

Gas laws

1. $X: t_1 = 28.3 \text{ sec}$ $RMM = ?$

$Q_2: t_2 = 20.0 \text{ sec}$
 $T \propto \sqrt{MM}$

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

$$\left[\frac{T_1}{T_2} \right]^2 = \frac{X}{32}$$

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

$$X = 64$$

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 $V = \frac{1}{5} \times \frac{100 \text{ cm}}{10 \text{ sec}}$

$$= 2 \text{ cm/sec}^{-\frac{1}{2}}$$

Rate of $W = \frac{10 \text{ cm}}{10 \text{ sec}}$
 $= 1 \text{ cm/sec}^{-\frac{1}{2}}$

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

$$2^2 = \left[\frac{MW}{V} \right] = \frac{4}{1} = \frac{MW}{16}, \quad \frac{4}{1} \times 16 = 64$$

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

$$\begin{aligned} V_1 &= 3.5 \times 10^{-2} \text{ m}^3 & V_2 &= 2.8 \times 10^{-2} \text{ m}^3 \\ P_1 &= 1.0 \times 10^5 \text{ Pa} & P_2 &= 1.0 \times 10^5 \text{ Pa} \\ T_1 &= 291 \text{ K} & T_2 &= ? \end{aligned} \quad \left. \right]^{-\frac{1}{2}}$$

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

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

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

$$4. \frac{TsO_2}{TO_2} = \frac{R.M.N.SO_2}{R.M.MO_2} \sqrt{\frac{1}{2}}$$

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

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

$$\frac{TsO_2}{50} = \sqrt{\frac{64}{32}} = 70.75 \sqrt{\frac{1}{2}}$$

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

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

$$\begin{aligned} \frac{RHCl}{RSO_2} &= \frac{\sqrt{MSO_2}}{\sqrt{MHCl}} \\ \frac{(1.5)^2}{RSO_2} &= \frac{\sqrt{64}}{\sqrt{36.5}} \\ (RSO_2)^2 &= \frac{2.25 \times 36.5}{64} \end{aligned}$$

$$RSO_2 = \sqrt{\frac{2.25 \times 36.5}{64}} = 1.133 \text{ cm/sec}$$

$$\begin{aligned} \frac{1.133 \text{ cm}^3}{42 \text{ cm}^3} &= \frac{1 \text{ sec}}{\frac{42 \times 1}{1.133}} \\ &= 37 \text{ sec} \end{aligned}$$

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

$$c) \frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2} \sqrt{\frac{1}{2}} \quad V_2 = \frac{P_1 V_1}{T_1} \times \frac{T_2}{P_2} \sqrt{\frac{1}{2}} \\ = \frac{250 \times 273 - 23}{273 + 127} \sqrt{\frac{1}{2}} = 156.5 \text{ cm}^3$$

7. a) RFM of $CaCO_3 = 40 + 12 + 48 = 100 \text{ kg.} \sqrt{\frac{1}{2}}$
 $\therefore 100 \text{ kg of } CaCO_3 \equiv 22.4 \text{ dm}^3 \text{ of } CO_2(g)$
 $\frac{1000 \text{ kg }}{100} \xrightarrow{?} \frac{22.4 \times 1000}{100} \sqrt{\frac{1}{2}} = 224 \text{ dm}^3 \sqrt{\frac{1}{2}}$

$$8. T_1 = 23 + 273 = 296 \quad T_2 = -25 + 273 = 248 \\ V_1 = 200 \text{ cm}^3 \quad V_2 = ?$$

$$P_1 = 740 \text{ mmHg} \quad P_2 = 780 \text{ mmHg} \\ \frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2} \\ \frac{740 \times 200}{296} \sqrt{\frac{1}{2}} = \frac{780 \times ?}{248} \sqrt{\frac{1}{2}}$$

$$\begin{array}{rcl} 296 & 248 \\ \therefore x = \frac{740 \times 200 \times 248}{296 \times 780} \\ & = 158.974 \text{ cm}^3 \sqrt{1} \text{ (penalize } \frac{1}{2} \text{ mark for units)} \end{array}$$

$$\begin{array}{l} 9. \quad Rk = \sqrt{Ms} \\ \quad \frac{Rs}{Mk} \\ \therefore \frac{12}{7.2} = \sqrt{x} \sqrt{\frac{1}{2}} \\ X = \frac{12^2 \times 16 \sqrt{\frac{1}{2}}}{7.2^2} \\ = 44.464 \sqrt{1} \end{array}$$

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. $\sqrt{1}$

$$\begin{array}{l} b) \frac{TCO_2}{TCO} = \sqrt{\frac{MCO_2}{MCO}} \sqrt{\frac{1}{2}} \\ \Rightarrow \frac{200}{T} = \sqrt{\frac{44}{28}} = \sqrt{\frac{44}{28}} \cdot 11 \sqrt{\frac{1}{2}} \\ \Rightarrow \left[\frac{T}{200} \right]^2 = \frac{11}{7} \\ \Rightarrow \frac{T}{200} = \sqrt{\frac{11}{7}} \end{array}$$

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

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

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

13.

$$(a) \text{Gas P}$$

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

$$\begin{array}{l} \frac{18}{54} = \sqrt{\frac{x}{17}} \\ \frac{1}{3} = \sqrt{\frac{x}{17}} \end{array}$$

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

$$9x = 17$$

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

$$x = 1.88$$

$$\begin{array}{l} Q = It \\ = 5 \times 386 = 1930C \end{array}$$

$$\begin{array}{l} (b) Pb^{2+}_{(g)} + 2e^{-} Pb_{(s)} (\frac{1}{2} mk) \\ \text{If } 2 \times 96500C = 207 (\frac{1}{2} mk) \\ 1930C = \frac{1930 \times 207}{2 \times 96500} (\frac{1}{2} mk) \\ = 399510 (\frac{1}{2} mk) \end{array}$$

$$193000C$$

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

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

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

$$\frac{TNH_3}{TB} = \frac{17}{34}$$

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

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

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

$$\frac{1x5}{246} = \frac{2xV_2}{400}$$

$$V_2 = \frac{400x1x5}{2x246} = 4.065 \text{ dm}^3$$

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

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

$$V_2 = \frac{P_1 V_1 T_2}{T_1 P_2} = \frac{740 \text{ mm Hg} \times 200 \text{ cm}^3 \times 284 \text{ K}}{296 \text{ K} \times 780 \text{ mm Hg}} = 158.97 \text{ cm}^3$$

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 100cm³ of CO₂ takes 30 seconds
 $\therefore 150 \text{ cm}^3 \text{ of } CO_2 \text{ takes } \frac{30}{100} \times 150 = 45 \text{ seconds} \sqrt{\frac{1}{2}}$

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

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

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

OR

$$\frac{RCO_2}{RNO_2} = \frac{\sqrt{M_r} NO_2}{\sqrt{M_r} CO_2}$$

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

$$\frac{3.33}{RNO_2} = \sqrt{\frac{46}{44}} \\ = 1.0225$$

$$RNO_2 = \frac{3.33}{1.0225} \\ = 3.26 \text{ cm}^3 \text{ per second}$$

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

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 of $NaOH = 40$

$$\text{Moles of } NaOH = \frac{8}{40} = 0.2M$$

$$\text{Moles of } NaOH \text{ in } 25\text{cm}^3 \\ \frac{25 \times 0.2}{1000} = 0.005$$

Mole ratio 1:2

$$\text{Moles of acid} = \frac{0.005}{2} \\ = 0.0025$$

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

3. No. Of moles of HNO_3 acid

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

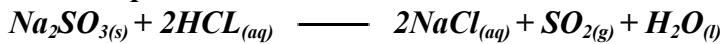
Mole ratio 1:1

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

$$\text{Then D grams is } 0.2 \times 56 \\ = 11.2 \text{ g}$$

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 $Na_2SO_3 : SO_2$ is 1:1

\therefore No. of moles of $Na_2SO_3 = 0.04 \text{ moles}$

$$\text{Mass of } Na_2SO_3 = 126 \text{ gmol}^{-1} \times 0.04 \\ = 5.04 \text{ g}$$

5. From the equation

- (3x24) litres of chlorine react with iron to produce [(56 x 2) + (35.5 X 3)] g of $FeCl_3$,
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. $\text{RMM} (\text{CH}_3\text{OOH}) = 60$

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

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

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

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

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

$$\frac{150 \times 1}{24000}$$

$$= 0.00625 \text{ moles of CO}_2$$

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 =	$\frac{0.00625}{106} = 0.00005625$
	18
Ratio	$\frac{0.00625}{0.00005625} = 111.11$
	0.00005625
= 1	= 9
$\text{Na}_2\text{CO}_3 \cdot 9\text{H}_2\text{O}$	



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

$$= 95$$

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

$$= 0.01789 \text{ moles}$$

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

$$0.01789 \text{ moles of MgCl}_2 = 0.01789 \times 2$$

$$= 0.03478 \text{ moles of Cl ions}$$

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

$$0.03478 \text{ moles} = \frac{0.03478 \times 6.0 \times 10^{23}}{1}$$

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

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

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

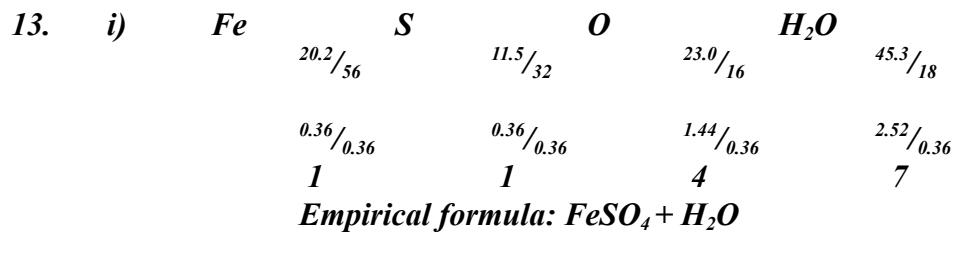
$$\text{If 1 mol O}_2 \quad 24000\text{cm}^3$$

$$0.1 \text{ Mol Mg} = 0.5 \text{ mol O}_2 = 1200\text{cm}^3$$

OR

$$\begin{array}{lcl} 2\text{mg} & : & \text{O}_2 \\ 2(24) & & 24000 \end{array}$$

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



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

14. R.F.M of PbI_2 = $207 + (127 \times 2) = 461$

2 moles of I ions produces 1 mole of PbI_2

$$\text{Moles of I ions} = \frac{0.1 \times 300}{1000} = 0.03 \text{ mole}$$

$$\text{Mole ratio } PbI_2 : I \text{ mole of } PbI_2 \text{ formed} = \frac{0.03}{2} = 0.015$$

$$\text{Mass of } PbI_2 \text{ formed} = 0.015 \text{ mole} \times 461 \\ = 6.915 \text{ g}$$

d(i) Yellow precipitate

15. a) i)
ii) At $25^\circ C$, sodium chloride is in solid form. Ions cannot move. Between 801 and $1413^\circ C$ 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 = $(4.0 - 2.4) = 1.6\text{g}$

$$\text{Moles of } O_2 = \frac{1.6}{16} = 0.1$$

If 1 mol O_2 _____ 24000cm^3

$$0.1 \text{ Mol Mg} = 0.5 \text{ mol } O_2 = 1200\text{cm}^3$$

OR

$$\begin{array}{ccc} 2\text{mg} & : & O_2 \\ 2(24) & & 24000 \\ \frac{2.4}{2(24)} & = \frac{x}{24000} & \end{array}$$

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

17. i) C_nH_{2n} , where n = No. of carbon atoms

ii) 70

iii) C_8H_{10} , $CH_3CH=CHCH_2CH_3$

OR $CH_3CH_2CHCH_2=CH_2$

18. i) Fe S O H_2O

$$\begin{array}{ccccc} 20.2/56 & 11.5/32 & 23.0/16 & 45.3/18 \\ 0.36/0.36 & 0.36/0.36 & 1.44/0.36 & 2.52/0.36 \\ 1 & 1 & 4 & 7 \end{array}$$

Empirical formula: FeSO₄ + H₂O

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

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

20. Mole of Mg that reacted = Answer in (c) (ii) $\times \frac{2}{1000}$
 $= \frac{26}{1000} = 0.026 \sqrt{\frac{1}{2}}$

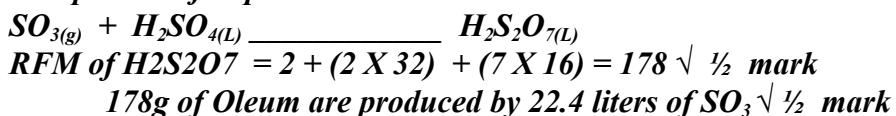
Mass of Mg in the alloy = 0.026×24
 $= 0.624\text{g} \sqrt{\frac{1}{2}}$

Mass Cu in the alloy = $(1.0 - 0.624)$
 $= 0.376\text{g} \sqrt{\frac{1}{2}}$
 % of Cu = $\frac{0.376}{1.0} \times 100$
 $= 37.6\% \sqrt{\frac{1}{2}}$

21. NH_(g) + HNO_(g) \longrightarrow NH₄NO_{3(s)}
 RMM of NH₄NO₃ = 80
 Moles of NH₄NO₃ = $\frac{4800}{80} = 60 \text{ moles}$

RMM of NH₃ = 17
 Mass of NH₃ = $60 \times 17 = 1020\text{KJ}$

22. From the equation of step 3



$$178 \text{ kg " " " " " } \frac{178 \times 1000 \times 22.4 \text{L}}{178\text{g}} \sqrt{\frac{1}{2}} \text{ mark} \\ = 22,4000 \text{ liters} \sqrt{\frac{1}{2}} \text{ mark} \\ (\text{Total 13 marks})$$

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

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

- Use value in d(ii) above

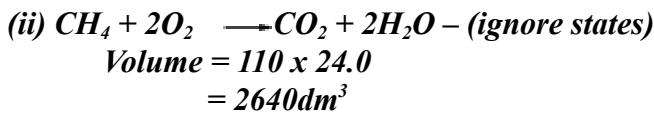
$$\text{ii) } \frac{480\text{cm}^3}{0.01} \sqrt{\frac{1}{2}} \text{ mark} = 48,000 \text{ cm}^3 \sqrt{\frac{1}{2}} \text{ mark} \\ \text{OR } \underline{4000 \times 480} = 48,000\text{cm}^3 \sqrt{\frac{1}{2}} \text{ mark}$$

$$40\text{cm}^3 \\ \text{i.e. Answer in e(i) } \times 480\text{cm}^3 \\ \text{Answer in d(i)}$$

[Total = 11 marks]

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

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



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

25. Volume of Cl₂ used
 $= 0.047 \times 24 = 1.128\text{dm}^3$ $\frac{1}{2}$

26. Mass due Carbon in CO₂ = $\frac{12}{4} \times 35.2 = 0.96$

$$\text{Moles carbon} = \frac{0.96}{12} = 0.08$$

$$\text{Mass due Hydrogen in H}_2\text{O} = \frac{2}{18} \times 1.40 = 0.156$$

$$\text{Moles hydrogen} = \frac{0.156}{1} = 0.156$$

Mole ratio C:H = 1: 1.95

E.F = CH₂

27. $\text{Na}_2\text{CO}_3 \times \text{H}_2\text{O} \longrightarrow \text{Na}_2\text{CO}_3 + \text{H}_2\text{O}$ $\sqrt{1}$

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

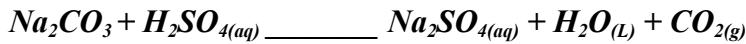
3

28. % of H₂O lost = 14.5%[^]
5 of anhydrous Na₂CO₃ = 85.5% ($\frac{1}{2}\text{mk}$)
R.F.M of Na₂CO₃ = 106 ($\frac{1}{2}\text{mk}$)
RMM of H₂O = 18 ($\frac{1}{2}\text{mk}$)

NaCO ₃	H ₂ O
<u>85.5</u>	<u>14.5</u>
<u>106</u>	<u>18</u> ($\frac{1}{2}\text{mk}$)
<u>0.8066</u>	<u>0.8055</u>
<u>0.8055</u>	<u>0.8055</u> ($\frac{1}{2}\text{mk}$)

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

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



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	$\frac{216}{16}$ 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

$$h(C_4H_{10}O) = 74$$

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

$$74h = 74$$

$$H=1$$

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

31. Moles $C_4H_{10} = \frac{1.12}{22.4} = 0.05 \text{ mol}$

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

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

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

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

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

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

$$\begin{aligned} \Delta T \times \text{mass} \times C & Q = 315V = 112500 \\ & = \frac{75 \times V \times 4.2}{1000} = 112.5 \quad V = \frac{112500}{315} \quad \frac{1}{2} \text{ mK} \\ & V = 357. \text{ km}^3 \quad \frac{1}{2} \text{ mK} \end{aligned}$$

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

$$\text{Mol. Na}_2\text{CO}_3 = \frac{19.6}{106} = 0.8149057$$

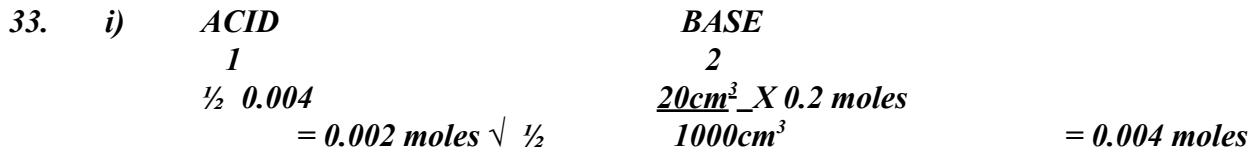
$$\text{Molarity of Na}_2\text{CO}_3 = \frac{0.1849057}{0.25} = 0.73962 \text{ M}$$



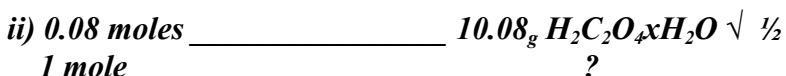
Mole ratio $\text{Na}_2\text{CO}_3 : \text{Mg Cl}_2$ is 1:1

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

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

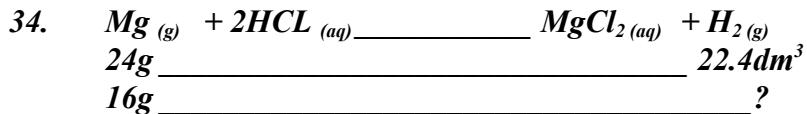


$$\begin{array}{c} 25 \text{ cm}^3 \quad 0.002 \text{ moles} \checkmark \frac{1}{2} \\ \frac{1000 \text{ cm}^3}{1000 \text{ cm}^3} \quad ? \\ 1000 \text{ cm}^3 \times 0.002 \text{ moles} = 0.08 M \checkmark \frac{1}{2} \end{array}$$

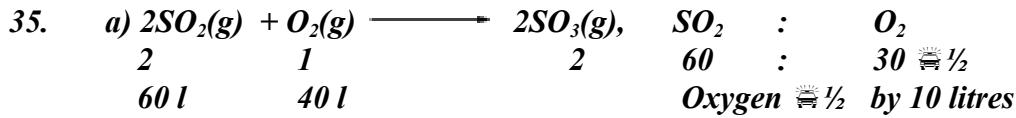


$$\begin{array}{c} \frac{1 \text{ mole}}{0.08 \text{ moles}} \times 10.08 = 126 \checkmark \frac{1}{2} \\ 126 \quad H_2C_2O_4xH_2O \end{array}$$

$$\begin{array}{c} 18x = 126 - 90 \checkmark \frac{1}{2} \\ 18x = 36 \\ X = 2 \quad \checkmark \frac{1}{2} \end{array}$$



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



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	$\frac{8.4}{56}$ 0.15	$\frac{3.6}{16}$ $\frac{1}{2}$ $\frac{0.225}{0.15}$
Mole ration	$\frac{0.15}{0.15}$ 1 2	$\frac{0.225}{0.15}$ $\frac{1}{2}$ $\frac{1.5}{3}$ $x2$

∴ The empirical formula is Fe_2O_3