkmark^{1/2}
 \end{aligned}$$

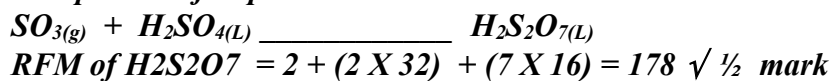
$$\begin{aligned}
 \text{Mass Cu in the alloy} &= (1.0 - 0.624) \\
 &= 0.376\text{g} \checkmark^{1/2}
 \end{aligned}$$

$$\begin{aligned}
 \% \text{ of Cu} &= \frac{0.376 \times 100}{1.0} \\
 &= 37.6\% \checkmark^{1/2}
 \end{aligned}$$



$$\begin{aligned}
 \text{RMM of NH}_3 &= 17 \\
 \text{Mass of NH}_3 &= 60 \times 17 = 1020\text{KJ}
 \end{aligned}$$

22. From the equation of step 3



178g of Oleum are produced by 22.4 liters of SO_3 $\checkmark^{1/2}$ mark

$$178 \text{ kg} \quad \text{“} \quad \text{“} \quad \text{“} \quad \text{“} \quad \text{“} \quad \text{“} \quad \frac{178 \times 1000 \times 22.4\text{L}}{178\text{g}} \checkmark^{1/2} \text{ mark}$$

$$\begin{aligned}
 &= 22,4000 \text{ liters} \checkmark^{1/2} \text{ mark} \\
 &\text{(Total 13 marks)}
 \end{aligned}$$

23. i) Moles of copper = $\frac{0.635}{63.5} = 0.01$ moles

$$\text{Volume of 1M Nitric acid} \frac{40}{0.01} = 4000\text{cm}^3 \checkmark^{1/2} \text{ mark}$$

- Use value in d(ii) above

$$\text{ii) } \frac{480\text{cm}^3}{0.01} \checkmark^{1/2} \text{ mark} = 48,000 \text{ cm}^3 \checkmark^{1/2} \text{ mark}$$

$$\text{OR } \frac{4000 \times 480}{1} = 48,000\text{cm}^3 \checkmark^{1/2} \text{ mark}$$

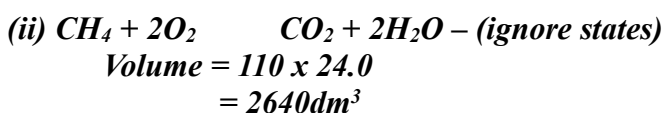
$$40\text{cm}^3$$

i.e. $\frac{\text{Answer in e(i)} \times 480\text{cm}^3}{\text{Answer in d(i)}}$

[Total = 11 marks]

24. (i) $\frac{35.2 \times 1000}{100 \times 16}$ $\checkmark \frac{1}{2}$
 $= 10\text{Moles}$ $\checkmark \frac{1}{2}$
 Or mass of $\text{CH}_4 = \frac{35.2 \times 5}{1000} = 1.76\text{g}$ $\checkmark \frac{1}{2}$
 Mass in g = $1.76 \times 1000 = 1760\text{kg}$

Moles of methane = $\frac{1760}{16}$ $\checkmark \frac{1}{2}$
 $= 110\text{Moles}$ $\checkmark \frac{1}{2}$



Mark consequential from equation and b(ii) (Without equation max *TZM*)

25. Volume of Cl_2 used
 $= 0.047 \times 24$ $\checkmark 1$
 $= 1.128\text{dm}^3$ $\checkmark \frac{1}{2}$

26. Mass due Carbon in $\text{CO}_2 = \frac{12}{44} \times 35.2$
 $= 0.96$
 Moles carbon = $\frac{0.96}{12} = 0.08$
 Mass due Hydrogen in $\text{H}_2\text{O} = \frac{2}{18} \times 1.40$
 $= 0.156$
 Moles hydrogen = $\frac{0.156}{1} = 0.156$
 Mole ratio C:H = 1: 1.95
 E.F = CH_2

27. $\text{Na}_2\text{CO}_3 \cdot x\text{H}_2\text{O}$ $\text{Na}_2\text{CO}_3 + \text{H}_2\text{O}$ $\checkmark 1$

34.8g	$\frac{15.9\text{g}}{106}$	$\frac{18.9\text{g}}{18}$	
	$\frac{0.15}{1} \checkmark 1$	$\frac{1.15}{0.15}$	3
	x	$= 7 \checkmark 1$	

28. % of H_2O lost = 14.5%
 5 of anhydrous $\text{Na}_2\text{CO}_3 = 85.5\%$ ($\frac{1}{2}\text{mk}$)
 R.F.M of $\text{Na}_2\text{CO}_3 = 106$ ($\frac{1}{2}\text{mk}$)
 RMM of $\text{H}_2\text{O} = 18$ ($\frac{1}{2}\text{mk}$)

Na_2CO_3	H_2O	
$\frac{85.5}{106}$	$\frac{14.5}{18}$	$(\frac{1}{2}\text{mk})$
$\frac{0.8066}{0.8055}$	$\frac{0.8055}{0.8055}$	$(\frac{1}{2}\text{mk})$

$$n = 1 (\text{Na}_2\text{CO}_3 \cdot \text{H}_2\text{O}) \quad (\frac{1}{2}\text{mk})$$

$$29. \quad \text{Moles of Na}_2\text{CO}_3 = \frac{20 \times 0.1}{1000} = 0.002 \text{ moles}$$



Mole ratio 1 : 1

$$\text{Moles of H}_2\text{SO}_4 = \text{Moles of Na}_2\text{CO}_3 = 0.002 \text{ moles}$$

$$\text{Molarity of H}_2\text{SO}_4 = \frac{10000 \times 0.002}{13} = 0.154 \text{ moles}$$

30.

Element	C	H	O
%	68.9	13.5	21.6
Molar mass	12	1	16
Moles	$\frac{68.9}{12}$ 5.403	$\frac{13.5}{1}$ 13.5	$\frac{21.6}{16}$ 1.35
MR	$\frac{5.43}{1.33}$ 4	$\frac{13.5}{1.35}$ 10	$\frac{1.35}{1.35}$ 1
Ratio	4	10	1

$$h (\text{C}_4\text{H}_{10}\text{O}) = 74$$

$$h (12 \times 4) + (10 \times 1) + 16 = 74$$

$$74h = 74$$

$$H = 1$$

Formula $\text{C}_4\text{H}_{10}\text{O}$

$$31. \quad \text{Moles C}_4\text{H}_{10} = \frac{1.12}{22.4} = 0.05 \text{ mol}$$

$$\text{Heat produced} + 0.05 \times (3000) = 150 \text{ kj}$$

$$\text{Usefull heat} = \frac{75 \times 150}{100} = 112.5 \text{ kj}$$

$$\text{Let volume of water} = V$$

$$\text{Room temperature} = 25^\circ\text{C}$$

$$\text{Boiling point} = 100^\circ\text{C}$$

$$\text{Change in temperature, } \Delta T = 100 - 25 = 75^\circ\text{C} \quad \frac{1}{2} \text{ mk}$$

$$\Delta T \times \text{mass} \times C = Q \quad 315V = 112500$$

$$= \frac{75 \times V \times 4.2}{1000} = 112.5 \quad V = \frac{112500}{315} \quad \frac{1}{2} \text{ mk}$$

$$V = 357. \text{km}^3 \quad \frac{1}{2} \text{ mk}$$

$$32. \quad \text{RFM Na}_2\text{CO}_3 = 43 + 12 + 48 = 106$$

$$\text{Mol. Na}_2\text{CO}_3 = \frac{19.6}{106} = 0.1849057$$

$$\text{Molarity of Na}_2\text{CO}_3 = \frac{0.1849057}{0.25} = 0.73962 \text{ m}$$



Mole ratio Na CO₃ : Mg Cl₂ is 1:1

$$\therefore \text{mol. Mg Cl}_2 \text{ Reacted} = 0.1849$$

$$\begin{aligned}
 \text{If } 2.0 \text{ mol.} &= 1000 \text{ cm}^3 \text{ solution mg cl}_2 \\
 = 0.1849 \text{ mol} &= \frac{0.1849 \times 1000}{2} \\
 &= 92.45 \text{ or } 92.5 \text{ cm}^3
 \end{aligned}$$

33. i) **ACID** **BASE**

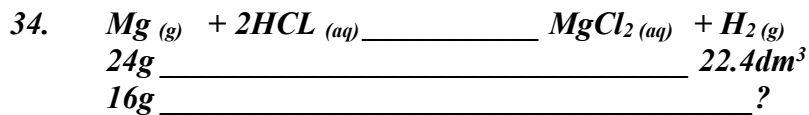
1	2
$\frac{1}{2} \times 0.004$	$\frac{20 \text{ cm}^3}{1000 \text{ cm}^3} \times 0.2 \text{ moles}$
$= 0.002 \text{ moles } \checkmark \frac{1}{2}$	$= 0.004 \text{ moles}$

$$\begin{aligned}
 \frac{25 \text{ cm}^3}{1000 \text{ cm}^3} \times 0.002 \text{ moles } \checkmark \frac{1}{2} \\
 \text{?} \\
 1000 \text{ cm}^3 \times 0.002 \text{ moles} = 0.08 \text{ M } \checkmark \frac{1}{2}
 \end{aligned}$$

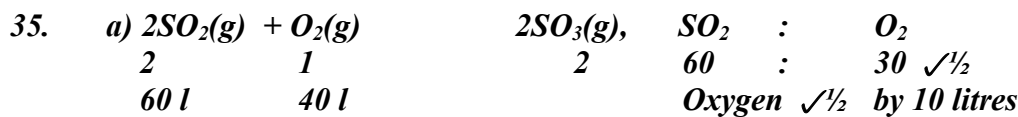
ii) $0.08 \text{ moles} \times 10.08 \text{ g H}_2\text{C}_2\text{O}_4 \times \text{H}_2\text{O} \checkmark \frac{1}{2}$
 $1 \text{ mole} \times \text{?}$

$$\begin{aligned}
 \frac{1 \text{ mole}}{0.08 \text{ moles}} \times 10.08 &= 126 \checkmark \frac{1}{2} \\
 126 \times \text{?} &= \text{H}_2\text{C}_2\text{O}_4 \times \text{H}_2\text{O}
 \end{aligned}$$

$$\begin{aligned}
 18x &= 126 - 90 \checkmark \frac{1}{2} \\
 18x &= 36 \\
 x &= 2 \checkmark \frac{1}{2}
 \end{aligned}$$



$$1.6 \text{ g} \times 22.4 \text{ dm}^3 \checkmark \frac{1}{2} = 1.4933 \text{ dm}^3$$



36. Mass of Oxygen = 12 - 8.4 = 3.5g

Element	Fe	O
Mass	8.4	3.6
R.A.M	56	16
No. of moles	$\frac{8.4}{56}$	$\frac{3.6}{16} \checkmark \frac{1}{2}$
	0.15	0.225 $\checkmark \frac{1}{2}$
Mole ration	$\frac{0.15}{0.15}$	$\frac{0.225}{0.15} \checkmark \frac{1}{2}$
	1	1.5 x2
	2	3 $\checkmark \frac{1}{2}$

∴ The empirical formula is Fe₂O₃