Answers section I & II

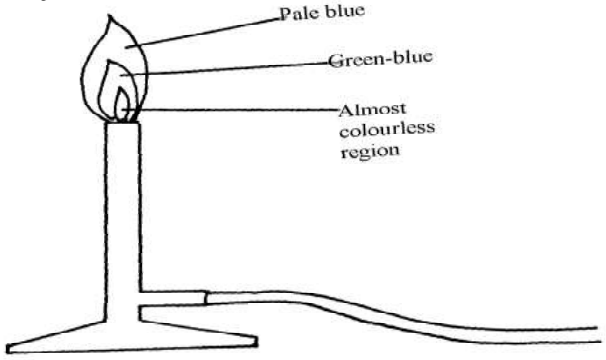
1. Introduction to chemistry

1. *a) F is place in the middle of the flame while G is placed at the upper region of the flame*
   b) Non- luminous flame

2. *. A,D,C,B, and C all correct*
   A,D,C,D correct answers are exclusive
   A,D,C ½ mk otherwise penalize

3. *a) The laboratory gas burns in excess oxygen*
   OR burns completely or produces CO_2 and H_2O only
   - No unburnt carbon remains
   OR No soot is formed// Produced.

   b)



4. *a) a substance which when taken alters the body chemistry*

   b) - alcohol
   - Tobacco

5. *(a) A- Downward delivery /upward displacement of air*
   B – Over water ✓ ½
   (b) A – Denser than air

6. *(i) P – Haxane*
   (ii) W – Water

7. *Name – Mortar. √½*
   Use – Holding solid substances being crushed. √½
   Name – Crucible √½
   Use – Holding solid elements being heated strongly. √½

8. *T – has a very small hole which releases the gas in small quantities /in form of a jet.*
   U – It is heavy for stability

9. *(a) It is very hot. (1 mk) √1*
   (b) The upper √1 part. Because all the gases undergo complete √1 combustion. √1 (2 mk) } 3

10. *The crystal dissolved✓ ½ . Blue colour spreads in water ✓ ½ . The crystal broke up into smaller particles of copper (ii) sulphate and diffused in all direction*

11. *(a) W has more energy levels than S. √1*
    (b) C has got (12) protons pulling the 10 electrons while A has 11 protons
    2 pulling 10 electrons. √1

2. Simple classification of substances

1. *a) X – melting point √ ½*

Z – Boiling point √ ½

b) Its melting point is lowered and becomes less sharp due to the introduction of an impurity √1

2. *Luminous flame produces soot while non- luminous flame does not√1*
   Luminous flame is yellow in colour while non- luminous flame is blue in colour
   OR accept any correct answer

   b) The luminous flame is moderately hot and is clearly visible hence no danger is posed

3. *a) X*
   Gives the greatest number of spots hence the greatest number of pure substances √ 1
   b) The ink is made of more than one pure substance hence will also undergo chromatography

4. *(a) sublimation*
   (b) Bleaching action
   (c) Polymerization

5. *Adds excess dilute hydrochloric acid/ sulphuric (vi) acid*
   Filter to obtain copper metal
   Wash with distilled water

6. *To separate samples of CUO and charcoal in test tubes, dilute mineral acid is added with shaking CUO black dissolves to form blue solution √ ½*
   Charcoal does not dissolve in dilute mineral acids

7. *a) Is the process for the separation of a mixture of solutes by their different rates of movement over a porous medium caused by moving solvent*
   b) - Separation of dyes
   - To analyse and identify mixtures of substances which are difficult to separate by other means
   - Used to analyze dyes in food colouring (Any two each one mark)

8 *a) Element R – Sulphur*
   b) Mix solid P oxide with water
   put blue and litmus paper, Blue litmus paper remains blue, red litmus paper changes to blue.
   Put blue and red litmus papers in water
   Blue changes to red, red remain red.

9. *5 and 4 BOTH MUST BE CORRECT*

10. *EITHER*
- *In separate test tubes, boil about 5cm³ of each solution.*
- *Sodium hydrogencarbonate solution remains colourless forms no precipitate*
- *Calcium hydrogencarbonate solution changes from colourless to white precipitate*

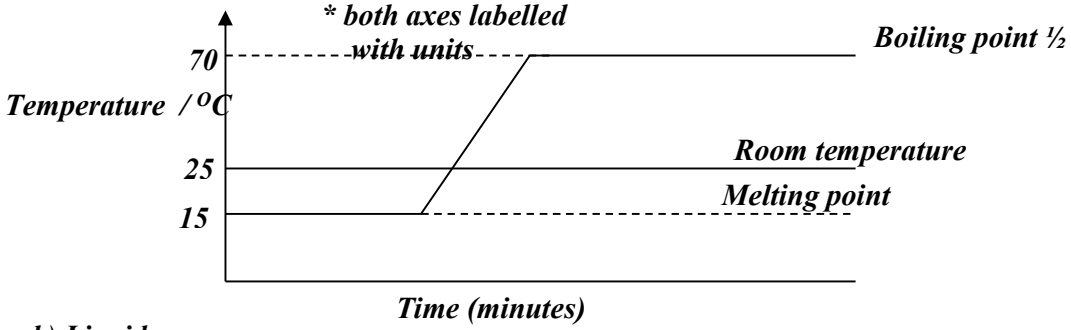
OR

$2NaHCO_{3aq} \longrightarrow Na_2CO_3 + CO_{2(g)}n + H_2O_{(e)}$

$Ca(HCO_3)_{2\,(aq)} \longrightarrow CaCO_{3(s)} + CO_{2\,(g)} + H_2O_{(e)}$

HEAT must be mentioned or implied.

11. *a)*



b) Liquid

12. *(i) Range of boiling points / no sharp boiling points*
    (ii) Carry out fractional distillation √1

13. *(i) Evaporation*
(ii) Uses a lot of fuel
(iii) Any soluble salt and water

14. *Melting points is the specific ✓½ constant temperature✓½ for a particular substance when a solid ✓½ change to a liquid✓½*

16. *(a) To cool/condense vapour. √1* *(1 mk)*
(b) Water. √1 *(1 mk)* } *3*
(c) Blue solid √1 changes to white solid. √1 *(1 mk)*

17. *(a) Solvent front ✓*
(b) C ✓

18. *a) Chemical ✓½*
b) Physical ✓½
c) Physical ✓½
d) Chemical ✓½

19. *- Smoky/ sooty ✓*
- Not hot enough ✓

20. *a) Chemical ✓½*
b) Physical ✓½
c) Physical ✓½
d) Chemical ✓½

21. *- Smoky/ sooty ✓*
- Not hot enough ✓

22. *- Boiling point*
- Melting point
- Density
- Refractive index

23. *i) Pass the mixture of gases through concentrated sulphuric (vi) acid ✓½ . Ammonia and ethane will dissolve ✓½*
- Hydrogen ✓½ being insoluble ✓½ is then obtained

24. *a) i)*

ii) A and C

b) Since NH4CL sublimes but CaCL2 does not, sublimation process would do. Heat the mixture, NH4CL sublimates into vapour and condences on the upper cooler parts of the test tube. CaCL2 remains at the bottom of the heating tube

c) i) Fractional distilation
ii) Separating funnel method 8
Since the two liquids are immiscible pour the mixture into the separating funnel and allow to settle. The denser liquid will settle down and the less dense one will form the second layer on top. Open the tap and run out the liquid in the bottom layer leaving the second layer in the funnel

25. *(i) Condenser*
(ii) To indicate when a liquid is boiling, a thermometer reads a constant temperature
(iii) A
(iv) Ethanol
Reason:- It has a lower boiling of 78°C compared to water with a boiling point of 100°C
or - The liquid with the lower boiling point boils first and its vapours are condensed and the condenser to be collected as the first distillate
(v) Fractional distillation
(vi) - To separate components of crude oil
- To isolate O_2 and N_2 from air
- To manufacture spirits
(vii)- They are immiscible liquids
- They have different but close boiling points

26. *(a) Wire gauze*
(b) Sodium chloride solution (or any named slat solution)
(c) Evaporation

27. *a) i) – Colourless liquid is seen on the cooler parts of the test tube.* *✓1 mk.*
- Blue crystals change to a white powder. *✓1 mk*

ii) Water ✓1 which was originally water crystallization.
$CuSO_4 , 5H_2O(s) \longrightarrow CuSO_4(s) + 5H_2O(l)$ *✓1*

b) NaOH(s) absorbs water from the air and forms a solution. It is a deliquescent substance. ✓1
Anhydrous $CuSO_4$ absorbs water from air to form hydrated Copper (II) sulphate which is blue but no solution is formed ✓1 it is hygroscopic

28. *a)i)Ethanol, acetone (any organic solvent)*
ii) Its <u>most soluble</u> in the solvent and less sticky
iii) - Cut out the yellow pigment
- put in organic solvent to dissolve the pigment
- filter and evaporate the filtrate to get the pigment
iv)Above the red pigment and below the edge.

b)-Heat the mixture aluminum chloride sublime and collect be cooler part of the tube and sodium chloride left at bottom of the tube
- Scratch the condense $alcl_3$ place in a beaker
(c)Add cold water to the mixture, and stir to dissolve R. Filter to get solid S and V on residue . Evaporate the future to get R. put S and in no water and stir to dissolve and filter to get S as residue evaporate future to get V

29. *Add cold water to the mixture, and stir to dissolve R. Filter to get solid S and V on residue . Evaporate the future to get R. put S and in no water and stir to dissolve and filter to get S as residue evaporate future to get V*

30. *Heat the mixture Ammonium chloride sublimes and is collected on the cooler parts. Add water to the remaining mixture, stir and filter. Lead (ii) Oxide remains as residue. Evaporate the filtrate to dryness to obtain sodium chloride*

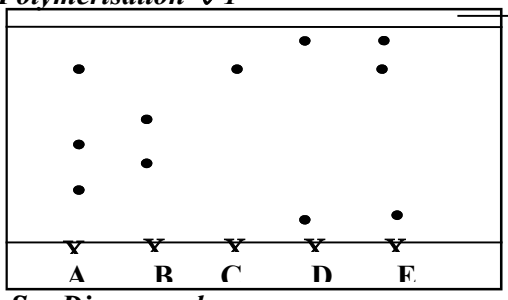
31. *a)* *- Fractionating column must have beads*
- Wrong cold water circulation in the condenser
b) *T*

32. *a) Sublimation. ✓1* *(3 mks*

b) Bleaching ✓1

c) Polymerisation ✓1

33.



(a) See Diagram above

- Solvent front should be slightly above the furthest pigment

(b) C ✓ ½

- It contains only one pigment

34 . - Add either to the mixture. Stir and filter

- Add alcohol to the residue, stir and filter

- Evaporate to filtrate to obtain C

35. - Black crystals changes directly into purple vapour√1

*- The iodine crystals (sublimes) changed directly into a purple vapour without passing liquid state and changed back to black iodine crystals on the upper cooler parts of boiling tube√ (*Correct colour must be stated 2 mks

3. Acids, bases and combustion

1. a) B

b) PH of potassium hydroxide is higher than that of aqueous ammonia. KOH ions are dissociated more than that of aqueous NH_3

2. (a) (i) X

(ii) W✓ 1

(b) V✓ 1

3. a) Methyl Orange Red/Pink ✓½

Phenolphthalein Colourless/Pink ✓½

b) The PH of 0.1M KOH is higher than of 0.1M aqueous ammonia ✓1

KOH is strongly dissociated in solution. ✓1

4. a) K

b)i) G

ii) I

5. Copper (II) oxide is insoluble in water hence there are no OH- ions in the mixture

6. a) S is acidic and would make the situation worse √ ½

b) Discovery of drugs processing and testing is the work of chemists. Chemists are professionals who have studied chemistry √ ½

7. Its due to formation of insoluble Lead(II) carbonate hence preventing any further reaction.

8. CaO is used in correcting soil acidity. √1

9. (a) Pink ✓ 1

(b) 7.0 ✓ 1

10. (a) alkali is soluble base. √1 ✓1

(b) Because it is lighter than air. √1

11. *(a)*

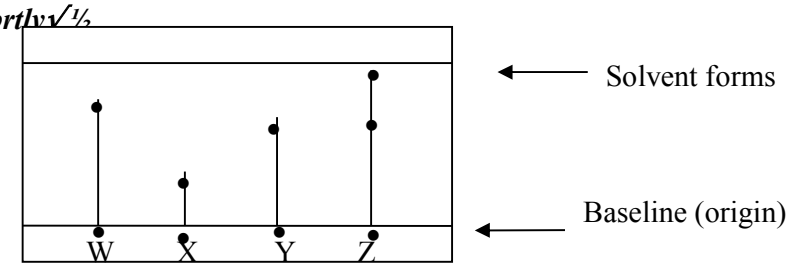
Solution	*Blue litmus paper*	*Indicator W*
	BLUE	
	…RED……	

(b) Phenolphthalein

12. *a)-give inconsistent results✓½*

-expire shortly✓½

b) I.



II. Maximum sports-award 1 ½ mks

Fail any one- award

III W✓½ and Y✓½

13. *Sting of a bee is acidic ✓1 and is neutralized by sodium hydrogen carbonate✓½ into a salt, carbon IV) oxide and water. This gives pain relief. ✓½*

14. *(a) There was production of effervescence . The lemon juice contain an acid that reacts with the carbonate to produce carbon (IV) oxide.*

(b) No production of bubbles. Copper is below hydrogen in the reactivity

15. *(a) Yellow*

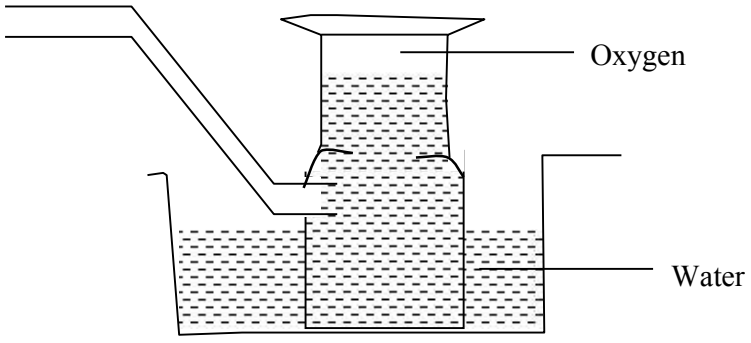
Colourless✓ ½

16. *(i) K and M* ✓ 1

(ii) K and M✓

Air and combustion

1.



2. *a) 3 M_g + $N_{2\,g}$ _____ $M_{g\,3}\,N_{2\,g}$*

b) Argon

- It is inert

3. *a) Rust is hydrated iron (III) Oxide*

b) *- Electroplating*

- Painting

- Oiling

- Galvanization

c) *- Salts*

- Acids

4. a) Moles of copper $^{8}/_{64}$ = 0.125 moles of Mg $^{3}/_{24}$ = 0.125Mg reacts with both O2 and N2 gases in the air while copper reacts with)2 only
There is greater change in the reaction with copper and smaller change in reaction with Mg

b) $CUO_{(g)} + H_2SO_{4(q)}$ _____ $CUSO_{4(aq)} + H_2O_{(l)}$
Balanced
Chemical symbols correct
State symbols correct

5. a) Dust particles
b) They readily solidify hence may block the pipes
c) Argon

6. - Water rose up the test-tube to occupy the space of active air √½ which has been used in resting. √½
- Iron wool turned reddish – brown √½ due formation of red-oxide of iron √½ which is rust.

7. a)i)rusting occurred√ ½
ii) No rusting√ ½
b) In (i) iron is more reactive than copper hence undergoes corrosion√1
in (ii) zinc is more reactive than iron hence undergoes corrosion in place of iron√1

8. a) To remove any magnesium oxide coating from the surface of magnesium// To remove any oxide film on it

b) White solid which is magnesium oxide

c) Increase in mass was due to oxygen which combined with magnesium

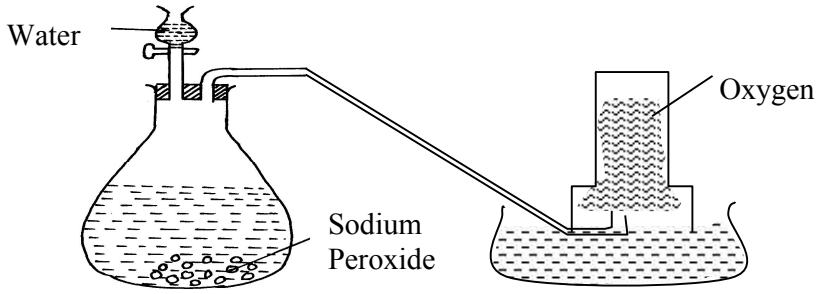
d) $2Mg(s) + O_{2(g)}$ _____ $2MgO(s)$
Penalize ½ for wrong or missing state symbols

e) The filtrate is magnesium hydroxide which is an alkaline
Red litmus paper changed blue, but blue litmus paper remained blue

9. (a) So that they may stick to the gas Jar to prevent them from falling into water when the gas jar is inverted
(b) Iron filings turned to reddish brown because they reacted with oxygen in presence of moisture to form rust.
- The level of water inside the gas jar rise so as to occupy the volume initially occupied by part of air used up for rusting
(c) - Air is made up of two parts; - the active part that is necessary for rusting and the inactive part that is not used for rusting

- oxygen is the active part of air

(d)



- Neat diagram-
- correct method of collection

(e) - For cutting and welding metals
- Rocket fuel
- Mountain climbing
- Sea diving
- Used in explosions (any two)

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Penalize ½ for wrong or missing state symbols

e) The filtrate is magnesium hydroxide which is an alkaline
Red litmus paper changed blue, but blue litmus paper remained blue

11. (i) Oxygen
(ii) Sodium hydroxide is a strong base
(iii) Slightly soluble in water

12. (i) White fumes form in the gas jar which disappear after sometime.
- The level of water rises in the gas jar.
(ii) $P_{(s)} + O_{2(g)} \longrightarrow P_2O5_{(s)}$
$P_2O_{(s)} + 3H_2O_{(l)} \longrightarrow 2H_4PO_{4(aq)}$
(iii) Magnesium react with oxygen and nitrogen hence greater of fraction of air is used.
(iv) (a) Blue litmus changed to red as remained red. The solution was acid due to phosphoric
(b) Red litmus changed to blue as blue remained blue due to formation of basic magnesium hydroxide ammonia solution.
(v) – Pass air over conc. KOH / NaOH to absorb CO_2
- Pass the remaining gases over hot copper solid which reacts with oxygen.
- Collect the remaining gas over water. The gas is mainly nitrogen.

13. a) i) $3Mg(s) + N_2(g) \longrightarrow Mg_3N_2(s)$ √1
ii) Gas with √1 choking irritating smell.
Mg_3N_2 reacts with water to form ammonia √1 gas.
iii) It remains blue. √½ Ammonia gas is alkaline. √½

14. (a) (i) Phosphorous
(ii) - Do not react with water when being inserted into the tube

- reacts with oxygen when exposed to air.

(b) $4P(s) + 3O_{2(g)} \longrightarrow 2P_2O_{3(s)}$
or $4P(s) + SO_{2(g)} \longrightarrow 2P_2O_{5(s)}$

(c) (i) $\frac{Y - X}{y} \times 100$

(ii) – Wrong reading of volume
- Phosphorous can go off before complete combustion

(d) (i) – Red litmus paper no effect
- Blue litmus paper turns red due to formation of phosphoric acid/phosphorous (V) Oxide whish is an acidic oxide

(ii) – Oxygen

(iii) – Burning of candle
- Use of pyrogallol
- Rusting of iron fillings

15. i) $P_{4(g)} + 5O_{2(g)} \_\_\_\_\_ 2P_2O_{5(s)}$
// $P_{4(s)} + 3O_{2(g)} \_\_\_\_\_ 2P_2O_{3(g)}$ Anyone √1 mark

ii) Phosphorous (v) or (iii) oxide formed is an acidic Oxide which dissolves in water to form a strong acidic solution of phosphoric acid whose PH is 2

16. (a) – Iron nails turns brown.
- Water rises up the delivery tube/water level drops in the trough (any ½mk) ½
Explanation: Oxygen has been used up in rusting of iron nails hence water rises up to take the place of oxygen

(b) $4Fe_{(s)} + 3O_{2(g)} + 2H_2O_{(l)} \rightarrow 2Fe_2O_3.2H_2O_{(s)}$ 1
(accept a balanced chemical equation)

17. a) $FeCO_{3\,(s)} \longrightarrow Fe\,O_{(s)} + CO_{2(g)}$

$Fe(s) + 4\,H_2O_{(g)} \longrightarrow Fe\,O_{4\,(s)} + 4H_{2\,(g)}$
Or
$2\,Fe_{(s)} + 2O_{2(g)} \longrightarrow Fe_3\,O_{4(s)}$

b) $Fe_3O_{4(s)} + 8H^+_{(aq)} \longrightarrow 4H_2O_{(l)} + 2\,Fe^{3+}_{(aq)} + Fe^{2+}_{(aq)}$

18. a) N_2O ✓1 (Nitrogen (I) oxide) – Denitrogen Oxide.
b) K_2O ✓1 (Potassium oxide)
c) Al_2O_3 (Aluminium oxide)

19. a) water √1
b) $2Na_2O_{2(S)} + 2H_2O_{(L)} \rightarrow 4NaOH_{(aq)} + O_{2(g)}$ √1 mk
Penalize ½ - wrong missing state symbols

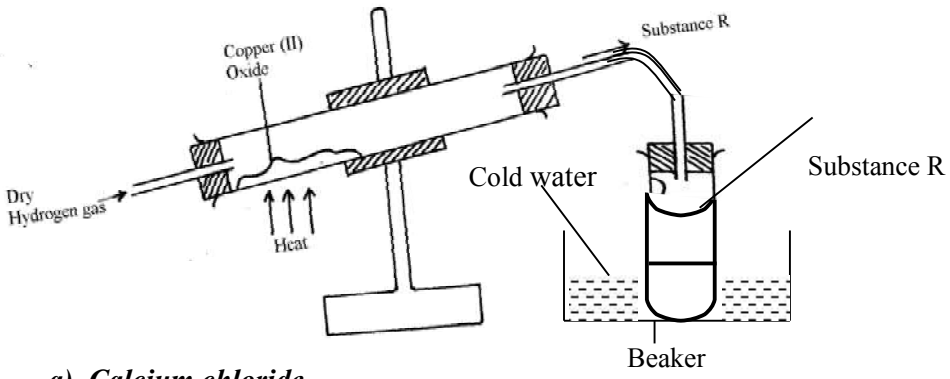
5. Water and hydrogen

1. (a) Aluminium is above hydrogen in the reactivity series of elements

(b) (i) The reaction is too exothermic that alot of heat is produced causing ignition of hydrogen in presence of oxygen

(ii) $K_{(s)} + H_2O_{(g)} \longrightarrow KOH_{(aq)} + H_{2(g)}$
$H_{2(g)} + O_{2(g)} \longrightarrow H_2O_{(g)}$

2.



3. a) *Calcium chloride*
   Drying agent

   b) $2H_{2(g)} + O_{2(g)}$ _____ $2H_2O_{(g)}$

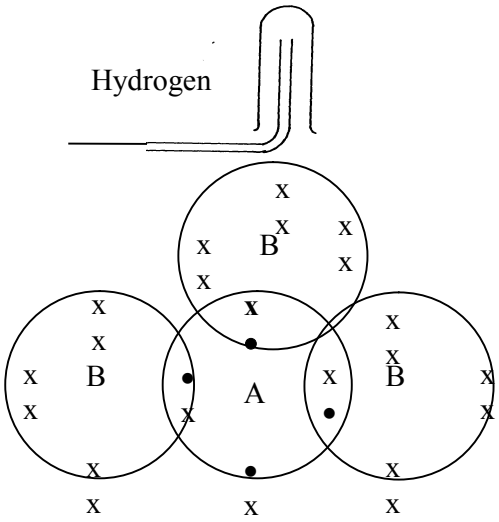
4. (i) *Steam*
   (ii) $Mg_{(s)} + H_2O_{(g)}$ $MgO_{(s)} + H_{2(g)}$ ✓ 1
   (iii) *Gas P is passed through the combustion tube before heating is commenced*

5. a) $2H_{2(g)} + O_{2(g)} \longrightarrow 2H_2O_{(l)}$ ✓1

   b) – *Turns anhydrous white paper* ✓½ *copper (II) sulphate into blue.* ✓½ *Or*

   - *Turns anhydrous blue* ✓½ *cobalt (II) chloride into pink.* ✓½

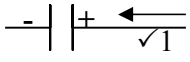
6. a)



b)*reverse steam*√1

7. (a) *N*
   (b) $4H_2O_{(g)} + 3Fe_{(s)} \longrightarrow Fe3O4_{(s)} + 4H_{2(g)}$ *(Not balanced 0mk)*

8. (a)
   (b) $Pb^{2+(l)} + 2e^- \longrightarrow Pb_{(s)}$ B.E ✓ ½ S.S ✓ ½
   (c)



9. (a) $Zn(s) + 2HCl(aq) \longrightarrow ZnCl_2(aq) + H_2(g)$ ✓1
   (b) *Concentrated sulphuric (IV) acid or anhydrous calcium chloride.* ✓1

(c) Copper cannot displace hydrogen from its solution. ✓1
(d) (i) $2H_2(g) + O_2(g) \longrightarrow 2H_2O(l)$ ✓1
(ii) Before: Pass hydrogen / through the tube before lighting ✓1 to drive off air.
End: There should be a continuous flow of hydrogen after / putting off the flame to avoid an explosion. ✓1

(e) – Filling balloons ✓1
- Manufacture of margarine.
- Manufacture of ammonia.
- Conversion of coal to synthetic petrol.
(f) $Zn(s) + H_2O(g) \longrightarrow ZnO(s) + H_2(g)$ ✓1
(g) S, ✓½ P, ✓½ Q, ✓½ R, ✓½
(h) It adds to unsaturated oils and hardens them. ✓1

10. *a) i) Heating of copper (ii) Oxide to be shown on the diagram*
ii) To drive out air because mixture of air and hydrogen is explosive when lit
iii) $CuO_{(g)} + H2_{(g)}$ _____ $Cu_{(g)} + H2O_{(g)}$
(penalize ½ mark for wrong S.S)
iv) To prevent re-oxidation of hot copper by the atmospheric oxygen
v) Reducing agent
vi) Black copper (ii) Oxide turns to brown showing that copper (ii) Oxide has been reduced to copper
vii) Zinc is more reactive than hydrogen and therefore cannot be reduced by hydrogen

11. *(a) Hydrogen gas*
(b) - Calcium react with water forming calcium hydroxide solution
– Calcium hydroxide solution dissociates to produce calcium ion (Ca^{2+}ions) and hydroxide (OH^-) ions responsible for basic properties.

6. Structure of the atom and the periodic table

1. *$Na_2CO_3 + 2HNO_3$ ____ $2NaNO_{3\,(L)} + CO_{(q)} + H_2O_{(C)}$*
Mole ration 1 : 2
a) Moles of HNO_3 in $20cm^3$ = 20/1000 x 0.25
= 0.005 moles

b) Moles of Na_2CO_3 in $25cm^3$ = ½ of 0.005 moles
= 0.0025

c) If $25cm^3$ = 0.0025 moles
in $250cm^3$ = ?
$$\frac{250 \times 0.0025}{25}$$
= 0.025 moles

RFM of Na_2CO_3 = 106
I mole of Na_2CO_3 = 106g
0.025 moles = ?
$$\frac{0.025 \times 106}{1}$$
= 2.65g of Na_2CO_3

2. *(a) A= 2.8.1*

B= 2.1

(b) B

Strong attraction of the outermost energy level electron to the nucleus make it difficult to remove This is due to smaller atomic radius compared to A

Or - Outermost electrons are closer to the nucleus hence higher force of attraction

3. $R.A.M = \frac{(62.93 \times 69.09) + (64.93 \times 3091)}{100}$

$= \frac{4347.834 + 2006.99}{100}$

$= 63.5482$

≈ 63.5

4. (a) $R.A.M = \frac{(33 \times 2) + (30 \times 1)}{3}$ ✓ 1

$\frac{99}{3} = 33$ ✓ 1

(b) Number of electrons of C = 57-31 = 26

Number of electrons of B is the same as for C = No. of Protons

B = 26 protons

5. $\frac{69.09}{100} \times 62.93 + \frac{30.91}{100} \times 64.93$ ✓1 ½

43.4783 + 20.0698 ✓1

$= 63.548 \simeq 63.55$ ✓1

6. $\frac{63x + 65(100 - x)}{100} = 63.55$

$63x + 6500 - 65x = 6355$

$2x = 6355 - 6500$

$2x = -145$

$X = 72.5$

% abundance of ^{63}M = 72.5%

^{65}M = 27.5%

7. a) Valency of G is 3

b) G is a group 3 element

8. a) i) 11 protons

ii) 16 protons

b) Formula of compound = T2Z

Mass number of T = 11+ 12 = 23

Mass number of 2 = 16+16 = 32

Formula Mass of T2Z = (23x2) + 32 = 78

c) – When molten

- When in aqueous solution

9. Silicon (iv) Oxide has giant atomic structure with strong covalent bond holding the atom together. These require a lot of energy to break, hence it has high melting point. Carbon (IV) Oxide has simple molecular structure with weakVan Der Waals forces holding the molecules together which require little energy to break, hence sublimes at low temperature and is a gas at room temperature and pressure

10. O_2 2.8 O 2.6

The oxide ions has 2 extra electrons that causes greater electron repulsion than in oxygen atom

11. To separate samples of CUO and charcoal in test tubes, dilute mineral acid is added with shakingCuO black dissolves to form blue solution ✓ ½

Charcoal does not dissolve in dilute mineral acids

12. $\frac{(90 \times 8) + 10Q}{100} = 28.3$ (½mk)

$100 \times \frac{2520 + 10Q}{100} = 28.3 \times 100$

2520 + 10Q = 2830 (½mk)
10Q = 2830 – 2520
10Q = 310
Q = 31
Electron arrangement of X = 284 (½mk)
Atomic No. = 14 (½mk)
No. neutrons = 31 – 14 = 17 (½mk)

13. *L_3 has delocalised electrons while the others has less*

14. *(a) Is a constant temperature at which a solid changed to a liquid/ A point at which a solid changes to a liquid which a solid changes to a liquid without change in temperature.*

15. *(a) P ✓½ and S ✓½ ✓*
They have the same atomic numbers. ✓ } *Both must be there to score 3*
(b) 4 (7, -3) ✓

16. *a) B✓½ - its ion has a stronger nuclear charge than that of A✓1*
b) D✓½ - has the weakest nuclear charge as compared to the other non- metals ✓1

17. *(a) CA ✓1*

(b) (i) E ✓1
(ii) B ✓1

(c) Period 3, ✓½ Group 2, ✓ ½

(d) (i) The atomic radius of F is greater than that of C ✓1 because F has more energy levels.
(ii) The atomic radius D is smaller than that of C ✓1 because of increased positive charge in the nucleus which attracts the electrons more. ✓1

(e) (i) Electrovalent bond ✓ ½
(ii) Covalent bond ✓½

(f) (i) $4C + O_2 \longrightarrow 2C_2O$ ✓1
$G + O_2 \longrightarrow GO_2$ ✓1
(ii) C_2O is basic while ✓1
GO_2 is acidic. ✓1

18. *(a) B – ammonia gas ✓1*
C - nitrogen (II) oxide (NO) ✓1
E – water ✓1
F – unreacted gases ✓1

(b) The mixture of ammonia and air is passed through heated/ catalyst where ammonia (II) is oxidized to nitrogen (II) oxide. ✓1

(c) Gases are cooled and air passed through heated/ catalyst where ammonia is further oxidized to nitrogen(IV) oxide. ✓1

(d) Fractional distillation, ✓½
Water with a lower boiling point ✓½ than nitric (V) acid, distills left leaving the concentrates acid.

19. *(a) (i) C*
(ii) D or E ✓1
(iii) F ✓

(iv) D or E

✓ *(v) A*

✓ *(vi) D* ✓ ½

(b) Atomic radius of Y is smaller than that of X. The effective nuclear charger in Y is greater than in X hence outer electrons strongly pulled to the centre reducing the radius. ✓½

(b) (i) ✓ ½

(ii) Period – 3 ✓ ½ *Group – IV*

(c) (i) On the grid (period 2 Group 7) ✓1

✓ *(ii) Halogen*

(iii) – Used in hospitals with patients with breathing difficulties ✓

- Used by mountain climbers and deep sea divers

(iv) Basic ✓1

20. A (i) P – ionic configuration - 2

- Formula of oxide – PO

Q – Atomic number – 20

R- Atomic number – 19

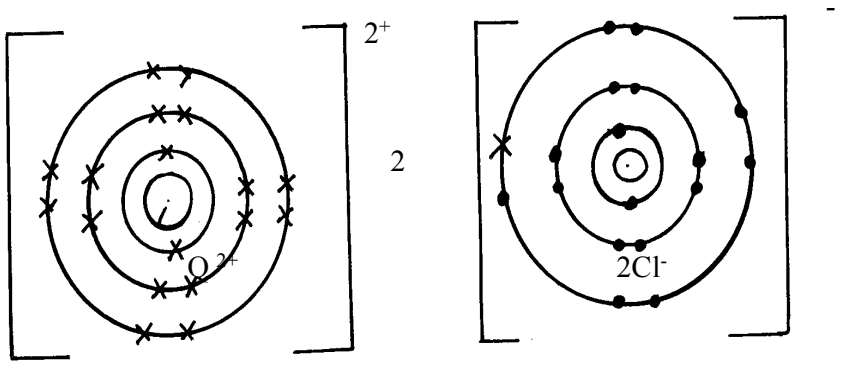
T – Ionic configuration – 2.8.8

Formula of oxide – TO2

(ii) R – Has the largest atom with one outer electron hence easily loses it.

(iii) S – is the smallest atom of a non-metal with a deficit of only one electron hence easily gains.

(iv)



(v) T is insoluble – It has a molecular structure/non-metal

(B)(i) It is coated with an un reactive layer of aluminium oxide which prevents it form reacting.

(ii) Valency – The number of electrons an atom gains or loses during a reaction.

Oxidation number – The resultant charge of an atom has after gaining or loosing electrons.

21. a) +3 + P = (-2x3)= 0

+3+P – 6 = 0

P = +3✓

b) Mg- its oxidation state increases from Zero to +2 ✓ 1 mark

22. a) Group 1 – Because √½ it has 1 electron in its outermost energy level.

Group 7 – It requires √½ 1 electron to fill its outermost energy level.

b) Alkaline earth metals √1

c) PV_2 √1

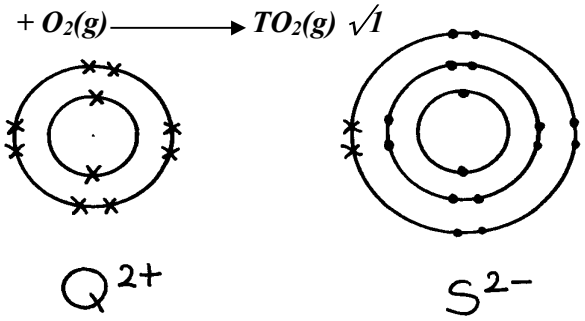
d) Q has <u>higher</u> √½ m.p than J. Q has a giant metallic <u>structure and strong metallic bonds.</u> √½ While J has <u>molecular structure</u> and Vander

Waals forces which are <u>easy to break</u>. √½

e) R. √1

f) $T(s) + O_2(g) \longrightarrow TO_2(g)$ √1

g)



h) – Filling electric light bulb √1 accept any other correct one.

23. (a) (i) X Rj: If actual symbols are given.

(ii) Q. Rj. Actual symbols.
<u>Explanation:</u> It looses the outermost energy level <u>most</u> readily.

(iii) Halogens

(iv) I). Moving across a period there is increased nuclear charge.
II). Going down a group the energy levels increase in number.

(v) V- <u>Explanation</u> It has a complete outermost energy level/ Has a stable octet.

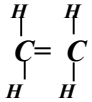
(vi) Z_2R Rej. Interchange of letters, RZ_2.

24. a) i) I S√1- It readily gain one electron on ionization √l
II Q - It readily give out one electron on ionization √l

ii) Alkali metals √l
iii) WS_3 √l
iv) Bond - covalent √½
Structure – Giant atomic structure √½
v) It is stable. Cant remove nor add electrons on its outermost energy level
vi) T has a smaller radius than Q because it has fewer energy levels than Q

25. The melting point increases from A to C this is due to increase in number delocalized electron hence increase in the strength of metallic bond.
D forms a giant structure with strong covalent bonds. Hence high melting.
It exhibits allstrophy ie may exist as two different form in the same state.
C2 $(SO_4)_3$
Noble gases or inert
Used in filament bubls
Used to produce an inert atmosphere in high temperature inetallurgical processes e.g welding.
C is amphoteric oxide
F acidic it is non –metal oxide.

Ethene



Acidified potassium Manganate VI abromine water it from a colourless solution

$CH_2CH_2 + H_2 \longrightarrow CH_3CH_3$
Nickel catalyst

26. *a) 2 : 8*
b) W_2O_3

27. *i) Delocalized electrons*
ii) Mobile ions
iii) Mobile ions

28. *- Sodium has a larger raius than aluminium*
- Aluminium has more protons than sodium hence a more effective nuclear charge than sodium

29. *a) 2.5*
b) Q Group 1 ✓½, Period 4 ✓½
R Group 2 ✓½, Period 3 ✓½

30. *Ethanol contains molecules ✓1 which are not ✓1 responsible for electrical conductivity. (2 mks)*

31. *a (i) Q*
(ii) R

32. *(a) K and N because they have the same number of electrons on their outermost energy level ✓*
(b) L_2O_7
(c) L_1 because it has 7 electrons on the outermost energy level or reacts by gaining electrons or the ionic radius is larger than the atomic radius (½mk)

33. *a) Formula; J_5G_2 √1*
b) E form ironic structures due to ionic bonding in its oxide. While G form molecular structure due to covalent bonding in it oxide

Chemical families

1. *a) - Non- metallic group*
- Ionic radius larger than atomic radius
b) X – has smallest atomic radius hence more electronegative

2. *To prevent filament from burning out. Provides an atmosphere in which burning cannot occur i.e. inert atmosphere*

3. *a) Halogens*
(b) X & Y
(c) Z is the largest atom with the highest number of energy levels occupied by electrons. The longer an atom is the higher the forces of attraction that hold the molecules of the element together
(d) $3Z_{(g)} + 2Fe_{(s)} \longrightarrow FeZ_{3(s)}$ ✓
(e) The blue litmus paper turned red that bleached. This is because it dissolves in water to form\ an acid and bleaching solution of HO^{-1}

4. *(i) Down the group an extra energy level is added*
(ii) In group x elements form ions by ionizing the outer energy levels
(iii) A cross the period an extra proton is added which increased he nuclear attraction force
(iv) BF_2
(v) – Ionic /electrovalent
- Involves loosing & gaining of electrons
(vi) G, F,E
-E has smallest atomic radius hence protons can attract an electron easier than in G

5. *R – has the smallest atomic ✓½ size hence its outermost electrons are more strongly held to the nucleus resulting in high ✓½ value of ionization energy*

6. *- Add dilute nitric acid to lead (u) carbonate*

$$PbCO_3(s) + 2HNO_3(aq) \longrightarrow Pb(NO_3)_2(aq) + CO_2(g) + H_2O(l)$$ √1

- React the resulting solution with solution of sodium sulphate i.e

$Na_2SO_4(aq) + PB(NO_3)_2(aq) \longrightarrow PbSO_4(s) + 2NaNO_3(aq)$ ✓½

- *Filter to obtain lead (u) sulphate as residue.* ✓½
- *Dry the salt of lead (u) sulphate in between the filter papers or in sunshine.* ✓½]

7. *a) Is one of the atoms of the same element having a different mass number from the rest, but same atomic number with others of the same element*

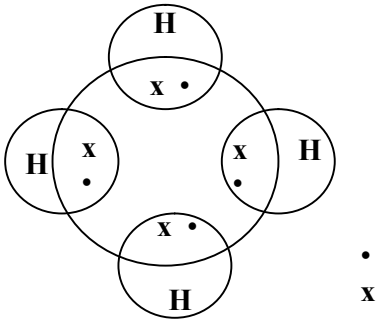
b) $\frac{92.2 \times 28}{100}$ ✓½ + $\frac{4.7 \times 29}{100}$ ✓½ + $\frac{3.1 \times 30}{100}$ ✓½ = 28.11 ✓½

8. *a) Alkaline earth metals* √1
   b) P has the smallest atomic radius due to electrons of P are closest to the nucleus √1
   c) $Q_{(S)} + 2H_2O_{(L)} \longrightarrow Q(OH)_{2(aq)} + H_{2(g)}$

Structure and bonding

1. *Ethanol contains molecules ✓1 which are not ✓1 responsible for electrical conductivity*
2. *a) A covalent bond is formed by equal contribution of the shared electrons by the atom. ✓1*
   Co-ordinate bond is where the shared electrons are contributed by one of the atoms. ✓1

b)



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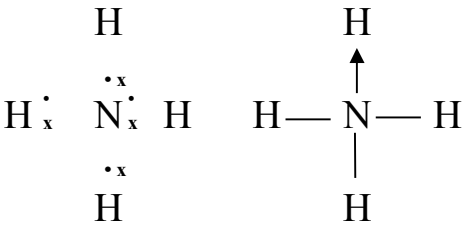
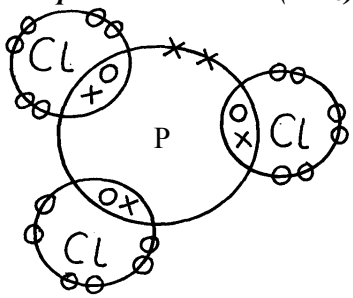
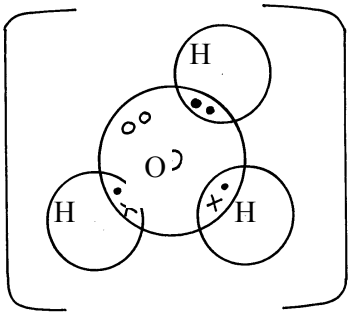


3. *a) Have delocalized valency electrons ✓1*
   b) Aluminium is a better conductor/Aluminium has three delocalized electrons while magnesium has 2. ✓1 It is resistant to corrosion.
4. *In addition to vander waals forces, strong hydrogen ✓ bonds exist in ethanol. These bonds require ✓ more energy to break.*

5. *a) Is a covalent bond in which the shared pair of electrons comes from the same atom*
6. *Magnesium has more delocalized electrons than sodium*
7. *(a) Phsophorous chloride (PCl_3)*



(b) Hydroxonium ion (H_3O^+)



8. *Aluminium – it has more delocalized (3) electrons than copper (2 e^-)*
9. *Hydrogen chloride has got only Van der waal while water has H-bonds in addition to Van der waal forces which are stronger*
10. *It contains white hoe carbon particles (½mk) that allow to give out light (½mk). When those particles cool down (½mk) they turn black and settle down as soot.(½mk)*
11. *Aluminium chloride hdrolyses √1 in solution producing hydroxonium ions √½ which turn blue litmus paper red. √½*
12. *Silicon (IV) oxide forms giant √1 atomic structure of strong covalent√½ bonds having high melting point. Carbon (IV) oxide is simple molecular substance of weak intermolecular √½ attraction forces√1 9the Van der Walls' forces) that have low melting point.*
13. *i)A: 2,4√ ½*
    B: 2,7√ ½
14. *(a) Because aluminium √1 has <u>more</u> delocalized √1 electrons than magnesium.*
    (a) It does not corrode. √1
15. *Magnesium oxide has a giant ionic ✓½ structure while silicon (iv) Oxide has a giant atomic structure. Mg O in molten state ✓½ contains delocalized ions ✓½ which conduct electricity while S_1O_2 has no ions present ✓*
16. *a) i)*
    ii) At 25C, sodium chloride is in solid form. Ions cannot move. Between 801 and 1413C 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) $^{720}/_{12}$ = 60
17. *(a) (i) NACl has mobile ions in molten state and in aqueous solution*
    (ii) Graphite has delocalized electrons in the structure which carry electric current
18. *(i) I) C <u>Reason:-</u> Good conductor of electricity in both molten and solid state..*

    II) D-<u>I</u>ts melting point is below room temp. and boiling point above room temp.

    (ii) It exist in allotropic form.
    (iii) A conducts electricity by use of mobile ions while C conducts by use of delocalized electrons.
    Both <u>must</u> be correct for the 1 mk.
19. *I (a) $2Na_{(s)} + 2CH_3CH_2OH_{(l)} \longrightarrow 2CH_3CHONa_{(aq)} + H_{2(g)}$*

(b) Mole ratio btn Na: H = 2:1

Mole of Holes H_2 = $\frac{1200cm^3}{2400cm^3}$

= 0.05moles

Moles of Na = 0.05 x 2

= 0.1moles

Mass of Na = 0.1 x 23

= 2.3g of sodium

(c) Mole ration $C_2H_5OH:H_2$

Moles of C_2H_5OH = 0.05 x 2

= 0.1moles

mass of C_2H_5OH reacted = 0.1 x 46

= 4.6g

Mass evaporated = 50- 4.6

= 45.4g of C_2H_5OH

(d) – Has molecular structure – with hydrogen bonds being molecules

While - C_2H_5ONa – has giant ionic structure with ionic bonds

(a) Water

(b) In ethanol – sinks in water and stream of bubbles observed /seen

While in water – floats on water and darts on water

- Hissing sound is heard (any two)

20. (a) ionic or electrovalent

F is metal and H is non metal.

b) (i) J atomic radius decrease a long a period from left to right nuclear change attraction increase positive nuclear change increase due to increase in the number of protons.

(ii) F has a smaller atomic radius than N level down the grown.

c) W is group 5 period 3

d) Transition metals.

e) J has 3 valence electrons which and delocalizal whole Q has only 2 electron : hence J has high electrical conductivity due to high number of decalized electron.

f) The reactions have both metallic and non metal properties

g) H is more reactive than M non metal reactivity increase up the group due to decrease in electro negativity down the group.

21. (a) (i) Ionic bond

Y losses that is gained by Z

(ii) Atomic radius of A is larger than that of B has higher nuclear charge than A

Electrons in B are drawn closer to the nucleus(½mk)

(iii) Z is more reactive than B

Z has a smaller atomic radius so will readily attract extra electron

(b) (i) Energy needed to remove an electron from an atom in gaseous state

(ii) R has a largest atomic radius; (½mk)

Therefore the electron is easily lost

(iii) Reacts vigorously with water producing gas bubbles that give the hissing sound and propels the metal

The metal floats on water as it is light

(iv) $2Q_{(s)} + H_2O_{(l)} \longrightarrow 2QOH_{(aq)} + H_{2(g)}$

22. a) i)

Atomic number	*Oxide formula*	*State at RT*
N-12	*P_2O_3*	*Q - solid*
R- 15	*R_2O_5*	*S- Gas*

ii) The atomic radius decreases across the period from M to V. Due to increasing nuclear charge// increasing number of protons which pulls the outermost electrons closer to the nucleus

iii) Element V is chemically stable// stable electronic configuration does not gain or loss// share electrons with oxygen to form an oxide

b) i)

Oxide	*Structure*	*Bond type*
No	*Giant ionic*	*Ionic/ electro valent*
TO2	*Simple covalent/ molecular*	*Covalent*

(½ mark each – total 2 marks)

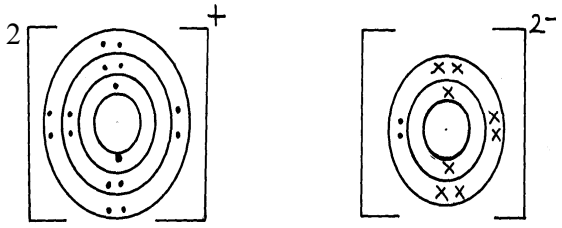
c) i) P is a metal with valency electrons free to move but T is a non- metal// molecular has no free valency electrons// molecules are electrically neutral

ii) Amphoteric oxide

23. (i) Period 2 its electronic arrangement is 2,3, or it has two energy levels.
- Accept shells or orbitals in place of energy levels
(ii) I- Across a period nuclear charge increases from, left to right exerting greater pull/attraction on available electrons
II-A_4 gains an electron and the incoming electron is repelled by other electrons or electron cloud increases
(iii) A_2

(iv) $\left[A_1 \; \bullet \; x \right]^{+} \left[x \; xx \; x \; x \; A_4 \; \bullet \right]^{-}$ ✓ 1

24. a) P_2Q ✓ reject QP_2



25. (i) Ice : Bonding : - Covalent ✓½ ½ mk
Structure : - Simple molecular ✓½ ½ mk } *2*
(ii) Magnesium chloride : Bonding : - Ionic ✓½ ½ mk
Structure: - Giant ionic ½ mk

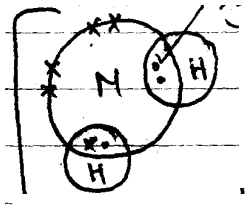
26. (i) Ice : Bonding : - Covalent ✓½ ½ mk
Structure : - Simple molecular ✓½ ½ mk } *2*
(ii) Magnesium chloride : Bonding : - Ionic ✓½ ½ mk
Structure: - Giant ionic ½ mk

27. (a) Zinc oxide √1 ZnO (1 mk)
(b) $ZnO_{(s)} + H_2SO_{4(aq)}$ √1 ⟶ $ZnSO_{4(aq)} + H_2O$ (1 mk) } *3*

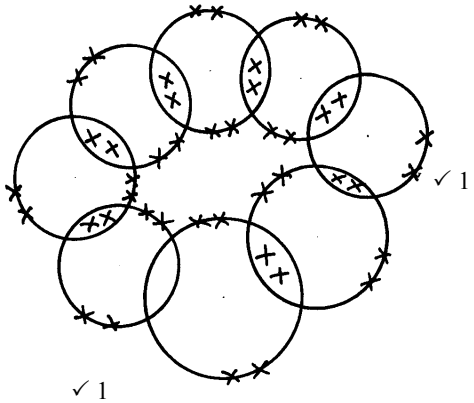
(c)

$\left[Zn(OH)_4 \right]$ √1 *(1 mk)*

28. (a)



Electrons ✓ ½
Charge ✓ ½



✓ 1

(b) C ⇌ O ✓ 1

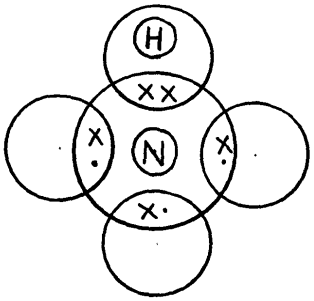
29. Diamond has giant atomic structure in each carbon atom✓½ is bonded to four other ✓½ carbon atoms arranged in regular tetrahedron shape in all direction forming rigid (strong)✓½ mass of atoms due to uniformity of covalent bonds between the atoms✓½ (2mk)

30. 3 Covalent √1 bonds and one dative √1 bond

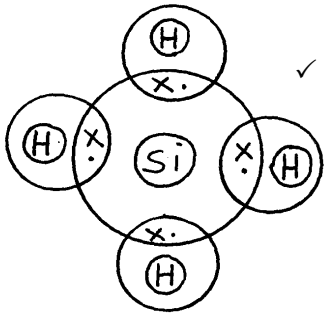
31. - CB_2
- Ionic bond

32. (a) Covalent bond is bond between non-metal atoms where shared electrons are donated equally by all the atoms involved.
Dative bond is a bond in which shared electrons are donated by one atom. ✓1½
(b) The presence of triple bond in nitrogen requires very high temperatures to break

33. (i)



✓ 1
- award 1mk if one Hydrogen two electrons donated by nitrogen
- 0mk if all hydrogen atoms shares electron with nitrogen



✓ 1
- award full mark if Silicon and Hydrogen shares electrons

34. (a) Chlorine (I) Oxide ✓ ½

(b) - Na_2O has stronger ionic bond between ions in it, while SO_2 has a weak Van der walls bond between its molecule

- ∴Na_2O requires more heat energy to weaken or break the ionic bonds than SO_2 requires breaking Van der walls bonds ✓½

35. *$ALCL_3$ has simple molecular structures with weak Vander waals between the molecules*
M_gCL_2 has giant ionic structures with strong ionic bonds
Due to insoluble coating of aluminum oxide which prevents any reaction √1

4. Salts

1. *a) Conc. H_2SO_4 / H_2SO4*
b) Heat the solution to concentrate it.
Allow for crystals to form ✓½ Filter ✓½
c) Anhydrous Copper(II) sulphate/$CUSO_4$(s)
2. *a) To MgO, add excess HNO_3, ✓½ HCl or H_2SO_4 . Add NaOH or KOH or NH_4OH to the mixture, ✓½ Filter ✓½ and dry ✓½ the residue.*
b) – Anti-acid (Treatment of acid indigestion)
- Making tooth past ✓1

3. *Add excess lead (II) Oxide to dilute nitric (v) acid and filter to get lead (II) nitrate solution.*
Add sodium carbonate solution to lead (II) nitrate to precipitate lead (II) carbonate and wash with distilled water.
4. *a) Sodium nitrate/ sodium nitrite*
b) Black charcoal glows red
Grey ash formed
c) carbon (II) oxide

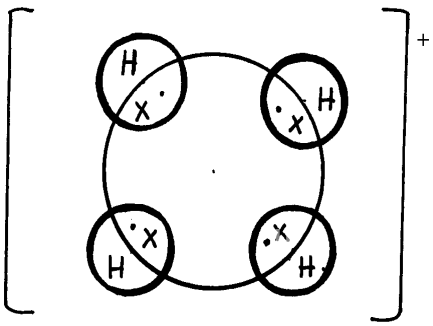
5. *.a)*

Particle	*Mass number*	*Number of protons*	*Number of neutrons*	*Number of electrons*
E	*37*	*17*	*(i) 20*	*18*
F	*32*	*(ii) 16*	*16*	*16*
G	*(iii) 39*	*19*	*20*	*18*
H	*40*	*20*	*(iv)*	*18*

b) E,G and H

6. *a) They became a white powder*
b) Efflorescency
7. *Add water to sodium oxide to form sodium hydroxide solution. Bubble excess carbon (IV) oxide in sodium hydroxide solution to form sodium hydrogen carbonate. Heat sodium hydrogen carbonate solution to evaporate water.* ✓½
8. *NH_4Cl decomposes on heating to produce NH_3 and HCl (g). $NH_{3(g)}$ is lighter than $HCl_{(g)}$ hence diffuses faster and turns red-litmus to blue HCl is denser hence diffuses at a slower rate: changes blue litmus to red*

9.



10. a) i) Hydroscopy// hygroscopic
ii) Deliquescence// Deliquescent
iii) Efflorescence// Efflorescent

b) i) $Zn(OH)_4^{2-}$
ii) $Cu(NH_3)_4^{2+}$

11. (a) (i) $2KNO_{3(s)} \longrightarrow 2KNO_{2(s)} + O2(g)$- ½mk for wrong states
(ii) $2AgNo_{3(s)} \longrightarrow 2Ag_{(s)} + 2NO_{2\,(g)} + O_{2\,(g)}$

12. (a) (i) Carbon (iv) Oxide
Dilute hydrochloric acid
(ii) $Mg(HCO_3)_{2(aq)} \longrightarrow MgCO_{3\,(s)} + H_2O_{(l)} + CO_{2(g)}$
(iii) Add sodium carbonate/any soluble carbonate (named) solution;
Filter
Dry the residue between two filter papers

13. a) magnesium Oxide
b) $2Mg_{(s)} + O2_{(g)} \_\_\_\_\_ 2MgO_{(s)}$

c) i) Sodium sulphate
ii) $MgCO_3$

d) $MgO_{(s)} + H_2SO_{4(aq)} \_\_\_\_\_ M_gSO_{4(aq)} + H_2O_{(L)}$
e) $Mg^{2+}{}_{(aq)} + CO^{2-}{}_{3(aq)} \_\_\_\_\_ M_gCO_{3(s)}$
f) $M_gCO_{3(g)} \_\_\_\_\_ M_gO_{(g)} + CO_{2(g)}$
g) Na^+ ions and SO_4^{2-} ions
h) Precipitation/ double decomposition
i) Crystals turn to a white powder. The salt is efflorescent hence it looses its water of crystallization forming a powder

14. a) i) Hydroscopy// hygroscopic
ii) Deliquescence// Deliquescent
iii) Efflorescence// Efflorescent

b) i) $Zn(OH)_4^{2-}$
ii) $Cu(NH_3)_4^{2+}$

15.
- Dissolve lead (ii) nitrate crystal in a given amount of distilled water in a beaker
- To dilute sulphuric✓½ (vi) acid in a beaker add magnesium✓½ oxide powder
- React the two solutions obtained
- Filter the mixture
- Dry the residue between filter papers to obtain a dry sample of lead (ii) sulphate

16. (a) Zinc oxide √1 ZnO (1 mk)
(b) $ZnO_{(s)} + H_2SO_{4(aq)}$ √1 $\longrightarrow ZnSO_{4(aq)} + H_2O$ (1 mk)
(c) $Zn(OH)_4^{2-}$ √1 (1 mk)
} 3

17. (i) Efflorescence
(ii) $Na_2Co_3.10H_2O$ (If letters are joined – no mark)

18. (i) Pb^{2+} ✓ 1
(ii) White precipitate formed soluble in excess ✓ 1

19. Calcium oxide hygroscopic atmospheric water vapour ad becomes wet
Some laboratory gases are acidic
While calcium oxide is basic
Therefore calcium oxide reacts with the gas//calcium oxide would absorb the gas

20. A piece of marble chips was strongly heated in air for about 30 minutes. Some drops of water

were added drop by drop to the product when it was still warm.

Answers

i) It decomposes to give Calcium oxide/Lime and Carbon (IV) oxide

$CaCO_{3(s)} \longrightarrow CaO_{(s)} + CO_{2(g)}$

ii) Alot of heat is evolved which makes the piece of lime swell hence the name quick lime and Calcium hydroxide(slaked lime) is formed. ✓½

$CaO(s) + H_2O(l) \longrightarrow Ca(OH)_2(aq)$ ✓1

21. a) i) Gas C $O_{2(g)}$ √ ½ Gas B NO_2 √ ½

ii) Zn^{2+} and NO_3^+ √ ½

b) $ZnO_{(g)} + 2HNO_{3\,(aq)} \_\_\_\_\_ Zn(NO_3)_{2(aq)} + H_2O_{(l)}$

Balanced

State symbols

Chemical symbols

22. (a) Glowing splint is relighted/rekindles

(b) Pale yellow solid

23. a) Deliquescence√1

b) Deposition √1

24. a)- To MgO add excess HNO_3 √ ½ (Or HCL or H_2SO_4)

- Add NaOH or KOH or NH4 OH to the mixture √ ½
- Filter and dry the residue√1

b) Uses as

- Anti – acid or tooth paste √

25) - Dil NaOH may not absorb all the carbon (IV) oxide gas produced

- Candle may go off before all the oxygen is used due to build up carbon (IV) oxide

26 a) Acid salts $NaH_2PO_{4(S)}$ √1

Basic salts – M_g (OH) $CL_{(s)}$ √1

Normal salts – Ca $(NO_3)_{2(S)}$ √1

Double salt – $Fe(NH_4)_2$ $(SO_4)_2$ $6H_2O$√1

b) i) Hydrolysis – Reaction of water with a compound to form at least two products √1

ii) Moist litmus paper turns red due to the HCL gas produced √1

Or accept equation for the explanation

$FeCL_{3(S)} + 3H_2O_{(L)} \longrightarrow Fe(OH)_{3(S)} + 3HCl_{(g)}$

Effect of an electric current on substances

1. (a) $Pb^{2+}{}_{(l)}$ $2e^-$n $Pb_{(s)}$

(b) - There is liberation of brown vapour

- The brown vapour is due to the formation of bromine molecule

2. E – Giant ionic structure

F – Giant metallic structure

3. (a) - Electrolytes are melts or acqueous solutions which allow electric current to pass through them and are decomposed by it while non-electrolyte are melts or acqueous solution which do not conduct electric current

- Electrolytes contain mobrite ions while non-electrolyte contains molecules.

(c) (i) I bulb did not light when sugar solution was put into the beaker

II bulb light when slat solution was put into the beaker

(ii) Non- electrolyte I
Electrolyte II

(b) (i) heating

(ii) Cathode

$Pb^{24} + 2e^- \longrightarrow Pb_{(s)}$ *grey deposit metal is observed*

(iii) Anode

$2Br^-_{(aq)} \longrightarrow Br_{2(g)} + 2e^-$

A brown yellow gas is evolved

4. *a) i) Decomposes to* Pb^{2+} *and ions which are later reduced to Pb and are oxidized to Br*
ii) $Br_{2(g)}$ *produced is poisonous*

5. *I (a) Crystallization – The solidifying of a salt form a saturated solution on cooling.*
(b) Addition of sodium chloride to soap-glycerol mixture in order to precipitate the soap.
II– to the nitric acid in a beaker, add barium carbonate solid as you stir until effervescence stops.
- Filter to obtain the filtrate
- Add dilute nitric acid to the filtrate and filter to obtain the residue
- Dry the residue under the sun or between filter papers.

III (a) (i) K^+
(ii) NO_3

(b) $2KNO_{3(s)} \xrightarrow{\text{heat}} 2KNO_{2(s)} + O_{2(g)}$

(IV) $Cu(NH_3)_4^{2+}$

(V) In water HCL ionizes into mobile into mobile ions which conduct because water is polar while methyl is non-polar hence HCl does not ionize hence does not conduct electricity

6. *(i) Faraday first low of electrolysis.*
The mass of a substance dissolved on liberated in electrolysis is proportional to the quantity of electricity which passes through the electrolyte.
(ii) (anode) – Brown/fumes of a gas were evolved (cathode) – grey beads.

7 *a) (i) Place elilute nitric acid* (HNO_3) *in a beaker and warm.*
- *Add lead II oxide until no more dissolves*
- *Filter the un reacted lead II oxide*
- *Heat to evapourae & leave to crystallize.*

(ii) $Pbo_s + 2HNO_{3aq} \longrightarrow pb(No_3)_{2\ aq} + H_2O_n$

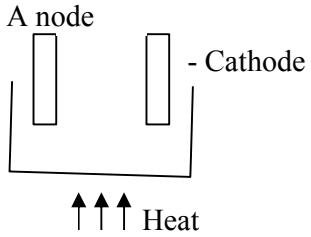
b)(i) Crystals crack and split because of the gas accumulating inside
- *Brown gas of Nitrogen IV oxide.*
- *Solid resolute, lead II oxide which is orange when hot is yellow when cold.*

(ii) $2\ pb(NO_3)_{2s}\ 2\ Pbo_s + o_{2(g)} + 4NO_{2(g)}$

c) (iii) white precipitate which is incolible is excess ammonia

(iv) $pb^{24}{}_{aq} + 20H^-_{aq} \longrightarrow pb\ (oH)_{2\ (s)}$

8. *(a)*



(b) To let the gas produce out, so that it does not explode due to pressure.
(e) At the anode a pale yellow gas is observed

Cathode – grey solid is formed.

(d) Anode $2F^{-}_{(c)} \longrightarrow F_{2(g)}, e\ 2e^{-}$

Cathode $pb^{24}{}_{l} + 2e^{-} \longrightarrow pb_{(s)}$

(e) the gas produce is poisonous.

II a) C

b) Because it does not conduct electricity in solid state and not soluble.

c) B because it does not conducts electricity in solid state but in molten or aqueous solution it conducts.

d) Metallic bond.

9. a) A is Anode ✓1

B is cathode. ✓1

b) Bromine gas. ✓1

c) $2Br^{-1}(l) - 2e^{-} \longrightarrow Br_2(g)$ ✓1

10. B and D or F_2 and Ne

11. a) i) olcum

ii) Water

b) i) $SO_{3\ (g)} + H_2S)_{4(L)}$ _____ $H_2S_2O_{7(L)}$

ii) $H_2S_2O_{7(L)} + H_2O_{(L)}$ _____ $2H_2SO_{4(}$

12. a) Source of heat. ✓1

b) The solid $PbBr_2$ melts to form Pb^{2+} ✓½ and 2 Br^{-} ✓½ that conduct electric current in the circuit hence the bulb lights/Pb^{2+} and $2Br^{-}$ carry the current. ✓1

6. Carbon and its compounds

1. a) – making of pencil

- As a lubricant

b) Graphite has delocalized in its structure hence it conducts electricity. Carbon uses all the four valency electrons to form covalent bonds hence do not have delocalized elect conduct electricity

2. a) Carbon (IV) oxide (CO_2) ✓1

b) $2NaHCO_3(s) \longrightarrow Na_2CO_3(s) + H_2O(l) + CO_2(g)$ ✓1

c) – Paper manufacture ✓1

- Manufacture of glass.

- Softening of hard water.

3. Magnesium has a higher affinity for combined oxygen that carbon./Mg is more reactive than carbon thus displaces it from its oxide.

4 a) Carbon (iv) Oxide

b) Blue flame. Carbon (iv) oxide burns in air with a blue flame 1

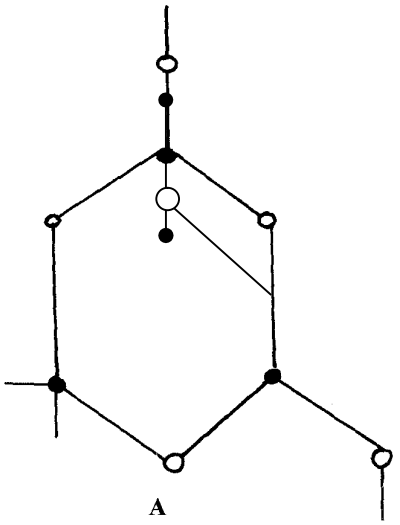
5. a) A brown solid is formed

b) $CuO_{(g)} + C_{(g)}$ _____ $Cu_{(g)} + CO_{(g)}$

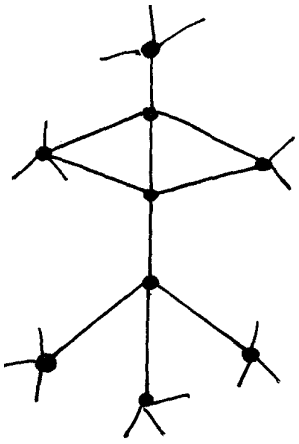
c) As a fuel in water gas

6. *(a) Covalent bond is bond between non-metal atoms where shared electrons are donated equally*
by all the atoms involved.
Dative bond is a bond in which shared electrons are donated by one atom. ✓½
(b) The presence of triple bond in nitrogen requires very high temperatures to break

7. *(a) Reduction by using carbon*
b) J, carbon and H
decreasing order of reactivity 7. Study the structures **A** and **B**:



A
Silicon (IV) Oxide



B
Diamond

8. *(i) Have giant atomic structure*
(ii) To make drill bits or used in jewellery (any one) ✓1

9. *(a) Allotropy is the existence of an element √1 in more than one form without change of state.*
(b) Graphite contains delocalized √1 electrons between the layers while diamond has no free √1 electrons. Its atoms are strongly bonded. 3

10. *(a)* $C_{(s)} + CO_{2(g)} \longrightarrow 2CO_{(g)}$ *√1 (1 mk)*
(b) Burn charcoal in sufficient √1 oxygen Carbon (II) oxide (being a reducing agent) is easily oxidized to carbon (IV) oxide. √1 (1 mk) 3

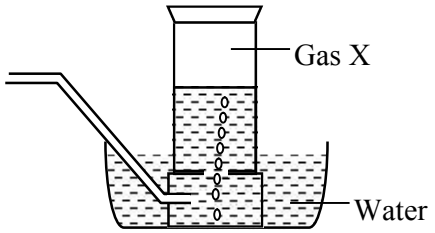
11. *(a) Black*✓½ *solid changes to reddish brown*✓½
(b) $CuO_{(s)} + CO_{(g)} \longrightarrow Cu_{(s)} + CO_{2(g)}$ ✓ *(1 mk)* 2

12. *(a) Difference forms of a substance at the same physical state;*
(b) In graphite each carbon is bonded to 3 others and there are Vander waals forces between hexogous;
- In diamond each carbon atom is covalently bonded to four others making a rigid mass;

13. *a) - Copper (ii) oxide changes ✓½ from black to brown/ reddish brown/ red brown✓½*
- A white ppt forms in the boiling tube ✓½
b) $CO_{2(g)} + Ca(OH)_{2(aq)} \_\_\_\_\_ CaCO_{3(g)} + H_2O_{(l)}$ *✓1*
c) Unreacted carbon (ii) Oxide is poisonous/ toxic/ pollutant it is converted to the less harmful gas CO_2

14. *a) A the substance is a gaining kinetic energy making it to vibrate vigorous up B, at point B to C the kinetic energy a gained is used to beak down the particle in solid state at this point the substance start melting and the temperature is constant.*
d) It is not water because the melting of water is 100^0c not 115^0c.
e) The melting point will be lower because of the impurity Nacl.
f) The temperature is constant.

15. *(a) (i) Carbon (II) Oxide or CO – (reject Carbon monoxide)*
(ii) Combines with haemoglobin to form caborhaemoglobin which prevents carrying of oxygen
(b) (i) $CO_{(g)} + C_{(s)} \longrightarrow 2CO_{(g)}$
(ii) $ZnO_{(s)} + CO_{(g)} \longrightarrow Zn_{(s)} + CO_{2(g)}$
(c) Orange/yellow Lead (II) Oxides turns grey
(d) $CaCO_{3(s)} + 2HCl_{(aq)} \longrightarrow CaCl_{2(aq)} + CO_{2(g)} + H_2O_{(l)}$
(e) Methanoic acid and concentrated sulphuric acid
(f)



16. *(a) (i) - Ammonia gas ✓1*
- Calcium carbonate. ✓1
- Brine ✓1 or Concentrated sodium chloride.
- Coke (Any three materials)

(ii) - Carbon (IV) oxide. ✓1
- Ammonia gas. ✓1
- Water (Any two)

(iii) Chamber 3 ✓1
Chamber 2 ✓1

(iv) U – Ammonia chloride ✓1
V – Sodium hydrogen carbonate. ✓1

(b) (i) $HN_3(g) + H_2O(l) + CO_2(g) + NaCl(aq) \longrightarrow NH_4Cl(aq) + NaHCO_3(s)$
OR
$NH_3(g) + H_2O(l) + CO_2(g) \longrightarrow NH_4HCO_3(aq)$
$NH_4HCO_3(aq) + NaCl(aq) \longrightarrow NH_4Cl(aq) + NaHCO_3(s)$

(ii) $NaHCO_3 \longrightarrow Na_2CO_3(s) + CO_2(g) + H_2O_{(l)}$

(iii) $Ca(OH)_2(s) + 2NH_4Cl(aq) \longrightarrow CaCl_2 + 2NH_3(g) + 2H_2O(l)$

c)
- Manufacture of glass.
- Softening of hard water.
- Manufacture of papers.
- Manufacture of soap.
- Refining of metals.

17. (a) (i) – The gas is collected over water
- The gas is not passed through a drying agent
(ii) $PbCl_2$ is formed which is insoluble hence prevents contact between the carbonate and the acid
(iii) $CO_{2(g)} + C(s) \xrightarrow{\text{Heat}} 2CO(g)$
$CO_{2(g)} + 2NaOH_{(aq)} \longrightarrow Na_2CO_{3(aq)} + H_2O_{(l)}$

(iv) – Solid CO_2 used as a refrigerant
- Used in making aerated drinks
- Solid CO_2 is used in cloud-seeding
- CO_2 used as an ingredient/air material in solvary process

(v) – Denser than air
- Does not support combustion (burning)

(b) Reducing Property
(c)- $Al_2(CO_3)_3$ hydrolyses in water/moisture forming H^+ ions which reacts with the carbonate and dissolves
(d) $(NH_4)_2 CO_{3(s)} \xrightarrow{\text{Heat}} NH_{3(g)} + CO_{2(g)} + H_2O_{(g)}$

18. Brown fumes of a gas are produced as the charcoal dissolves in the acid. The charcoal reduces nitric (V) acid to nitrogen (IV) oxide gas that is brown while the charcoal is oxidized to carbon (IV) oxide.

19. (a) Due to formation of calcium hydrogen carbonate which is a soluble salt

(b) $2CaCO_{3(s)} + 2CO_{2(g)} + 2H_2O \longrightarrow 23Ca(HCO_3)_{2(aq)}$
(- Award 1mk if equation is correctly balanced
- Penalize ½ mk if equation if not balanced)

20. a) A – Concentrated sulphuric acid (vi) acid √1
b)
c) $HCOONa_{(s)} + H_2SO_4 \longrightarrow HCOOH_{(L)} + NaHSO_{4(S)}$

Hence; $HCOOH_{(l)} \longrightarrow CO_{(g)} + H_2O_{(L)}$
Accept conc H_2SO_4 (reject where concentrated is not mentioned)
Workability √1
Correct method of collection√1
Of the gas √1
The two equations should be mentioned 2 mks

Gas laws

1. $X: t_1 = 28.3sec$ $RMM = ?$
$Q_2: t_2 = 20.0sec$ $RMM=32$

$T \propto \sqrt{MM}$ ✓

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

$\left(\frac{T_1}{T_2}\right)^2 = \frac{X}{32}$ ✓

$\left(\frac{28.3}{T_2}\right)^2 = \frac{X}{32}$ ✓

$X = \frac{28.3^2 \times 32}{400}$ ✓

$X = 64$

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

$= 2cm/sec$ ✓ ½

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

$= 1cm/sec$ ✓ ½

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

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

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

$MW = 64$

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; $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

$V_1 = 3.5 \times 10^{-2} m^3$ $V_2 = 2.8 \times 10^{-2} m^3$

$P_1 = 1.0 \times 10^5 Pa$ $P_2 = 1.0 \times 105 Pa$ ✓ ½

$T_1 = 291K$ $T_2 = ?$

$$T_2 = \frac{P_2V_2T_1}{P_1V_1}$$

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

$T_2 = 232.8k$ ✓

4. $\frac{TsO_2}{TO_2} = \frac{R.M.N.SO_2}{R.M.MO_2}$ ✓½

$SO_2 = 32 + (16 \times 2) = 64$ ✓½

$O_2 = (16 \times 2) = 32$ ✓½

$$\frac{TsO_2}{50} = \sqrt{\frac{64}{32}} \text{ ✓½} \qquad = 70.75 \text{ ✓½}$$

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

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

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

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

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

$RSO_2 = \sqrt{\frac{2.25 \times 36.5}{64}}$

1.133 cm/ sec

$1.133\ cm^3$ _____ 1 sec

$42\ cm^3 = \frac{42 \times 1}{1.133}$

$= 37$ sec

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

b)

c) $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$ √ ½ $V_2 = \frac{P_1V_1}{T_1} X \frac{T_2}{P_2}$ √ ½

$\frac{250 \times 273 - 23}{273 + 127}$ √ ½

$= 156.5cm^3$

7. a) RFM of $CaCO_3 = 40 + 12 + 48$

$= 100kg.$ √½

∴ 100 kg of $CaCO_3 \equiv 22.4dm^3$ of $CO_2(g)$

1000 kg " " ⟶ ?

$= \frac{22.4 \times 1000}{100}$ √1 $= 224\ dm^3$ √½

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

$V_1 = 200cm^3$ $V_2 = ?$

$P_1 = 740mmHg$ $P_2 = 780mmHg$

$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

$\frac{740x200}{296}$ √1 $= \frac{780x?}{248}$ √1

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

$= 158.974\ cm^3$ √1 (penalize ½ mark for units)

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

$\therefore \frac{12}{7.2} = \sqrt{x}$ √½

$X = \frac{12^2}{7.2^2} \times 16$ √½

$= 44.464$ √

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. √1

b) $\frac{TCO_2}{} = \sqrt{MCO_2}$

$$\frac{TCO}{T} = \sqrt{\frac{\overline{MCO}}{\overline{MCO}}} \quad \checkmark\frac{1}{2}$$

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

$$\Rightarrow \left(\frac{\cancel{200}}{T}\right)^2 = \frac{\cancel{11}}{7}$$

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

$$\Rightarrow T = 200.0.79772 \checkmark\frac{1}{2} = 159.5 \text{ Seconds.} \checkmark\frac{1}{2}$$

12. a) Y ✓1

b) Z and W ✓1 have same atomic number but different mass number. ✓1

13. (a) Gas P

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

$\frac{18}{54} = \sqrt{\frac{x}{17}}$

$\frac{1^2}{3^2} = \left(\sqrt{\frac{x}{17}}\right)^2$

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

$9x = 17$

$x = {}^{17}/_{9}$

$x = 1.88$

$Q = It$

$= 5 \times 386 = 1930C$

(b) $Pb^{2+}_{(l)} + 2e\ Pb_{(s)}$ (½mk)

If 2 x 96500C = 207 (½ mk)

1930C = $\frac{1930 \times 207}{2 \times 96500}$ (½ mk)

$= \frac{399510}{193000C}$ (½mk)

$= 2.07g$ (½mk)

14. i) Delocalized electrons

ii) Mobile ions

iii) Mobile ions

15. $\frac{TNH_3}{TB} \quad \frac{MNH_3}{MB}$ ✓ ½

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

$\frac{TNH_3}{110} = \frac{17}{34}$ ✓ ½

$TNH3 = 110 \times \frac{17}{34}$ ✓ ½ = 77.78 seconds ✓ ½

16. $\frac{P_1 V_1}{T1} = \frac{P_2 V_2}{T_2}$

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

$V2 = \frac{400 \times 1 \times 5}{2 \times 246}$

$= 4.065\ dm^3$

17. a) $V_1 = 200\ cm^3$ $V_2 = ?$

$T_1 = 296\ K$ $T_2 = 284K$

$P_1 = 740\ mmHg$ $P_2 = 780\ mm\ Hg$

$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

$V_2 = \frac{P_1V_1T_2}{T_1P_2} = \frac{740\ mm\ Hg \times 200cm^3 \times 248K}{296K \times 780\ mm\ Hg}$

$= 158.97\ cm^3$

b) 60 l ✓1

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) $\frac{Time\ CO_2}{Time\ NO_2} = \frac{\sqrt{M_rCO_2}}{M_rNO_2}$

Where $100cm^3$ of CO_2 takes 30 seconds

∴ $150cm3$ of CO_2 takes $^{30}/_{100} \times 150$

$= 45$ seconds√

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

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

$TNO_2 = 46\ sec$

OR

$\frac{RCO_2}{RNO_2} = \frac{\sqrt{M_rNO_2}}{M_rCO_2}$

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

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

$= 1.0225$

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

$= 3.26\ cm^3$ per second

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

Moles of NaOH = $\frac{8}{} = 0.2M$ ✓

40

Moles of NaOH in 25cm3

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

Mole ratio 1:2

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

$= 0.0025$

$\frac{1x\ 0.245}{0.0025} = 98$ ✓

3. No. Of moles of HNO_3 acid

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

Mole ratio 1:1 ✓

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

Then D grams is 0.2 X 56

$= 11.2g$

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

$= 0.04$moles

Equation:

$Na_2SO_{3(s)} + 2HCL_{(aq)} \longrightarrow 2NaCl_{(aq)} + SO_{2(g)} + H_2O_{(l)}$

Mole ratio Na_2SO_3 : SO_2 is 1:1

∴No. of moles of $Na_2SO_3 = 0.04$moles

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

$= 5.04g$

5. From the equation

- (3x24) litres of chlorine react with iron to produce [(56 x 2) + (35.5 X3)] g of $Fecl_3$.

325 g of $Fecl_3$ is produced by 72 litres of cl_2

Then 0.5g of fecl3 is produced by:

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

$= 110.78\ cm^3$

6. RMM (CH_3OOH) = 60 ✓ ½

Mass of $15cm^3$ and = $1.05 \times 15 = 15.75g$ ✓ ½

Moles in $500cm^3$ solution = $\frac{15.75}{60} = 0.2625$ ✓ 1

Molarity = $\frac{1000 \times 0.2625}{5000}$ $= 0.525M$ ✓ ½

7. If $24000cm^3 = 1$mole

$150cm^3 = ?$ ✓

$\frac{150 \times 1}{24000} = 0.00625$moles of CO_2

Since the ratio of Na_2CO_3; O_2 produced is 1:1 the mass of $Na_2CO_3 = 0.00625 \times 106 = 0.6625g$

Na_2Co3	H_2O
Mass 0.6625g	1.0125g
RFM 106	18
Mole 0.6625 = $\frac{0.00625}{106}$	$\frac{1.0125}{18} = 0.5625$

Ratio	***0.00625***	***0.05625***
	0.00625	***0.0.00625***
	= 1	***= 9***
$Na_2CO_3.9H_2O$		

8. ***$MgCl_2 \longrightarrow Mg^{2+}{}_{(s)}\ 2Cl^-$***

R.F.M of $MgCl_2$ = 24 + 71
= 95
Moles of Mass = 1.7 / R.F.M 95
= 0.01789moles
I mole of $MgCl_2$ = 2moles of Cl-ions
0.01789moles of $MgCl_2$ = 0.01789 x 2
= 0.03478moles of Cl^-ions
1mole = 6.0 x 10^{23}ions
0.03578moles = $\frac{0.03578 \times 6.0 \times 10^{23}}{1}$
= 2.1468 x 10^{22} ions of Cl^-

12. ***Mass of O_2 = (4.0 – 2.4)= 1.6g***
Moles of O_2 = $^{1.6}/_{16}$ = 0.1

If 1 mol O_2 _____ 24000cm^3
0.1 Mol Mg = 0.5 mol $_{O2}$ = 1200cm^3

OR

2mg	***:***	***O2***
2(24)		***24000***
$^{2.4}/_{2(24)}$	$= {}^{x}/_{240000}$	

X = $\frac{2.4 \times 24000}{2(2.4)}$ = 1200cm3

13. ***i)***

Fe	***S***	***O***	***H_2O***
$^{20.2}/_{56}$	$^{11.5}/_{32}$	$^{23.0}/_{16}$	$^{45.3}/_{18}$
$^{0.36}/_{0.36}$	$^{0.36}/_{0.36}$	$^{1.44}/_{0.36}$	$^{2.52}/_{0.36}$
1	***1***	***4***	***7***

Empirical formula: $FeSO_4 + H_2O$

ii) 6.95g $= {}^{6.95}/_{278}$ ***= 0.025***
∴ 0.05 moles in 250cm^3 = 0.025 x $^{1000}/_{250}$ = 0.1

14. R.F.M of pbI_2 = 207 + (127X2) = 461
2 moles of I^-ions produces I mole of pbI_2
Moles of I^-ions = $\frac{0.1 \times 300}{1000}$ = 0.03 mole
Mole ratio PbI_2: I^- mole of PbI2 formed = $\frac{0.03}{2}$ = 0.05
I : 2
Mass of pbI_2 formed = 0.015 mole X 461
= 6.915 g

d(i) Yellow precipitate

15. a) i)

ii) At 25C, sodium chloride is in solid form. Ions cannot move. Between 801 and 1413C sodium chloride is in liquid state, ions are mobile

b) Both ammonia and water are polar moleculer 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) $^{720}/_{12}$ = 60

16. Mass of O_2 = (4.0 – 2.4)= 1.6g
Moles of O_2 = $^{1.6}/_{16}$ = 0.1

If 1 mol O_2 _____ 24000cm3
0.1 Mol Mg = 0.5 mol O2 = 1200cm3
OR
2mg : O_2
2(24) 24000
$^{2.4}/_{2(24)}$ = $^{x}/_{240000}$

X = $\frac{2.4 \times 24000}{2(2.4)}$ = 1200cm3

17. i) C_nH_{2n}, where n = No. of carbon atoms
ii) 70
iii) C_sH_{10}, $CH_3CH=CHCH_2CH_3$
OR $CH_3CH_2CHCH_2= CH_2$

18. i)

Fe	S	O	H_2O
$^{20.2}/_{56}$	$^{11.5}/_{32}$	$^{23.0}/_{16}$	$^{45.3}/_{18}$
$^{0.36}/_{0.36}$	$^{0.36}/_{0.36}$	$^{1.44}/_{0.36}$	$^{2.52}/_{0.36}$
1	1	4	7

Empirical formula: $FeSO_4 + H_2O$

ii) 6.95g = $^{6.95}/_{278}$ = 0.025
∴ 0.05 moles in 250cm^3 = 0.025 x $^{1000}/_{250}$ = 0.1
Concentration = $^{6.95}/_{278}$ x $^{1000}/_{250}$ = 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 = $\frac{\text{Answer in (c) (ii)}}{1000} \times \frac{2}{2}$

$= \frac{26}{1000} = 0.026$ √½

Mass of Mg in the alloy = 0.026 x 24

= 0.624g √½

Mass Cu in the alloy = (1.0 – 0.624)

= 0.376g √½

% of Cu = $\frac{0.376}{1.0} \times 100$

= 37.6% √½

21. $NH_{(g)} + HNO_{(g)} \longrightarrow NH_4NO_{3(s)}$ ✓1

RMM of $NH_4NO_3 = 80$

Moles of $NH_4NO_3 = \frac{4800}{80} = 60$moles ✓1

RMM of $NH_3 = 17$

Mass of $NH_3 = 60 \times 17 = 1020$KJ 1

22. From the equation of step 3

$SO_{3(g)} + H_2SO_{4(L)}$ _____ $H_2S_2O_{7(L)}$

RFM of H2S2O7 = 2 + (2 X 32) + (7 X 16) = 178 √ ½ mark

178g of Oleum are produced by 22.4 liters of SO_3 √½ mark

178 kg " " " " " " $\frac{178 \times 1000 \times 22.4L}{178g}$ √1 ½ mark

= 22,4000 liters √½ mark

(Total 13 marks)

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

Volume of 1M Nitric acid $\frac{40}{0.01}$ = 4000cm3 √½ mark

- Use value in d(ii) above

ii) $\frac{480cm^3}{0.01}$ √½ mark = 48,000 cm^3 √½ mark

OR $\frac{4000 \times 480}{40cm^3}$ = 48,000cm3 √½ mark

i.e. $\frac{\text{Answer in e(i)} \times 480cm^3}{\text{Answer in d(i)}}$ [Total = 11 marks]

24. (i) $\frac{35.2 \times 1000}{100 \times 16}$ ✓ ½

= 10Moles ✓ ½

Or mass of $CH_4 = \frac{35.2 \times 5}{1000} = 1.76g$ ✓ ½

Mass in g = 1.76 x 1000 = 1760kg

Moles of methane = $\frac{1760}{16}$ ✓ ½

= 110Moles

(ii) $CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$ – (ignore states)
Volume = 110 x 24.0
= 2640dm^3
Mark consequential from equation and b(ii) (Without equation max *TZM*)

25. Volume of Cl2 used
= 0.047 x 24 ✓ 1
= 1.128dm^3 ✓ ½

26. Mass due Carbon in $CO_2 = {}^{12}/_{4} \times 35.2$
= 0.96
Moles carbon = $^{0.96}/_{12}$ = 0.08
Mass due Hydrogen in H_2O = 2/18 x 1.40
= 0.156
Moles hydrogen = $\frac{0.156}{1}$ = 0.156
Mole ratio C:H = 1: 1.95
E.F = CH_2

27. $Na_2CO_3 \ x \ H_2O \longrightarrow Na_2CO_3 + H_2O$ ✓1

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

28. % of H_2O lost = 14.5%^
5 of anhydrous Na_2CO_3 = 85.5% (½mk)
R.F.M of Na_2CO_3 = 106 (½mk)
RMM of H_2O = 18 (½mk)

$NaCO_3$	H_2O	
$\frac{85.5}{106}$	$\frac{14.5}{18}$	(½mk)
$\frac{0.8066}{0.8055}$	$\frac{0.8055}{0.8055}$	(½mk)

n = 1 ($Na_2CO_3.H_2O$) (½mk)

29. Moles of $Na_2CO_3 = \frac{20 \times 0.1}{1000} = 0.002$ moles

$Na_2CO_3 + H_2SO_{4(aq)} \_\_\_\_\_ Na_2SO_{4(aq)} + H_2O_{(L)} + CO_{2(g)}$
Mole ratio 1 : 1
Moles of H_2SO_4 = Moles of Na_2CO_3
= 0.002 moles
Molarity of $H_2SO_4 = \frac{10000 \times 0.002}{13} = 0.154$ moles

30.

Element	C	H	O

%	*68.9*	*13.5*	*21.6*
Molar mass	*12*	*1*	*16*
Moles	$^{68.9}/_{12}$ *5.403*	$^{13.5}/_{1}$ *13.5*	$^{216}/_{16}$ *1.35*
MR	$^{5.43}/_{1.33}$ *4*	$^{13.5}/_{1.35}$ *10*	$^{1.35}/_{1.35}$ *1*
Ratio	*4*	*10*	*1*

h ($C_4H_{10}O$) = 74
h (12x4) + (10x1) +16 = 74
74h = 74
H= 1
Formula $C_4H_{10}O$

31. *Moles C_4H_{10} = $\frac{1.12}{22.4}$ = 0.05 mol*
Heat produced + 0.05 X (3000) = 150 kj
Usefull heat = $\frac{75X150}{100}$ = 112.5 kj
Let volume of water = V
Room temperature = 25°C
Boiling point = 100°C
Change in temperature, ΔT = 100-25 = 75°C ½ mk
ΔT X mass X C Q 315V = 112500
= $\frac{75 X V X 4.2}{1000}$ =112.5 V = $\frac{112500}{315}$ ½ mk
1
V = 357.km³ ½ mk

32. *RFM Na_2CO_3 = 43 + 12 + 48 = 106*
Mol. Na_2CO_3 = $\frac{19.6}{106}$ = 0.8149057
Molarity of Na_2Co_3 = $\frac{0.1849057}{0.25}$ = 0.73962m
$Na_2Co_{3(aq)} + MgCl_{2(aq)} + MgCo_{3(s)}$
Mole ratio $Na CO_3 : MgCl_2$ is 1:1
∴ mol. $MgCl_2$ Reacted = 0.1849
If 2.0 mol. = 1000cm3 solution mg cl_2
= 0.1849mol = $\frac{0.1849 X 1000}{2}$
= 92.45 or 92.5 cm³

33. *i)* *ACID* *BASE*
1 *2*
½ 0.004 *$\frac{20cm^3}{1000cm^3}$ X 0.2 moles*
= 0.002 moles √ ½ *= 0.004 moles*

25cm³ _____ 0.002 moles √ ½
1000cm³ _____ ?
1000cm³ X 0.002 moles = 0.08 M √ ½

ii) 0.08 moles _____ 10.08$_g$ $H_2C_2O_4xH_2O$ √ ½
1 mole _____ ?

$$\frac{1 \text{ mole}}{0.08 \text{ moles}} \times 10.08 = 126 \surd \tfrac{1}{2}$$

126 _____ $H_2C_2O_4xH_2O$

$18x = 126 - 90 \surd \tfrac{1}{2}$

$18x = 36$

$X = 2 \quad \surd \tfrac{1}{2}$

34. $Mg_{(g)} + 2HCL_{(aq)}$ _____ $MgCl_{2\,(aq)} + H_{2\,(g)}$

$24g$ _____ $22.4dm^3$

$16g$ _____ ?

$$\frac{1.6\,g}{} \times 22.4dm^3 \surd \tfrac{1}{2} = 1.4933\ dm^3$$

35. a) $2SO_2(g) + O_2(g) \longrightarrow 2SO_3(g)$,

2	1	2	SO_2	:	O_2
60 l	40 l		60	:	30 ✓½
			Oxygen ✓½		by 10 litres

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	$\frac{3.6}{16}$ ✓½ 0.225 ✓½
Mole ration	$\frac{0.15}{0.15}$ 1 2	$\frac{0.225}{0.15}$ ✓½ 1.5 x2 3 ✓½

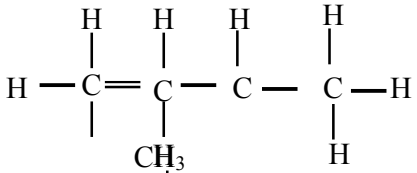
∴ The empirical formula is Fe_2O_3

Organic chemistry 1

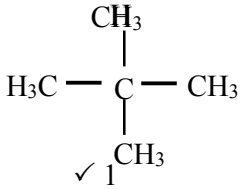
1. a) Bromine decolorized immediately in ethane gas √1
   b) Temperature between150°C - 250°C or temperature of 180°C
   c) Carbon (IV) oxide or $CO_{2(g)}$ √

2. (a) Butane
   (b) Manufactures of cooking fats and margarine

3. (a)



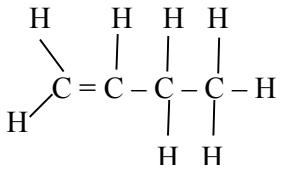
(b)

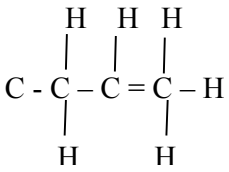


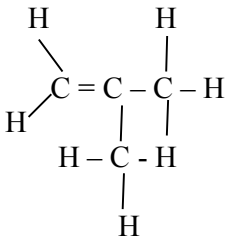
✓ 1

4. *a) Existence of cpds with the same molecular formula but different structural formula/arrangement of atoms*

b)



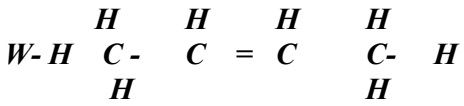




n – butane/ ✓½ *2 – butane/ ✓½*
l – butane/ But-2-ene 2 - methyl
But-1-ene prop-1-ene

5. *a) 2.5*
b) Q Group 1 ✓½, Period 4 ✓½
R Group 2 ✓½, Period 3 ✓½

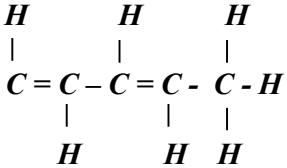
6. *a)*



7. *a) To produce simpler hydrocarbons of industrial importance e.g. ethane which is widely used*
b) Elevated temperature / high temperature 900 C
Catalyst
c) HC - C CH_3

8. *a) Reagent concentrated sulphuric acid*
Condition temperature 180^o C

9. *a) H_2 CHCL $CHCLCH_2CH_3$*
Name: 2, 3 dichloropentane
b) i) Structural Formula



ii) IUPAC name
pent – 1,3 – diene

10. *Isotopes are atoms of the same element with same atomic number but different mass numbers while isomers are compounds with the same molecular formula but different structural formula*

11. *Addition polymerization. ✓1*

12. *(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*

13. *$CH4 + 2O_{2(g)}$ ~~$CO_{2(g)}$~~ $2H_{2(l)}$*
$10cm^3$ $20cm^3$ $10cm^3$ ✓ ½

Volume of O_2 = $\frac{20}{100}$ x 150 ✓ ½

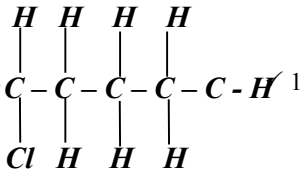
= 30cm³

Remaining volume of O_2 = 30-20=10cm³

Total volume of the gases = 20+10+10

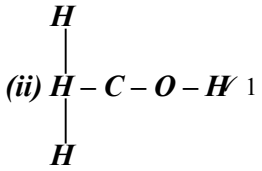
= 40cm³ ✓ ½

14. ***(i)***



✓ 1

(ii)



✓ 1

15.

T_2 = $\frac{690 \text{ X } 15 \text{ X } 259}{650 \text{ X } 105}$ ✓

= 39.3K ✓

= - 233.7°C ✓

16. ***$CH_2 = CH_{2g} + H_2SO_{4(L)}$ _____ $CH_3CH_2OSO_3H_{(aq)}$ ✓1 mark***

1 7 ***(a) i) Fractional Column.***

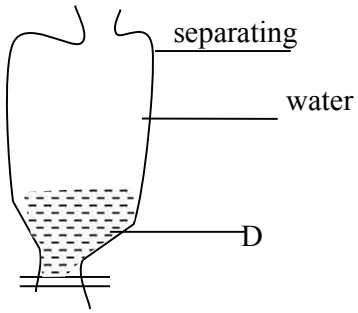
ii) fractional distillation.

iii)different boiling points.

IV I A II F III B

b) G – road making or water proofing

C jet fuel or cooking and lighting.



18. ***(i) ethyne*** ✓

(ii) Alkynes – because it has triple bond between the two carbon atoms

(iii) Water is calcium carbide

(iv) - Colourless, odourless ✓

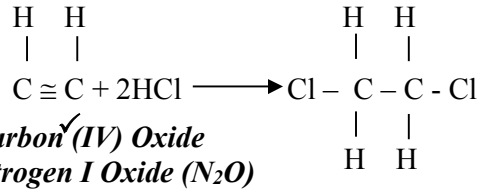
-less denser than air

- Insoluble in water but soluble in organic solvents ✓

(v) Hydrogenation

(vi) Halogenations

(vii)



(viii) Carbon (IV) Oxide ✓

(ix) Nitrogen I Oxide (N_2O)

19. ***(a) (i) Gas /vapour*** ✓1

(ii) B - It has the second lowest boiling point thus second lowest molecular mass ✓1

(iii) C is impure since it boils over a range of temperature ✓1

(iv) It is boiled heated and the vapour of the components condense at different temperatures ✓1

(v) - Liquid air ✓ 1

- Crude oil

20. (a) (i) Gas /vapour
(ii) B - It has the second lowest boiling point thus second lowest molecular mass ✓1
(iii) C is impure since it boils over a range of temperature ✓1
(iv) It is boiled heated and the vapour of the components condense at different temperatures ✓1
(v) - Liquid air ✓1
- Crude bil

21. a) i) Bitumen it has the highest boiling point
ii) Fractional distillation; during distillation petrol would distill off at 175C, while diesel will distill at 350C
iii) Each component is a mixture of hydrocarbons which have different boiling points
iv) Methane, CH_4, EthaneC_2H_6 propane, C_3H_8, Butane C_4H_{10}

b) i) Burning in limited amount of air will produce carbon monoxide (carbon (II) Oxide) which is poisonous
ii) Manufacture of Tar used in road tarmacking sealing of leakages on roofs

22. A. (i) Calcium carbide – CaC_2
(ii) Over water method
(iii) $CaC_{2(s)} + 2H_2O_{(s)} + 2H_2O_{(l)} \longrightarrow Ca(OH)_{2(aq)} + C_2H_{2(g)}$
(iv) $C_2H_2 + 2I_2 \longrightarrow C_2H_2I_2$
(v) The reaction if highly exothermic hence sand helps to absorb excess heat.

B. (i) A reaction in which an organism acid reacts with an alkanol to form a sweet smelling compound called ester.
(ii) $CH_3COOCH_3 + H_2O \longrightarrow CH_3COOH + CH_3OH$
(iii) Hydrolysis
C (i) F – Aluminium oxide – Al_2O_3
N – C_6H_{14} – Hexane
(ii) Cracking
D. A fuel

23. i) Cracking of crude oil fractions. ✓1
ii) Temp – 400 – 500^{0}c
Pressure – 200 – 500 atmospheric Any 2 = 1
Catalyst – Finally divided iron.
iii) $4NH_3(g) + 5O_2(g) \longrightarrow 4NO(g) + 6H_2O(l)$
iv) - Manufacture of nitrate fertilizers. ✓1
- Manufacture of explosives.
- Purification of metals.

b) - Red <u>brown gas</u> ✓1 with pungent irritating smell due to <u>reduction</u> of HNO_3 to NO_2
- Blue ✓1 solution due to formation of $Cu(NO_3)_2$

24. (a) (i) 2-bromo propene or 2- bromo prop-i-ene
(ii) Pent-i-ene
(b) (i) Changes form orange to Green
(ii) Effervescence//bubbles of gas produced
(c) Step 1
- Fermentation of glucose
Glucose broken down in obscene of oxygen using enzymes

- ***Dehydration of ethanol; using concentrated sulphuric (VI) acid and high temperature of 170^{o}C***

<u>Step II</u>

- ***Dehydration of ethanol; using concentrated sulphuric (VI) acid and high temperature of 170^{o}C***

(d) Compound A

(e) – release chlorine gas which destroy ozone layer

- Chlorine gas combines with vapour in atmosphere to form acid rain which destroy vegetation

- Chlorine gas can cause respiratory diseases

25. (a) (i) 2,2 – dimethyl pentane

(b) I carbon IV oxide.

II Hydrogen gas.

III Propane.

(ii) I Hydrogenation.

II Neutralization

III substitution

(iii) $CH_3CH_2CH_2Ol + 902_{(g)} \longrightarrow 6\ CO_{2\ (g)} + 8\ H_2O_{(l)}$

(iv) Condition Presence of U.u light

Reagents – Chlorine gas

(v) $CH_3CH_2\ CooH + NaoH \longrightarrow CH_3\ CH_2\ COONa + H_2O_{(c)}$

Mole ratio :

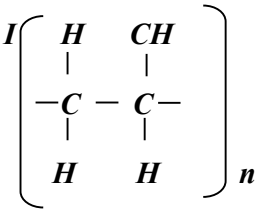
74 tones of acid 96 tones of salt

21.9 $\frac{21.9 \times 96}{74}$ = 28.4 tones

Or $\frac{21.9}{74}$ = 0.29 moles of salt

= 0.29 X 96 = 28.4 tones $\longrightarrow$

(iv) I



n

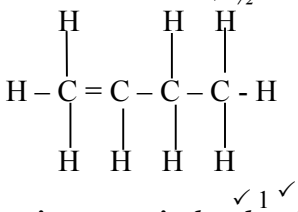
(ii) use in making – Plastic crates plastic boxes plastic ropes

(c) I (i) soap detergent

(ii) Soap less detergent

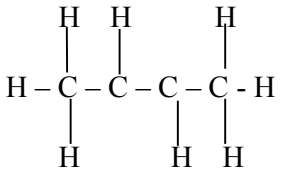
II Soap less Detergent - non biodegradable.

26. (i)



✓ ½ ✓1

But-i-ene Or (accept any 1)



✓ 1 ✓ 1

But-z-ene

✓ 1 ✓ 1

(ii) Bromine water is decolourised because X is unsaturated or has a (-C = C-) double bond.

(iii) $C_3H_{8(g)} + 5O_{2(g)} \longrightarrow 3CO_{2(g)} + 4H_2O_{(l)}$ ✓ 1

27. a) i) Propane

ii) But- 2 –yne

b) i) Ploythene

ii) Bubble pass ethane gas in acidified KMnO4 or acidified K2Cr2OT

c) i) CnH2n
ii) @5H10

d) i) Step I – hydrogen
Step II – Hydrogen chloride
Step IV – Sodalime

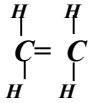
ii) 2CH = CH(g) + O2(g) _____ 4CO2(g) + 2H2O(L)

- *A fuel*
- *Manufacture of methanol*
- *Manufacture of methanol*

28. i) 2 – Methylprop – l ene √1 mark
ii) Pent – L – yne √1 mark [Total 12 marks]

29. The melting point increases from A to C this is due to increase in number delocalized electron hence increase in the strength of metallic bond.
D forms a giant structure with strong covalent bonds. Hence high melting.
It exhibits allstrophy ie may exist as two different form in the same state.
C2 (so4)3
Noble gases or inert
Used in filament bubls
Used to produce an inert atmosphere in high temperature inetallurgical processes e.g welding.
C is amphoteric oxide
F acidic it is non –metal oxide.

Ethene



Acidified potassium Manganate VI abromine water it from a colourless solution

$CH_2CH_2 + H_2 \longrightarrow CH_3CH_3$
Nickel catalyst

30. a) i) Bitumen it has the highest boiling point
ii) Fractional distillation; during distillation petrol would distill off at 175C, while diesel will distill at 350C
iii) Each component is a mixture of hydrocarbons which have different boiling points
iv) Methane, CH_4, EthaneC_2H_6 propane, C_3H_8, Butane C_4H_{10}

b) i) Burning in limited amount of air will produce carbon monoxide (carbon (II) Oxide) which is poisonous
ii) Manufacture of Tar used in road tarmacking sealing of leakages on roofs

31. i) C_nH_{2n}, where n = No. of carbon atoms
ii) 70
iii) C_sH_{10}, $CH_3CH=CHCH_2CH_3$
OR $CH_3CH_2CHCH_2= CH_2$

32. (a) Hydrocarbon. √1

(b) Black specks is carbon
Colourless gas is steam } *√1* *3*
Hydrocarbon burn in air to form carbon √½ and water √½

33. $NaCl_{(aq)}\ AgNO_{3(aq)} \longrightarrow NaNO_{3(aq)} + AgCl_{(s)}$
Moles of AgCl= Mass / R.F.M
= 2.36 / 143.5
= 0.016446moles ✓ ½
Mole ratio Nacl: AgCl
1 :1 ✓ ½
Moles of NCl = 0.61446moles
Mass of NaCl = RFM x moles
= 58.5 x 0.016446
= 0.962091g ✓ ½
Mass of solvent (water) = 2.63 – 0.962091
= 1.667909g ✓ ½
1.667909g of water dissolves 0.962091g of NaCl
100g of water dissolves = 100 x 0.962091g / 1.667909
= 57.68/100g of water ✓ ½

33. $24000cm^3 = 1mol$
$80cm^3 = \frac{80x1}{2400}$ ✓ 1
= 0.00333moles ✓ 1

34.. *(i)* $CH_3CH = CHCH_3$ *– But-z-ene*
(ii) $CH_3C(CH_3) = CH_2$ *; 2– methyl 1 prop-I-ene*
(iii) $CH_2 = CHCH_2CH_3$ *– But-I-ene*

35. *(a) Octane*
or $CH_3CH_2CH_2CH_2CH_2CH_2CH_2CH_3$ ✓½

36. *a) Existence of same molecular formula but different structural formula √1*
b) i)

Nitrogen and its compounds

1. *(i)* $4HN_3\ (g) + 5O_{2\ (g)}\ 4NO_{(g)} + 6H_2O_{(g)}$
(ii) Act as catalyst
(iii) $Zn(NH_3)_4^{2+}$

2. *a) Platinum/ copper*

b) Brown fumes ✓
Hot rod m continues to glow red
- NO formed reacts with oxygen to form NO_2 (brown flames)
- Reaction highly exothermic

3. a) Calcium hydroxide
b) $Ca(OH)_{2(g)} + 2NH_4CL_{(g)} \_\_\_\_\_ 2NH_{3(g)} + CaCL_2 + 2H_2O_{(L)}$

4. (a) It neutralizes air to prevent violent combustion reaction from occurring.
(b) Its inert and have very low b.pt of -196^oC
*MAT

5. a) X is Nitrogen. ✓1
b) It is less dense than air. ✓½
c) – In preservation of semen in artificial insemination. ✓1

6. a) (i) Solution A contains $Pb^{2+}(aq)$ ions ✓½
(ii) Solution B contains $Al^{3+}(aq)$ ions. ✓½
b) – A colourless liquid at cooler parts ✓1 of test-tube is formed.
- A white reside remains in the test-tube. ✓1

7. a) to expel air that is in the combustion tube so that oxygen in it does not react with hot copper✓1
b)brown✓½ copper metal will change to black✓½
c)nitrogen ✓1

8. (a) To increase the surface area over which the reaction occurs hence increased rate of reaction. ✓1
(b) NH_3 is basic and reacts with some moles of the acid hence reduction in concentration ✓1

9. (a) (i) The solution changes from <u>green</u> ✓1 to <u>brown</u> ✓1 (1 mk)
(ii) A brown ✓1 precipitate is formed. (1 mk)
(b) $Fe^{3+}_{(aq)} + 3OH^-_{(aq)} \longrightarrow Fe(OH)_{3(s)}$ ✓1 (1 mk)
} 3

10. (a) – Absorbs carbon (IV) oxide from ✓1 the air. (1 mk)
(b) $2\,Cu_{(s)} + O_2 \longrightarrow 2CuO_{(s)}$ ✓1 (1 mk)
(c) Because it has the rare gases. ✓1 (1 mk)
} 3

11. (a) Anion – CO_3
Cation – Cu^{2+}
(b) $Cu^{2+} + 4NH_3 \longrightarrow \{CuNH_3)_4\}^{2+}$

12. (a) (i) $NH_4NO_{3\,(s)} \longrightarrow N_2O_{(g)} + 2H_2O_{(g)}$
(ii) NH_4NO_3 should not be heated further if the quantity remaining is small because it may explode
or A mixture of NH_4Cl & KNO_3 can be used instead of NH_4NO_3 leading to double decomposition taking place safely without explosion
(iii) An hydrous calcium chloride in a u-tube ✓
(iv) Reacts with oxygen to form brown fumes of Nitrogen (IV) Oxide
$2N_2O_{(g)} + O_{2(g)} \longrightarrow 2NO_{2(g)}$
(v) – Has no colour ✓
- Has a slight sweet smell
- Fairly soluble in water ✓
- Denser than air ✓

(b) (i) Provides a large surface area for the absorption of ammonia gas by the water or prevent "bricking" back of water ✓

(ii) Water would brick back into the hot preparation flask causing it to crack or break /an explosion can occur ✓

(iii) Red litmus paper would turn to blue, blue litmus paper remains blue each ✓

13. (a) B – ammonia gas ✓1
C - nitrogen (II) oxide (NO) ✓1
E – water ✓1
F – unreacted gases ✓1

(b) The mixture of ammonia and air is passed through heated/ catalyst where ammonia (II) is oxidized to nitrogen (II) oxide. ✓1

(c) Gases are cooled and air passed through heated/ catalyst where ammonia is further oxidized to nitrogen(IV) oxide. ✓1

(d) Fractional distillation, ✓½
Water with a lower boiling point ✓½ than nitric (V) acid, distills left leaving the concentrates acid.

14. a)i) Fractional distillation
ii) Argon

b) A Sulphur
B Ammonia gas
C Oteum
D Amonium sulphate

c) i) Finely divided iron
ii) Vanadium (v) Oxide

d) Speeds up the rate of reaction by lowering the activation energy

e) $2NH_{3(g)} + H_2SO_{4(aq)}$ _____ $(NH_4)2SO_{4(aq)}$
f) R.M.M of (NH_4) = 132
Mass of N = 28
% N = $^{28}/_{132}$ x 100 = 21.212%

g) Used as a fertilizer

15. (a) (i) Fused calcium chloride /Cao (quick lime)
(ii) To remove carbon (IV) Oxide ✓1
(iii) $4Fe^{+}_{(s)} + 3O_{2(g)} \longrightarrow 3Fe_2O_{3(s)}$
OR $3Fe_{(s)} + 2O_{2(g)} \longrightarrow Fe_3O_{4(s)}$ ✓1
(iv) Argon/Helium/Neon/Krepton ✓1
(v) Provide very low temperature so that the semen does not decompose /is not destroyed
(b) (i) Concentrated sulphuric acid ✓1
(ii) $NaNO_{3(s)} + H_2SO_{4(l)} \longrightarrow Na_2HSO_{4(aq)} + HNO_{3(aq)}$ ✓1
OR $2NaNO_3 + H_2SO_{4(l)} \longrightarrow Na_2SO4 + 2HNO_3$
(reject unbalanced chemical equation)

✓ 1

(b) Copper reacts with 50% nitric acid to give nitrogen II Oxide which is colourless. Air oxidizes

Nitrogen II oxide to Nitrogen IV oxide which is brown.

$2NO_{(g)} + O_2 \longrightarrow 2NO_{2(g)}$ 1

colourless *Brown*

16. (a) (i) Nitrogen – Fractional distillation of liquid air –(½ mk)

Hydrogen – Cracking of alkanes

-Electrolysis of acidified water

(ii) Temperature – 400°C – 500°C

Pressure – 400atm – 500atm

Catalyst – kinely divided iron

(iii) Catalyst P – Nickel

Gas M – Nitrogen IV oxide

(iv) (a) $2NO_{(g)} + O_{2(g)} \rightarrow 2NO_{2(g)}$

(b) $NO_{2(g)} + H_2O_{(l)} \longrightarrow HNO_{2(aq)} + HNO_{3(aq)}$

(v) To a small portion of the nitrate liquid in a test tube add equal amount o freshly prepared iron (II) sulphate followed by some drops of conc. H_2SO_4 *slowly on the sides. If a brown ring forms on the boundary of the two solutions, a nitrate is confirmed.*

(vii) – Manufacture of nitrogenous fertilizers

- *Manufacture of synthetic fibres e.g nylon*
- *Manufacture of explosives e.g TNT*
- *Manufacture of textile dyes*
- *Manufacture of other acids e.g. phosphoric acid*

17. (a) (i) Nitrogen (I) Oxides.

Rej. Dinitrogen oxides.

(ii) $NH_4NO_{3(s)} \longrightarrow N_2O_{(g)} + 2H_2O_{(g)}$

(iii) The gas is soluble in cold water.

(iv) An irritating choking smell of a gas.

(b) (i) Platinum wire.

(ii) $4NH_{3(g)} + 5O_{2(g)} \longrightarrow 4NO_{(g)} + 6H_2O_{(g)}$

$2NO_{(g)} + O_2 \rightleftharpoons 2NO_{2(g)}$

(iii)

Nitrogen (I) Oxide	*Nitrogen (IV) Oxide.*
Colourless.	*Reddish brown.*
Relights a glowing splint.	*Extinguishes a glowing splint.*
Has a sweet smell.	*Irritating pungent smell.*
Fairly soluble in water.	*Readily soluble in water.*

(Accept any 1 correct comparative)

(c) (i) It corrodes/reacts with rubber and cork.

(ii) I) <u>Oxidized</u> : Sulphur /S

<u>Reduced:</u> Nitric (V) acid / $HNO_{(aq)}$

II) It decomposes by heat into NO_2 *which dissolves in the acid.*

18. a) Pass air through purifiers to remove dust particles by electrostatic precipitation. Then pass it through conc. Sodium Hydroxide to absorb CO2. Then through condensers at 25C to

remove water vapour. It is further cooled to liquefy it. The liquefied air is then fractionally distilled to obtain oxygen at – 183C

b) i) X – Ammonia// NH_3
Y- Air

ii) $4NO_{2(g)} + 2H_2O_{(s)} + O_{2(g)}$ _____ $4HNO_{3(aq)}$
Accept
$2NO_{2(g)} + H_2O_{(l)}$ _____ $HNO_{3(aq)} + HNO_{2(aq)}$
$2HNO_{2(aq)} + O_{2(g)}$ _____ $2HNO_{3(aq)}$

iii) Through fractional distillation

iv) $HNO_{3(aq)} + NH_{3(g)}$ _____ $NH4ND_{3(aq)}$
RMM of $NH_3 = 17$ RFM of $NH_4NO_3 = 80$
If 80g NH_4NO_3 _____ 17 g
960000 _____ $\frac{960000}{80 \times 1000} \times 17 = 2040kg$

19. (a) Potassium hydroxide solution
(b) To remove dust particles
(c) Water vapour Moisture
(d) -183°C
(e) Fractional distillation of liquid air
(f) Liquid air and passed through fractionating column, where nitrogen with lowest B.P -196°C distils out first and liquid oxygen with highest distil out last.
(g) Nitrogen in liquid form is used as a refrigerant e.g. in storing semen for artificial insemination
- Used as a raw material in Haber process e.t.c
II. Air is a mixture because:
- *It contains gases which are not chemically combined*
- *- The gases are not in fixed ratios.*

20. $HOCL_{(aq)} + Dye$ _____ $HCL_{(aq)} + [Dye + O]$
Coloured Colourless ✓

$H_2SO_{3(aq)} + [Dye + O]$ _____ $H_2SO_{4(aq)} + Dye$
Coloured Colourless

21. a) Drying agent ✓ ½ which must be CaO
Method of collection ✓- upward delivery
Workabillity ✓ ½

b) $2NH_4CL_{(g)} + Ca(OH)_{2(g)}$ _____ $CaCL_{2(g)} + H_2O_{(l)} + 2NH_{3(g)}$ ✓

22. a) Heat
b) $Cu_{(g)} + N_2O_{(g)}$ _____ $CuO_{(g)} + N2_{(g)}$
c) - Manufacture of ammonia
- In light bulbs
- As a refrigerant

23. – At 113°C consists of S_8 rings that flow easily;

- Darkens due to breaking of S_8 rings and forming long chains consisting of thousands of atoms. The chains also entangle;
- The long chains consisting of thousands of atoms. The chains also entangle;
- The long chains break near b.p. to form shorter one;

24. *Difference is at the cathode electrode where in concentrated sodium chloride sodium is deposited while in dilute sodium chloride, hydrogen is liberated, because*

25. *(i) $2N_2O_{(g)} + C_{(s)} \longrightarrow Co_{2(g)} + 2N_{2(g)}$*
(ii) Ammonium chloride and sodium nitrate
(iii) The hydroxide ions ✓1 (Ammonia dissolves forming ammonia hydroxide.(1 mk)

26. *(a) E - Ammonium chloride (½ mk)*
F – Aluminium hydroxide (½ mk)
(b) $Al_3+ + 3OH^-_{(aq)} \longrightarrow AL(OH)_{3(s)}$

27.
a) Zinc hydroxide
b) [Zn (NH3)4] 2+
c) $Zn^{2+}_{(aq)} + 2OH_{(aq)}$ _____ $Zn(OH)_{2(s)}$

28. *a) Plantinum/platinum Rhodium ✓1*
b) $4NH_3(g) + 5O_2(g) \longrightarrow 4NO(g)$ ✓1 $+ 6H_2O(l)$
c) – Fertilizers ✓1
- Preparation of Nitrogen (I) oxide.
- Explosives

29. *Blue ppt ✓1 is formed which dissolves in excess to form a deep blue ✓1 solution due to formation of tetra amine Copper (II) ions*

30. *(a) - Finely divided iron impregnated by alumina (Al_2O_3)*
- 200 atmosphere pressure
- Temperature of 450^oC ✓ ½

b) - CuO is reduced to Copper metal
- NH_3 is oxidized to water and nitrogen

31. *(a) Colour of copper (II) Oxide changes from black to brown*
(b) (i) Nitrogen /$N_{2(g)}$
(ii) Water/$H_2O_{(l)}$

5. Sulphur and its compounds

1. *(a) Frasch process*
(b) Hot compressed air
(c) Monoclinic / prismatic sulphur /beta sulphur✓
Rhombic/octahedral sulphur /alpha sulphur✓

2. *(a) RFM of H_2SO_3 = 98 (no units)*
Number of moles of $H_2SO_4 = \frac{1.8}{98}$
= 0.01837moles

Molarity of H_2SO_4 = $\frac{0.01837 \times 1000}{1}$

= 18.37M ✓ ½

(b) Apply formular; M conc. X Vol conc. = Mdil. x Vdil.

18.37 x V conc: = 0.2 x 500 ⟹ Vconc. = $\frac{0.2 \times 500}{18.37}$

= 5.44cm^3 of conc. H_2SO_4

3. ***(a) By dissolving in water***
   (b) – Manufacture of fertilizers
   - Manufacture of detergents
   - Cleaning of metal surfaces
   - As an electrolyte in car batteries
   - In refining of petroleum
   - Manufacture of synthetic fibre (e.g. rayon)
   - Manufactures of paints, dyes and explosives (award 1mk any one)

4. ***Chlorine bleaches permanently by oxidation ✓1 while sulphur (IV) oxide bleaches temporary by eduction. ✓1***

5. ***(i) Weak acid ✓1***
   (ii) Has few free H^+ (Hydrogen) ions

6. ***a) Vanadium (v) oxide V_2O_S √ ½***

   b) $2SO_{2\,(g)} + O_{2\,(g)}$ _____ $2SO_{3\,(g)}$ √ ½

   c) $SO_{3\,(g)} + H_2SO_{4\,(l)}$ _____ $H_2S_2O_{7\,(l)}$

   $H_2S_2O_{7(L)} + H_2O_{(L)}$ _____ $H_2SO_{4(l)}$

   Student must explain Explanation 1 mark

7. ***– Concentrated sulphuric acid <u>oxidizes copper turnings</u> to <u>copper(II) oxide black</u> solid,SO_2 gas and water. ½ mk***
   - Then copper (II) <u>oxide reacts excess conc. sulphuric acid</u> to produce copper (II) sulphate mk
   - Which is <u>dehydrated by conc.</u> Sulphuric acid to an <u>hydrous copper (II) sulphate</u> white solid 1½ Which dissolves in water to produce blue solution

8. ***a) Method of collection is wrong. √½ Should be collected by downward delivery/upward displacement of air √½ since the gas is denser than air.***

   b) $Na_2SO_3(s) + H_2SO_4(aq) \longrightarrow Na_2SO_4(aq) + SO_2(g) + H_2O(l)$ √1

   c) By passing it through calcium hydroxide in which the gas dissolves. √1

9. ***a) Dirty grey solids are formed. √1***

   b) $FeS_{(s)} + 2HCl_{(aq)} \longrightarrow FeCl_{2(aq)}$ √1 $+ H_2S_{(g)}$

   c) Iron powder has high surface area hence the reaction is none vigorous than iron fillings with low surface area.

10. ***a)a sulphate e.g. sodium sulphate√1***
    b)moist blue litmus paper turns to red✓½ then after some minutes to white✓½ .it is bleached by

sulphur(iv)oxide

$SO_{2(g)} + H_2O_{(l)} + Dye \longrightarrow H_2SO_{4(aq)} + (Dye\text{-}o)$ ✓1

(litmus) *(white)*

11. (a) – Flexible/elastic ✓1
- Strong and tough ✓1
- Non-sticky ✓1 (any two)

(b) Molten sulphur would have lost heat to the surrounding ✓½ hence solidify/ in the middle pipe ✓½ sulphur cannot solidify since hot air in the inner pipe and hot water in the outer pipe mountains high temperature. ✓1

12. (a) It dissolves in water releasing ✓1 a lot of heat which boils the acid which can easily be spilt to the body. ✓1 (2 mks)

(b) - It is used in manufacture ✓1 of batteries/acid accumulators. Any one
- Manufacture of soap, plastics, detergents. } 3

13. (a) Deposits of a yellow solid; and droplets of colourless liquid;

(b) $2H_2S_{(aq)} + SO_{(g)} \longrightarrow 2H_2O_{(l)} + 3S_{(s)}$

(c) Oxidizing agent

14. (a) A – takes in hot compressed air to force out molten sulphur to the surface.
B - takes out molten sulphur.
C – takes in super heated water to melt the sulphur.

(b) Rhombic, Monoclinic

(c) $S(s) + O_2(g) \longrightarrow SO_2(g)$

(d) Iron (II) sulphide.

(e) – Vulcanization of rubber.
- Making chemicals
- Manufacture of matches and fire works.

(f) (i) $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$

(ii) 24 dm^3 of SO_2 = 1 mole

$$6.0\ dm^3 \left(\frac{1\ mol \times 6\ dm^3}{24\ dm^3} \right) \checkmark ½ = 0.25\ mole \checkmark ½$$

From the equation :-

Moles of O_2 used = $\frac{0.25}{2}$ ✓½ = 0.125 moles ✓½

(iii) 1 mole of O_2 = 0.125

$$0.25\ mole = \left(\frac{24\ dm^3 \times 0.125\ mol}{1\ mol} \right) \checkmark 1$$

$= 3.\ dm^3$ ✓1

15. i) X – Rhombic ✓½

Y – Monoclinic ✓½

ii) I) Mg has a higher √1 √1 affinity for combined oxygen than S.

II) Add √1 dilute nitric acid to the mixture. It reacts with MgO √1 to form $Mg(NO_3)_2$

Filter √1 to obtain S as residue.

16. (a) (i) – Rhombic sulphur (½ mk)

(ii) Sulphur is heated until it boils. The boiling liquid sulphur is then poured into a beaker containing water to form plastic sulphur (½ mk)

(a)

() – sulphur (½ mk)

- Iron (II) Sulphide (Iron pyrites)
- Zinc sulphide (Zinc blend)
- Dust or Arsenic compounds (½ mk)

(c) – Avoid poisoning of the catalyst (Avoid destruction of catalytic properties by impurities)

(d) $2SO_{2(g)} + O_{2(g)} \rightarrow 2SO_{3(g)}$

(e) (I) – Vanadinim (V) Oxide (½ mk)

(II) - Heat incoming air (SO_2 & Air)

- Cools the SO_3

(III) - The reaction between SO_2 and water is highly exothermic which makes the solution boil to form a mist of dilute sulphuric (VI) acid which pollutes the environment

(g) I. – SO_2

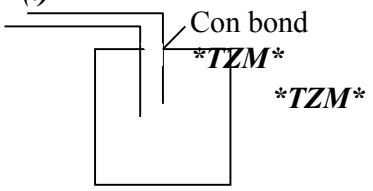
II- Un reacted SO_2 is recycled

- Absorbed by $Ca(OH)_2$ in tall chimneys

- Passed over hot carbon (IV) Oxide and sulphur which is recycled and Carbon (IV) Oxide released to the environment

(h) Manufacture of fertilizers

17. a) (i)



(ii) I ion II sulphide or copper II Sulphur

II anhydrous Calcium Chloride (zero of Calcium chloride)

III $Fe\ s_{(l)} + Hcl_{(aq)} \rightarrow Fecl_{2(aq)} + H_2s$

b) Fe^{3+} is reduced or Fe^{2+} or $Fe^{2+}_{(aq)}$ ions and formed

H_2S is oxidized to sulphur on sulphur is formed.

c) (i) Vanadium V oxide or platinised asbestos

(ii) I. The yield of SO_3 increase because increase in pressure favour the forward reaction since less number of SO_3

II. The yield of SO_3 is the same because catalyst only speeds the rate at which equibrium.

(iii) Exothermic reaction occurs. When dissolved in water produce acid spray (fumes) cause pollution.

18 (a) (i) Red-brown fumes

(ii) It is not an oxidizing agent

(iii) $S_{(s)} + 6HNO_{3(l)} \rightarrow 2H_2O_{(l)} + 6NO_{2(g)} + H_2SO_{4(l)}$

(iv) Neutralization

(v) Sulphuric acid
(vi) Forms acid rain / plant + yellowing corrodes metallic and stone works

19. a) i) They are different physical/ structural forms of an element

ii) Trausition temperature

b) i) X - Diluter
Y- Heat exchanger
Z- Roaster/ Burner

ii) Catalyst- Vanadium (v) Oxide, V_2O_5
Temperature – 450C
Pressure – 1 atmosphere

iii) I - They are purified not to poison the catalyst
II - The reaction in the convertor/ production of sulphur (vi) Oxide is exothermic/ heat is produced. Chamber Y is used to ensure temperature does not rise above 450^oC

iv) Step 2: $250_{2(g)} + O_{2(g)}$ _____ $250_{3(g)}$ √1 mark
Step 3: $50_{3(g)} + H_2SO_{4(L)}$ _____ $H_25_2O_{7(l}$ √1 mark
Step 4: $H_2S_2O_{7(L)} + H_2O_{(L)}$_____ $2H_2SO_{4(L)}$ √1 mark

20. - Test tube L- Acidified $KMnO_4$ changed from purple to colourless (it is decolourized) – SO_2 is a reducing agent. ✓1
- Test tube K $Hal^+/KMnO4$ was not decoloured – SO_2 was absorbed by ash solution hence did not reach the $H^+/KMnO_4$. ✓1 ✓1

21. a) Metal sulphide
b) Hydrogen sulphide is less soluble in warm water compared to cold water

22. SO_2 form acidic when it dissolves in atmospheric moisture. The acidic rain lowers soil PH/ corrodes stone building
No – disrupts the Ozone cycle hence causing depletion of Ozone layer which react with oxygen in the atmosphere to form NO_2 gas

23. a) The solution changed from brown/yellow ✓½ to light/pale green ✓½
b) $2FeCl(aq) + H_2S(g) \longrightarrow 2FeCl_2(aq) + 2HCl(aq) + S(s)$ ✓1 mk
c) Oxidation. ✓1 mk

24. Barium carbonate reacts with dilute sulphuric (VI) acid to form the insoluble Barium sulphate ($BaSO_4$) which covers the reactant. ✓ Barium Carbonate preventing any contact between the acid and the Carbonate salt.
Hence, the reaction is slow and stops after a very short time.
$BaCO_{3(s)} = H_2SO_{4(aq)}$ $BaSO_{4(s)} + CO_{2(g)} + H_2O_{(l)}$

Chlorine and its compounds

1. (i) It catches fine or presence white fumes
(ii) PCl_3 // Phosphorous Trichloride ✓
(iii) PCl_5 // Phosphorous Pentachloride ✓

2. (a) - In water hydrogen chloride dissociates to form hydrogen (H+) and chloride (Cl-) ions.
- The presence of H^+ ions in aqueous solution of hydrogen chloride is responsible for acidic properties which turns blue litmus paper red

(b) – To increase the surface area for the dissolution of the gas
- Prevent suck back (Award full 1mk for any one given)

3. *a) – Refrigeration ✓1*
- Maintains pressure in aerosol cans and enables sprays tobe sprayed in liquid form
b) – They deplete the ozone layer. ✓1
- They cause green house effect/Global warming.

4. *a) Acidify water with nitric acid ✓½. Add aqueous lead nitrate/$AgNO_3$ ✓½*
Formation of a white ppt. Show presence of Cl^{-1} white ppt of $PbCl_2$ or AgCl formed.

5. *a) Yellow solid deposit of sulphur on the wall of boiling tube*

b) $H_2S_{(g)} + CL_{2\,g}$ _____ $2\,HCl_{(g)} + S_{(s)}$

c) - Done in fume chamber/ open air
-Poisonous gases

6. *i) $2Fe_{(S)} + 3Cl_{2(g)}$ _____ $2\,FeCL_{3(g)}$*
$Fe_{(s)} + 2HCl_{(g)}$ _____ $FeCL_{2(g)} + H_{2(g)}$
N.B Must be balanced
State symbol must be correct
Chemical symbols must be correct

ii) In the absence of moisture, chlorine cannot form the acidic solution, hence no effect on the blue litmus paper

7 *a) Heat is necessary * REJECT high temperature ACCEPT, BOIL or if implied*
- *MnO_2 is a weak oxidizing agent.*

b) $Cl_2O_{(g)} + H_2O_{(l)} \longrightarrow 2HOCl_{(aq)}$ C.A.O

8. *(a) Chlorine gas*
(b) $HCl_{(aq)} + MnO_2 \longrightarrow MnCl_{2(aq)} + Cl_{2(g)} + 2H_{2(g)}$
(c) The petals turn to white due to the bleaching effect of NaOCl(sodium hypochlorite)

10. *(a) (i) $MnO_{2\,(s)} + 4HCl_{(l)} \longrightarrow MnCl_{2(aq)} + 2H_2O + Cl_{2(g)}$*
Penalize ½mk if state symbols are not correct
✓1 *(ii) $KMnO_4$ or PbO_2* ✓1
n (iii) The Chloride gas can be dried by passing it through a wash-bottle of concentrated ✓1
sulphuric acid and is then collected by downward delivery. ✓1 ✓1

(b)(i) A- Aluminium (III) Chloride
(ii) $2Al_{(s)} + 3Cl_{2(g)} \longrightarrow 2AlCl_{3(s)}$ ✓1
Penalize ½mk for wrong state symbols
(iii) Moles A_1 used from the equation in b(ii)
= $\frac{0.84}{27}$ = 0.031Moles ✓½
Moles of Cl_2 used = $\frac{0.031}{2} \times 3 = 0.047$
Mark consequently from the equation

11. *(a) $Cl_{2(g)} + H_2S_{(g)} \longrightarrow HCl_{(g)} + S_{(s)}$*
(b) Yellow solid particles deposited in the flask ✓½
(c) Excess chlorine and hydrogen sulphide gas should not be emitted into the atmosphere because they are pollutants /harmful ✓½

12. (a) Chlorine gas

(b) (i) Remove traces of hydrogen chloride gas
(ii) Drying agent

13. (a) Fe^{3+}
(b) It is an oxidizing agent ✓
(c) $2Fe(OH)_{3\,(s)} \longrightarrow Fe_2O_{3\,(s)} + 3H_2O_{(l)}$ ✓

14. (i) Anhydrous Calcium Chloride (½mks)
(ii) A white ppt is formed
HCl gas forms Cl^- ions solution which react with silver ions to form silver Chloride which is insoluble OR
$Hcl_{(aq)} + AgNO_{3\,(aq)} \longrightarrow HNO_{3(aq)} = AgCl_{(s)}$
$Cl^-_{(aq)} + Ag^+_{(aq)}$ ✓ $AgCl_{(s)}$

Acids, bases and salts

1. (a) Proton donor/electron acceptor/a substance which when dissolved in water dissociates/break to hydrogen ions as the only positive ion. ✓
(b) Water/ H_2O
(c) It is a proton donor/electron acceptor

2. (i) Ethylbutanoate
(ii) $CH_3CH_2CH_2$ $C - O - CH_2 - CH_3$ (||O)
(iii) Esters

3. (a) Temporary water hardness . This is because hardness is removed by boiling
(b) - Provide Ca^{2+} ions needed in formation of strong teeth and bones
- Hard water form a layer of carbonate of lead which prevent water coming in contact with lead which cause poisoning (award 1mk for any one) ✓½

4. Let x be the mass of FeSO4 crystals in saturated solution
∴ Mass of water = 45 – x ✓½ ✓½
X g of $FeSO_4$ dissolves in (45-x)g of water
$\underline{100x}$ of $FeSO_4$ dissolves in 100g of water
45 - x
So, solubility is $\underline{100x}$ = 15.65 ✓½
45 – x
100x = 15.56 (45 – x)
100x + 15.65x = 15.65 x 45
115.65x = 15.65 x 45
x = $\underline{15.65 \times 45}$ ✓½
115.65
= 6.0895
So solubility = 6.09g of $FeSO_4$ in 100g of water

5 . (a) $Ca(HCO_3)_{2(aq)} \longrightarrow CaCO_{3(s)} + CO_2 + H_2O_{(l)}$
or:- $Mg(HCO_3) \xrightarrow{\text{heat}} MgCO_{3(s)} + CO_{2(g)} + H_2O_{(s)}$ (award 1mk for any)

(b) - Addition of $Na_2CO_3(s)$
- Addition of $Ca(OH)_2(s)$
- Addition of aqueous ammonia (award 1mk each for any two; Total =2mks)

6. – Provides essential minerals e.g. Ca^{2+} for strong bornes and teeth ✓1
- It has a better taste

7. a) The acid is water H_2O
Reason H_2O has donated a proton (H+)
b) $2H^+_{(g)} + CO_3^{2-}{}_{(aq)} \_\_\_\_\_ CO_{2(g)} + H_2O_{(l)}$

8. Magnesium carbonate reacts w ith rain water

- ***Containing caborn (iv) oxide dissolved.***
- ***Forming magnesuin hydrogencarbonate***
- ***Or $MgCO_{3(s)} + CO_{2(g)} + H_2O_{(l)} + Mg(HCO_3)_{2\,(aq)}$***

9. (a) Lead ions ✓ 1
(b) Lead (II) hydroxide ✓ 1
(c) $[Pb(OH)_4]^{2-}$ ✓ 1

10. a) Solubility of a salt is mass of a salt that dissolves in 100g of water at a given temperature. ✓1
b) Mass of Q that crystallizes out = 19.0 – 7.4 ✓½ ***= 11.6 g.***
Mass of R that crystallizes out = 33 – 20.7 ✓½ ***= 12.3g.***
Total mass of crystals = 12.3 + 11.6 ✓½ ***= 23.9g*** ✓½

11. Mass of dry salt = 16.86 – 15.86 ✓½
= 1.00g ✓½
Mass of water = 26.86 – 16.86 = 10g ✓½
Mass of salt in 60g of water = $\frac{60x1}{10}$ = 6 g ✓½

12. (a) This is the maximum mass of a salt that will dissolve in 100g of water of a given temperature
(b) 15g dissolve in 25cm^3 water
? dissolve in 2100cm^3 water
= $\frac{15 \times 100}{25}$ = 60g/100gwater
(c) (i) in graph paper
(ii) Every point on the solubility curve is a saturated point of a solution which contains a maximum amount of salt X at a graph temperature
(iii) I 16g ✓
II 25g ✓
(iv) 25 – 16 = 9g/100g water ✓
(v) - Extraction of Na_2co_3 from Lake Magadi
- Extraction of Nacl from sea water ✓

13. Add Methyl benzene to the mixture and stir to dissolve iodine. Filter and crystallize the filtrate to obtain sodium chloride crystals.

14. (a) (ii) 72g /100g water ± 1.0
(iii) 100cm^3 dissolve 72g
1000cm^3 dissolve = $\frac{1000 \times 72}{100}$ ✓½
= 720g/l ✓ ½
$KClO_3 = 39 + 35.5 + 3 \times 16 = 122.5$
molarity = $\frac{720g/l}{122.5gmol^{-1}}$ ✓ ½
= 5.878mol/l ✓ ½
(iv) Mass dissolved at 62^o = 116g
Mass dissolved at 42^o= 66g ✓ ½ ✓1
mass crystallized out = 50g

(b) (i) $\frac{25 \times 0.2M}{1000}$ = 0.005mol ✓ ½
(ii) 0.005mol (mole ration Acid: Base = 1:1)

(iii) $20cm^3$ contain 0.005mol ✓½

$25cm^3$ contain = $\frac{(250cm^3 \times 0.005mol)}{20cm^3}$ ✓½

= 0.0625mol

(iv) Mass = ($0.0625 \times 40gmol^{-1}$) = 2.5g ✓1

(v) Mass of solvent = 28g – 2.5g = 25.5g ✓1 ✓1

solubility = $\frac{(100 \times 2.5)}{25.5}$ ½

= 9.804g/100g water ✓½

15. *a) Solubility refers to the maximum mass of solute dissolving in a 100g of a solvent at a particular temperature*

b) i) Fractional crystallization

ii) Scale = 1 mk
Plotting = 1 mk
Curve L = 1 mk
Curve M = 1 mk

iii) I = Actual value from students curve + 1C
II = Actual value from students curve + 1

iv) Mass per litre = $\frac{1000 \text{ X Actual value in iii (II)}}{100}$

Concentration = $\frac{\text{Above answer}}{132}$

= _____ M

16. *(a) (i) Conductivity decreases wince H^+ ions form he acid are neutralized by OH^- ions from the base. This reduces the concentration of ions available for conductivity.*

(ii) Conductivity increases since the OH^- ions accumulate after complete neutralization of the acid OH^- increases conductivity.

(iii) Neutralization leads to the formation of a slat. The ions in the salt are responsible for conducting of electricity.

(iv) They yield different concentration of H^+ ions
For HNO_3 – dissociates completely hence more H^+ ions
HCOOH – dissociates partially hence less H^+ ions

(b) $2HCOOH_{(aq)} + Na_2CO_{3(aq)} \longrightarrow 2HCOONa_{(aq)} + H_2O_{(l)} + CO_{2(g)}$

moles of HCOOH = $\frac{50}{1000} \times 0.1$
= 0.005moles

mole ration acid : base
2 : 1

moles of Na_2CO_3 = $\frac{0.005}{2}$
= 0.0025

Molarity of Na_2CO_3 = $\frac{0.0025 \times 1000}{20}$
= 0.125M

17. *a) i) I) Heating √1*

II) Filtration. √1

ii) Effervescence √1 / Bubles.

iii) $Zn^{2+}(aq) + 2OH^{-}(aq) \longrightarrow Zn(OH)_2(s)$ √1

iv) Pass the water vapour over white anhydrous √1 Copper (II) suplhate. It turns blue. √½

b) i) R is a mixture of sulphur √½ and insoluble √½ salt. It forms √1 a filtrate and residue in filtration of mixture

ii) Carbonate √1 / CO_3^{2-} √1
It produces CO_2 on reaction with H^+

iii) Zn^{2+} √1 Al^{3+} √1

18. a) The quantity of a substance in grammes that can dissolve in 100g of water at a given temperature

b) i) Fractioned crystallization
ii)
iii)
I 26C
II 18g

iv) 1 mole of salt M _____ 132g
$^{18x1}/_{132}$ = 0.13863636 moles
Concentration = $\frac{1000 \times 0.13863636}{100}$
= 1.386M

v) L = 20g M= 19g
38-20=18
22-19= 3+
Total 21 g

19. (a) (i) A saturated solution is one which cannot dissolve more solute at that particular temperature.
✓1 *(1 mk)*

(ii) Solubility of a soluble is the amount of grams of solute present in 100g of water at that particular temperature. ✓1 *(1 mk)*

(b) (i) Mole = M x $\frac{V}{1000}$

0.1 x $\frac{24}{1000}$ ✓1 = 0.0024 moles ✓1 *(2 mks)*

(ii) Moles of NaCl in $25cm^3$
Mole ratio is 1 : 1
Moles of NaCl = 0.0024 moles ✓1 *(1 mk)*

(iii) Moles of NaCl in 500 cm^3
If $25cm^3$ = 0.0024 moles
∴ 500 cm^3 = ?
= $\frac{500}{25}$ cm^3 ✓1 x 0.0024 moles
= 0.048 moles ✓1 *(2 mks)*

(iv) Mass of NaCl in $10cm^3$
Mass = moles x R.F.M.
= 0.048 x 58.5 = 2.808g

(v) Mass of water = mass of solution – mass of NaCl
= (10.70 – 2.808)g ✓1
= 7.892 g ✓1 *(2 mks)*

(vi) If 7.892 of H_2O ⟶ 2.808g ✓1
100g of H_2O ⟶ ?
$\frac{100g \times 2.808}{7.892g}$ ✓1
= 35.6g /100g of H_2O ✓1

20. *Add 100cm³ of 2M ✓potassium hydroxide or 200cm3 of 1M potassium hydroxide to the acid. Heat the solution until it is saturated and cool to obtain crystals. Dry the crystals between filter papers*

21. *(a) 139g of solution contains 39g solute*
∴90kg of solution contains $\frac{39 \times 90}{139} = 25.25g$
Mass of solvent = 90 – 25= 64.75g
(b) 80°C

22. *(a) Calcium hydrogen carbonate/Magnesium hydrogen carbonate;*
(b) Water boils off and is condensed leaving the salt;
(c) Provides minerals used to strengthen bones

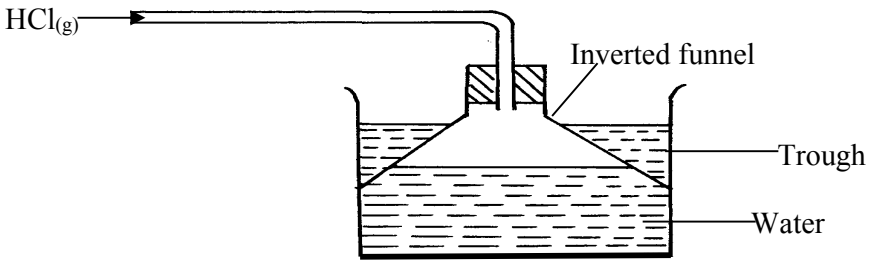
23. *(a) Delivery tube should not dip into solution*
- Thistle funnel should did into the solution
- Gas jar was no water/ little water in trough (1 each max 2)
(b) Oxygen

24. *a) acidity water with Nitric add aqueous lead nitrate or*
- silver nitrate formation of white precipitates shows presence
penalize fully for uric acid 1 ½ mk of chloride ions
b) provide essentials minerals e.g. Ca^{2+} ions

25. *a) I- $Cu(OH)_2$ or copper (II)hydroxide✓1*
b) $[Cu(NH_3)_4]^{2+}$✓1
c)Hydrogen sulphide or H_2Sg✓1

26. *i)this is the maximum mass of a salt that will dissolve in 100g of water at a given temperature ✓1*
ii)15g dissolve in 25cm³ water
xg dissolve in $\frac{15x100}{25}$g√1
= 60g/100g√1

27. *(a) Diagrammatical presentation on how to prepare an aqueous solution of hydrogen chloride gas*



(b) Ammonia gas **MAT*

28. *Mass of saturated soln. = 42.4 – 26.2 = 16.2*
Mass of dry solid Y = 30.4 – 26.2 = $^{4.2g}/_{12.0}$
Solubility of Y = $\frac{4.2 \times 100}{12.0}$
35g per 100g of water
(b) – Used is fractional crystallization of salt mixture.

29. *(a) 24 -19 = 5g of substance K will be produced*
Reason: Solubility decreases with increase in temperature ✓1
(b) Gaseous state

30. *Deep red solution will be formed. Equilibrium shifts to the right/forward reaction is favoured since Fe^{3+} ions favours forward reaction.* ✓1½

31. *a) They became a white powder*
b) Efflorescency

32. *a) calcium hydrogen carbonate/ magnesium hydrogen carbonate*

b) $Ca(LHCO_3)_{2(aq)} + Na_2CO_{3(aq)} \_\_\_\_\_ CaCO_{3(g)} + 2NaHCO_{3(aq)}$

$Mg(HCO_3)_{2(aq)} + Na_2CO_{3(aq)} \_\_\_\_\_ CaCO_{3(g)} + 2NaHCO_{3(a)}$

c) Contains Ca2+ ions needed to harden teeth and bones

33. *HCl g in water ionizes to produce H^+_{aq} and Cl^-_{aq}*
$HCl_{(g)}$ in methylbenzene remain as moles hence no H^+ ion

34. *(i) Weak acid ✓1*
(ii) Has few free H^+ (Hydrogen) ions

35. *(i) The reaction is too exothermic that alot of heat is produced causing ignition of hydrogen in presence of oxygen*
(ii) $K_{(s)} + H_2O_{(g)} \longrightarrow KOH_{(aq)} + H_{2(g)}$
$H_{2(g)} + O_{2(g)} \longrightarrow H_2O_{(g)}$

36. *(i) Sample 1 and 2*
(ii) Sample 2 contained ions that caused temporary hardness therefore required large (volume of soap solution before boiling, but after boiling the temporary hardness was removed, hence requiring very little volume (½mk) of soap solution to lather.

37.- *KOH has higher pH value than ammonia*
- KOH is a stronger base; dissociates fully ✓ ½
- Ammonia solution is a weak base; dissociates partially ✓ ½

Energy changes in chemical and physical processes

1. *(a) $\nabla H = \frac{120 \times 4.2 \times 4.5}{1000}$ (½mk)*
= + 2.268KJ✓ (½mk)

(b) RFM of $KNO_3 = 39 + 14 + 48 = 101$

6g ⟶ 2.268KJ

101g ⟶ $\frac{101 \times 2.268}{6}$ ✓ (½mk)

$= +38.178KJ\ mol^{-1}$ ✓ (½mk

2. (i) Heat evolved when one mole of a substance is completely burnt in oxygen

(ii) RFM of $C_2H_5OH = 46$

✓½ Molar mass = 46g

Heating value = $\frac{1370\ KJ}{46g}$ ✓½

= 29.78KJ/g (with units)

3. $Ca(q) + C(q) + 3/2\ O2\ (g)$

4. a) $C_2H_6O_{(l)} + 3O_{(g)}$ _____ $2CO_{2(g)} + 3H_2O$

b) DH = MCDT

$\frac{200}{1000} \times 4.2 \times 32.5 = -27.3Kj$

0.92g C_2H_6O _____ - 27.3Kj

46g " _____ ?

$\frac{46g \times 27.3Kj}{0.92} = -1365Kj$

DHC $C_2HSO_4 = -1365Kj\ mol$

5. i) U,V,Y,Z All the 4 or nay 3 exclusively correct penalize ½ mk if wrong answer

ii) YZ is/are included any 2 correct ½ mk

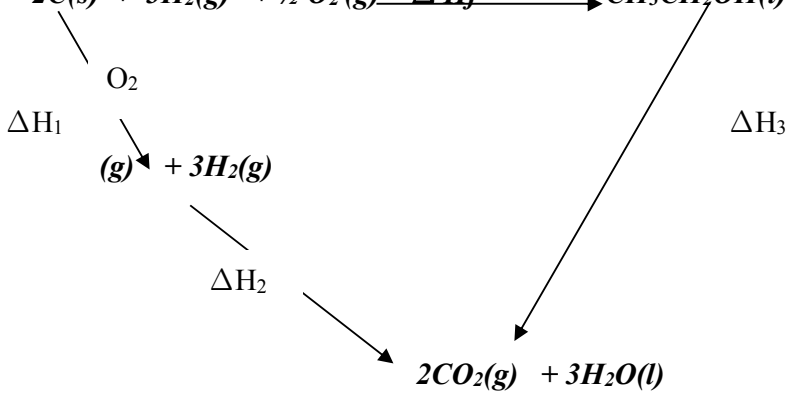
6. (a) 611-389 = +222KJ

(b) H = +222 – (611 – 100) ✓½

= -289KJ ✓1

(c) Exothermic reaction ✓½

7. $2C(s) + 3H_2(g) + ½\ O_2(g) \xrightarrow{\Delta Hf} CH_3CH_2OH(l)$



$\Delta Hf + \Delta H_3 = \Delta H_1 + \Delta H_2$

$\therefore \Delta Hf = \Delta H_1 + \Delta H_2 - \Delta H_3$ ✓½

$= -393 \times 2 + -286 \times 3 + 1386$ ✓1

$= -786 - 858 + 1386$

$= -1644 + 1386$ ✓1

$\Delta Hf = -258\ KJmol^{-1}$ ✓½

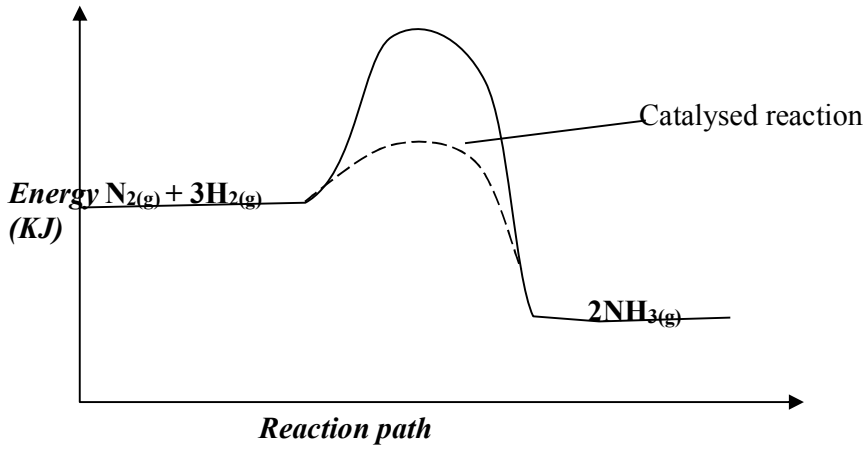
8. a) i) the yield of NH_3 would be lowered ✓½ any supply of heat makes NH_3 to decompose to

N_2 and H_2

ii)the yield of NH_3 would be increased

b)a catalyst accelerate the rates of both forward and reverse reactions equally✓½ . Equilibrium position is not affected by a catalyst✓½

c)



9. a) Breaking of 'C = C' = +610 KJ

Breaking of 'Br – Br' = +193

803✓

Formation of 2C – Br = -560

Formation of c-c +243 Kj

-346

- 103KJ✓ **2 marks**

b) Addition reaction/ halogenation ✓

10. *H H*

C = C + H – H H – C – C – H

H H H H

Bond breaking		*Bond formation*	
4 C-H – 4x410 = 1640		*6C – H*	*6x410*
C = C – 1 x610 = 610			*= 2460*
H – H – 1x436 =	*436*	*C – C –*	*3 45*
	2686		*2805*

H = 2686 – 2805

= -119 Kj/Mol

11. (i) Graph

*labeling -*TZM**

*plotting – *TZM**

*scale – *TZM**

*line – *TZM**

total 5mks

*(ii) Shown on the graph -*TZM**

(iii) Heat change = MCT

= 50 x 4.2 x 10.2

100

= 2.142kJ

(iv) RFM of KNO_3 = 39 + 14 + 48

= 101

H = 2.142 x 101 = -10.71Kjmol^{-1}

20.2

12. $MCT = \frac{100}{1000} \times 4.2 \times 6 = 2.52\ Kj$

$Moles\ of\ NH4NO_3 = \frac{1.6}{80} = 0.02\ moles$

$If\ 0.02\ mol \_\_\_\_\_ 2.52\ Kj$

$1\ mol \_\_\_\_\_ \frac{1 \times 2.52}{0.02} = +126KJ/mol$

13. *a)* $2\ NaHCO_{3\,(g)} \_\_\_\_\_ Na_2CO_{3(g)} + H_2O_{(1)} + CO_{2(g)}$

b) *i)* $2L_{(g)} + D_{2(g)} \_\_\_\_\_ 2LD_{(g)}$

ii) Amphoteric oxide

iii) Element H has a giant atomic structure with strong covalent bonds throughout its structure while D has simple molecular structure with weak Vander wall forces (2 m)

iv) *- Used in advertising signs (Advertisements)*

- Used in florescent tubes (Any two correct use)

v) C has a smaller atomic radius than B because it has stronger nuclear charge// more number of protons which attract the outer energy level electrons more firmly (2 mks)

vi) $4L_{(s)} + O_{2(g)} \_\_\_\_\_ 2\ L_2O_{(g)}$

$Moles\ of\ L = \frac{11.5}{23} = 0.5\ moles$

$Moles\ of\ O2 = \frac{0.5}{4} = 0.125\ moles$

$Volume\ of\ O_2 = 0.125\ mol \times 24 = 3\ dm^3$

$4L_{(s)} + O_{2(g)} \_\_\_\_\_ 2L2O_{(s)}$

$If\ 4 \times 23g \_\_\_\_\_ 24dm^3$

$11.5g\ of\ L \_\_\_\_\_ \frac{11.5 \times 24}{4 \times 23} = 3dm^3$

14. *(a) Drawn on the graph*

A = ½ mk
S = ½ mk
P = ½ mk
C = ½ mk

b) $32.5^oC \pm 1$ *Read from the student's correctly plotted graph.*

c) $20^oC \pm O.5$ *Line is extrapolated downwards from the student's correct graph.*

d) It is end point/ complete neutralization.

e) The reaction is exothermic hence as reaction proceeded more heat was produced.

f) Reaction was complete hence solution lost heat through radiation to the surrounding.

g) $10.2\ cm^3 \pm 0.1.$ *Read from the student's correct graph.*

h) $Moles = \frac{M \times V}{1000}$

$= \left(\frac{10.2 \times 4}{1000}\right) \surd ½ = 0.0408\ moles\ \surd ½$

i) $Moles = \left(\frac{M \times V}{1000}\right)$

$= \frac{2 \times 20}{1000}$ ✓½ $= 0.04$ moles ✓½

j) HBr : NaOH
0.0408 : 0.04
$\frac{0.0408}{0.04}$: $\frac{0.04}{0.04}$
1 : 1

$HBr_{(aq)} + NaOH \longrightarrow NaBr_{(aq)} + H_2O(l)$

k) $\Delta H = MC\,\Delta t$

$= \frac{-30.2g \times 4.2J \times 16.3}{g^0c}$

$= -2067.49J$ ✓½

Ans. in (h) = -2067.49 J.

∴ 1 Mole $= \frac{1 \times 2067.49J}{\text{Ans in "h"}}$ ✓½ e.g. $\frac{1 \times 2067.49}{0.0408}$

$= -Ans.$ e.g 50673.82 J mol^{-1}

Or 50.67382KJ mol^{-1} ✓½

15. a)(ii) Max. temperature attained : 29^0c

(iii) Temperature change o the reaction $= (29-115)^0c$

$= 14^0c$

Mass of NaOH used = (114.35 – 108 .15)g

= 6.2g

R.F.M of NaOH = 40g

Moles of NaOH used $= \left[\frac{6.2}{40}\right]$ moles

= 0.155moles

(v) Heat released = Mass X Specific Heat capacity X Temperature change

Mass of water used = (108.15 – 8)g

= 100.15g

∴ Heat released $= \left[\frac{100.15}{1000} X\ 4.18\ X\ 14\right]$ kj

=100.15kj

0.155 moles NaOH ⟶ 5.861 kj

1 mole NaOH ⟶ $\left[\frac{1x\ 5.861}{0.155}\right]$ kj $mole^{-1}$

$= -37.8$ kjmol^{-1}

(b) i) ΔH_3 and ΔH_4

ii) Condensation

iii) $\Delta H = \Delta H_1 + \Delta H_2 + \Delta H_3 + \Delta H_4$

iv) Exothermic.

16. I – a – Latent heat of fusion is the heat change that occurs when one mole of a solid substance

changes into liquid at constant temperature.

- Latent heat of vapourization is the heat change that occurs when one mole of liquid substance changes into gas at constant temperature.

b – BC – The liquid loses heat as it cools hence decrease in kinetic energy of the particles

- CD - The liquid changes to solid as temperature remains constant at freezing point.

*II. (i) Scale – *TZM**
*Plot – *TZM**
Line

(ii) Should be shown on the graph – if not shown penalize (½ mk)

(iii) Heat change = m x c x ΔT
Where m = (vol. of acid (20cm^3) + volume of bas in (b) above) x 1g/cm^3
ΔT-as read form the graph
(iv) moles of acid

$$\text{Moles of base} = \frac{0.5 \times \text{volume}}{1000} \text{ in (b) above}$$

Mole ratio acid: Base = 1:1
Moles of acid ⟶ heat change in (iii)above
1mole ⟶ ?

$$\text{Molar heat change} = \frac{1 \times \text{heat in (iii)}}{\text{Moles of acid}}$$

17. $Q = 40000 \times 60 \times 60 = 144000000c$

$$\text{Mass of Al} = \frac{144000000 \times 27}{3 \times 96500} \quad \checkmark 1$$

$$= 13.43kg \quad \checkmark 1$$

18. *(a) (i) Contains methane which is a fuel or contains methane which can burn*
(ii) Pass a known volume of biogas through Sodium hydroxide (Potassium hydroxide) solution to absorb Carbon (IV) Oxide. Measure the volume of remaining gas

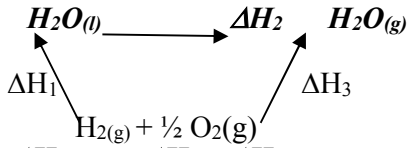
$$\% = \frac{\text{Volume of methane}}{\text{Volume of Biogas}} \times 100$$

19. *a) No effect – Reaction is not accompanied by volume changes/ similar volumes of reactants and products*

20. *a) – carbon IV Oxide;*
- Sulphur IV Oxide;
- Lead;
(b) Availed low sulphur diesel/ availed unleaded petrol

21. *(a) Heat change that occurs when one mole of hydrogen combines with one mole of hydroxide ions. //Heat evolved when one mole of water s formed during reaction of H^+ and OH^- ions*
(b) HCl produces a higher temperature rise than oxalic acid;
HCl is a stronger acid than oxalic acid;

22.



$\Delta H_2 = -\Delta H_1 + \Delta H_3$

$= \Delta H_3 - \Delta H_1$ ✓ 1

= -242 - -286 ✓ ½

= -242 + 286 ✓ 1

= +44KJ/mol ✓ 1 *(No units of sign = ½mk)*

23. (a) Chemical substance that burns to produce useful amount of heat.

(b) (i) Its cheap

(ii) Its readily available (½mk)

(iii) It burns slowly (½mk)

(iv) Does not produce poisonous gas. (½mk)

24. a) Metallic beaker would make most of the heat be lost to the environment

b) - Thermometer reading increased

- The reaction is exothermic

25. a) A substance that produce heat energy when burnt

b) 1. Availability

2. ease of transport

26. a) 1 mole Fe (56) required _____ 15.4 + 354

= 396.5Kj

10,000 (10 kg) _____ ?

$$\frac{10{,}000g \times 369.5\ Kj}{56g}$$

= 6596.285Kj

b) $\frac{-68Kj}{2}$ *= - 34 Kj* ✓ ½

27. a) ΔH_1 – Lattice energy ✓1

ΔH_2 – Hydrogen energy ✓1

b) $\Delta H_3 = \Delta H_2 + \Delta H_1$ ✓1

Reaction rates and reversible reactions

1. colour changes from red to blue

H_3O^+ions and $L^-_{(aq)}$ ions which form red solution.

2. (a) ΔH_4 – latent heat of fusion

(b) ΔH_3 - is negative particles lose hat/process is exothermic/heat is given out (any) ✓

3. a) H-H(g) + Cl – Cl (g) ⟶ 2H – Cl

Bonds broken bonds formed

/H-H = 435 KJ 2 H – Cl = 430 x 2

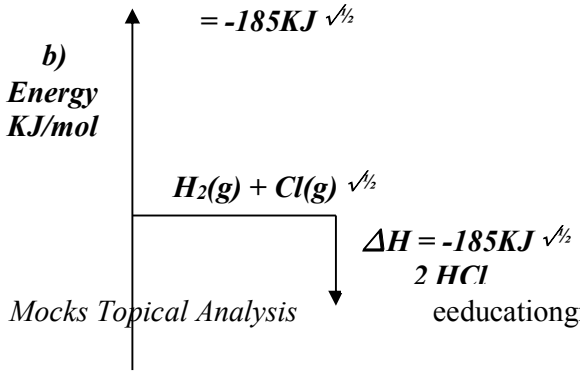
/ Cl – Cl = 240 KJ. = 860 KJ.

Total = 675 KJ.

ΔH_R = 860 + 675 ✓½

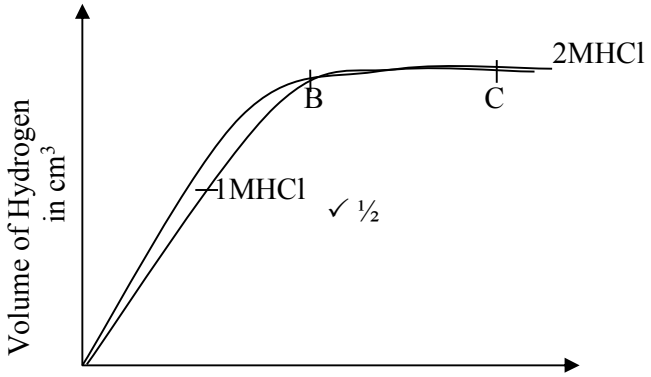
= -185KJ ✓½

b)



Reaction path. ✓½ for both axes

4.



- Graph should be less steeper showing lower reaction rate since HCl is less concentrated. ✓½

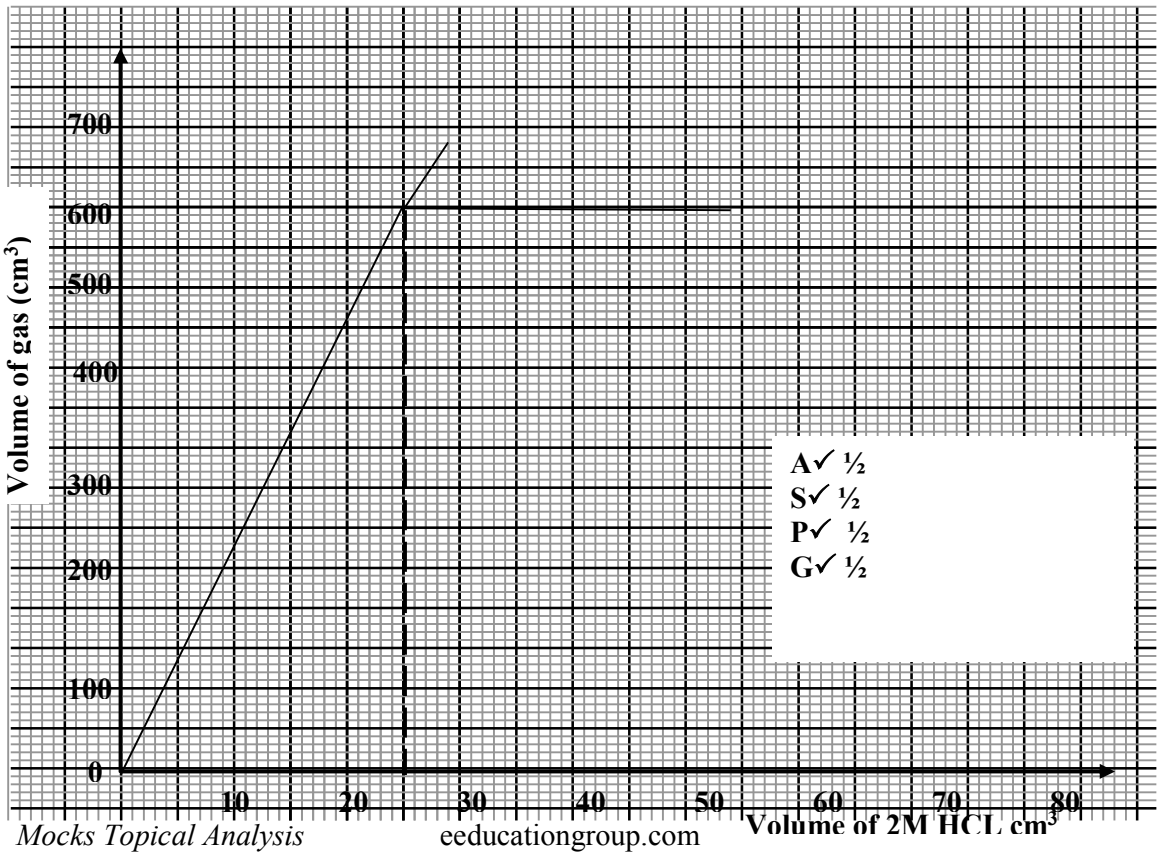
b) Graph flattens out at BC showing that all the magnesium has been used up, hence, no reaction is taking place ✓½ and there is therefore no evolution of hydrogen gas. ✓½ The volume of the gas, therefore, remains constant. ✓½

5. a) Pale yellow liquid is observed. ✓1 Backward reaction is favoured since ✓½ it is exothermic. Dinitrogen tetra oxide liquefies✓½ at very low temperature to pale yellow liquid.

b) Pressure increase, and favours backward reaction ✓½ which is at lower pressure; hence equilibrium shifts to the right. ✓½

6. a) $Mg(s) + 2\,HCl(aq) \longrightarrow MgCl_2(aq) + H_2(g)$ ✓1

b)



c) (i) Showing on the graph. √½ X Answer √½

(ii) Showing on the graph. √½ Answer √½

d) i) The rate of reaction increases. √1

The surface area of particles has been increased √½ thus increasing the area √½ of contact of the reacting particles.

ii) The rate of reaction increases. √1

Increase in temperature results in crease in the kinetic energy of the particles. This makes the particles move faster and collide more frequently with sufficient energy to cause more effective collision per given time. √1

7. I a) Drawn on graph paper

A = ½ mk
S = ½ mk
P = 1 mk
C = 1 mk

b) Rate of evolution of hydrogen gas increases with increase in length of magnesium ribbon.

c) Read from the student's graph. 1 mk – showing on graph
1 mk – for answer.

d) Shown on the graph paper.

II a)(i) Curve I ***Reason:*** *F increases as E decreases.*

(ii) Equilibrium is achieved.

8. $Q = 40000 \times 60 \times 60 = 144000000c$

$$\text{Mass of Al} = \frac{144000000 \times 27}{3 \times 96500} \quad \checkmark 1$$

$$= 13.43kg \quad \checkmark 1$$

9. a) Hydrochloric acid is a weaker oxidizing agent which cannot oxidize copper to form Nitrogen (VI) Oxide gas

b) It increases √1 mark

Molecules/ particles acquire the necessary activation energy// Kinetic energy. This increases the frequency of collisions hence the rate of reaction √½ mark

c) Graph - Scale 1 mark with axis well labeled
- Plotting + all points correct 1 mark
5 correct points ½ mark
Less than 5 points 0 mark
Correct smooth curve 1 mark
TOTAL 3 marks

d) i) 360cm³ Read correct value from graph + .05
-

ii) 40cm³ = Value from graph + .05
-
Read where it levels off

10. (a) $\frac{260 - 85}{2} = \frac{175}{2} = 87.5cm^3/mn;$

(b) 4 ½ min;

(c) Zinc was used up / H_2SO4 used up;

11. ***(a) Platinum / Platinum Rhodium***
(b) Pressure -9atm (½ mk)
Temp – 700°C – 900°C (½ mk)
(c) Reaction is exothermic

12. ***(a) (i) Will increase;***
(ii) Decrease;

13.

- ***Dissolve solid*** $\checkmark^{½}$ ***YSO_4 to obtain*** $\checkmark^{½}$ ***YSO_4 in solution,***
- ***Dissolve*** $\checkmark^{½}$ ***$X(NO_3)_2$ in water to obtain*** $\checkmark^{½}$ ***$X(NO_3)_2$ solution.*** ***3***
- ***Mix the two above solutions***
- ***Filter to obtain XSO_4 solid residue, rinse with water and dry by heating*** $\checkmark^{½}$
- ***under asbestos pad.***

14. $R_{(s)} + S^{2+}_{(aq)} \longrightarrow R^{2+}_{(aq)} + S_{(s)}$ ***√1 (1 mk)***
E.m.f = 0.47 – (-2.04)
= -0.47 + 2.04
= 1.57V √1 (1 mk) } ***2***

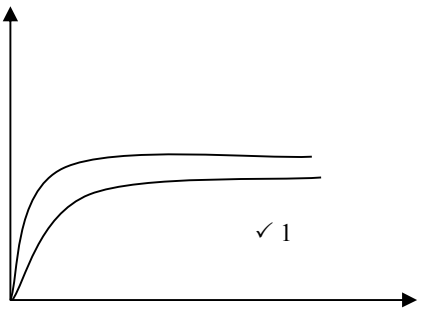
15. ***(a) – Water level rises. √1 (1 mk)***
Grey Iron wool changes to brown. √1 (1 mk)
(b) – Oiling and greasing. √1 (1 mk)
- Painting.
} ***3 (any one of these scores)***

16. ***(a) L is more ionized √1 than K hence reacts faster √1 producing higher volume of a gas. Or L is a stronger acid therefore ionized faster than K a weaker acid*** ***3***
(b) Increasing the temeprature √1 using zinc powder/increasing the concentration of acid.

17. ***Energy of reaction = Bond breakage + Bond formation. √1***
Bond formation = Energy of reaction – Bond Breakage
= -287 – 931 √1
= - 1218 K Joules per mole. √1 (3 mks) } ***3***

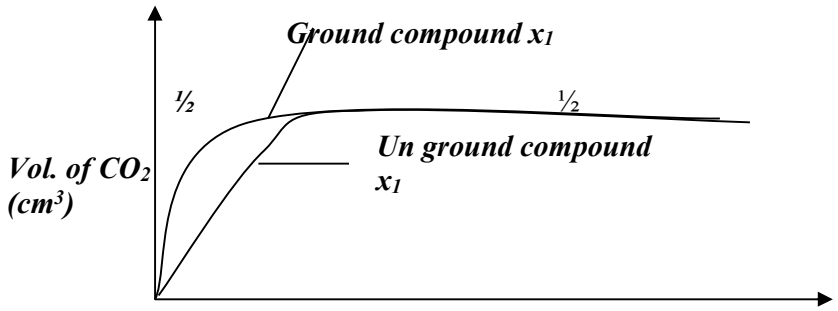
18. ***– No effect on the position of the equilibrium***
- RXM is neither endothermic nor exothermic hence not affected by changes in temperature enthalpy is zero. ✓1

19. ***(a)***



21. a)the minimum energy required by the reaction particles to cause a successful collision to form product

b)i)



NB. I) Sketch curve should be to the left and both flatten not at the same final volume
ii)curve is stop to the left due to the size of particles of ground compound x is reduced,✓½ increasing surface area✓½ of the particles thus increasing area of contact of

22 At equilibrium there will be very little of T that has reacted.✓1At equilibrium there will be a lot of T and very little V produced hence equilibrium lies to the left or forms the reactants✓1

23. - CB_2
- Ionic bond

24. - Intensity of red-brown fumes increases.
- High temperature vapourizes liquid nitrogen tetra-oxide to form nitrogen (IV) oxide that is red-brown.

25. a) Curve 1

b) After sometime, the rate of formation of $CaCL_2$ or rate of depletion of $CaCO_3$ become to low that cant be evaluated

26. a) Equilibrium shifts o the left, more CO_2 formed
(Increase in pressure favors reaction producing fewer molecules)
b) Equilibrium shifts to the left, more $CO_{2(g)}$ formed

27. The solution turns yellow. Equilibrium shifts to the left when NaOH is added, the OH^- ions react with H^+ ions forcing more of cr2 O^{72-} and H_2O to react forming more H^+ and $crO4^{2-}$ ions the reaction particles causing higher rate of reaction and twice shorter time✓½

28. (i) B ; The acid had higher concentration (½mk)
(ii) The rate of reaction is initially high (½mk) because of high concentration of the reactant but decreases (½mk) steadily as the concentration also decreases.

29. Yellow/brown colour of bromine water ((½mk) fades or becomes colourless because sodium hydroxide solution provides OH^- ions which reacts with H^+ ions to form water (½mk) shifts the equilibrium to the right
✓

Electrochemistry

1. i) Carbon – carbon/ platinum – carbon
ii) - The concentration of magnesium sulphate increase
- Hydrogen and oxygen given off at the electrodes reduce the water content

2. $Cu^{2+} + 2c-$ _____ $Cu_{(s)}$

Mass =

$$1.48 = \frac{63.5 \times I \times 2.5 \times 60}{2 \times 96500}$$

$$I = \frac{1.48 \times 2 \times 96500}{63.5 \times 2.5 \times 60}$$

$$= 29.988\ A$$

3. ***a) Anode is electrode A*** ***(1 mk)***
   B is cathode
   b) $2H^{+}_{(aq)} + 2e^{-} \_\_\_\_\_ H_{2\,(g)}$

   c) The acid becomes more

4. ***i) 200 X 58 X 60 C _____ 64.8g √ ½***
   9500C _____ 27g √ ½

$$\frac{27 \times 200 \times 58 \times 60}{64.8 \times 96500}\ \surd\ ½ \qquad = +3\ \surd\ ½$$

   ii) $40H^{-}_{(g)} \_\_\_\_\_ 2H_2O_{(L)} + O^{2}_{(g)} + 4e^{-}$ ***√ ½***

   4 X 96500 _____ 22.4dm³ √ ½

$$\frac{200 \times 58 \times 60 \times 22.4}{4 \times 96500\ C}$$

$$= 40.39dm^3\ \surd\ ½$$

5. ***a)*** $Mg_{(s)} + Pb^{2+}_{(aq)} \_\_\_\_\_ Mg^{2+}_{(aq)} + Pb_{(s)}$

   b) 0.13 – (-0.76)
   = +0.53V

6. ***(a) 2F = 10 ⇒ 2F – 10 = 0; 2F = 10 ∴F = +5***
   F = +5 (penalize -5)
   (b) Group VI

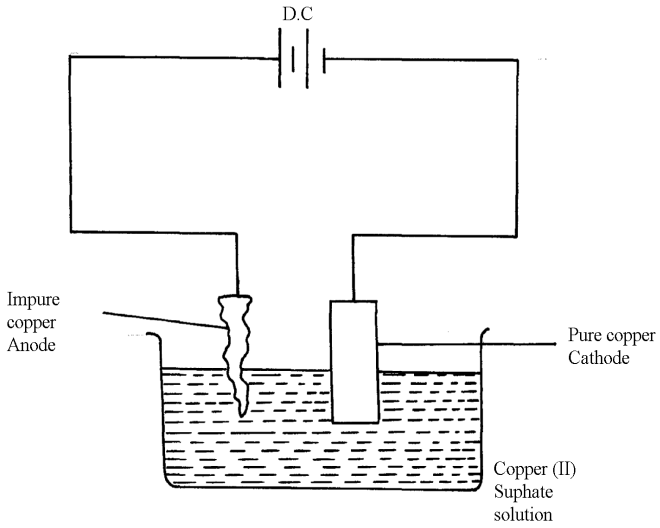
7. ***Aluminium has a higher electrical conductivity than sodium. √1 Aluminium has three delocalized √½ electrons in its metallic structure while sodium has only one delocalized electron in its structure. √½***

8. ***Q = It √½***
   = 3 x 50 x 60 √½
   = 9000 C √½
   1 mole of Zn is liberated by a charge of 2 f.
   i.e 96500 x 2 x ⟶ 65g of Zn
   9000C ⟶ ?

$$= \frac{65 \times 9000}{96500 \times 2}\ \surd 1 \quad = 12.124g\ Zn\ \surd ½$$

9. a) Q is sulphur (IV) oxide $SO_2(g)$. ✓1

b)



- Impure copper is the while pure copper is cathode. During electrolysis impure copper is purified and pure copper deposited on the cathode as shown in the half electrode reaction below;

CATHODE EQUATION:

$Cu^{2+} + 2e \longrightarrow Cu(s)$ ✓½

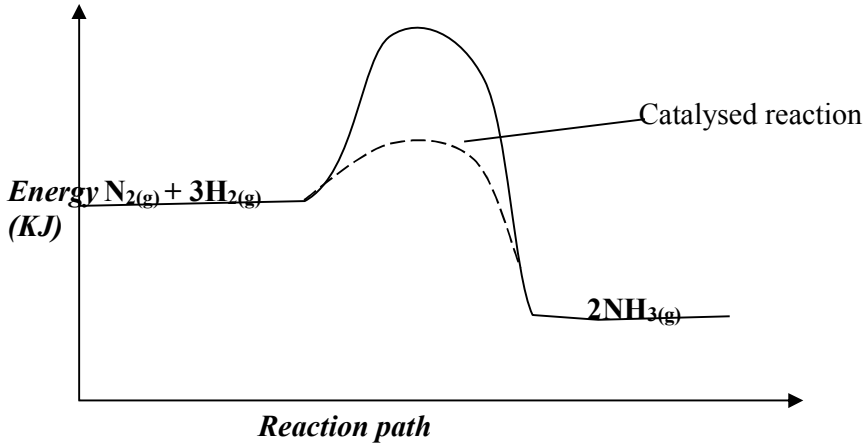
- The cathode is therefore removed and replaced after an interval.

10. a) i) the yield of NH_3 would be lowered ✓½ any supply of heat makes NH_3 to decompose to N_2 and H_2

ii)the yield of NH_3 would be increased

b)a catalyst accelerate the rates of both forward and reverse reactions equally✓½ . Equilibrium position is not affected by a catalyst✓½

c)



11. a)T✓

b)$Z_S + 2G^+ \longrightarrow 2G_{(S)} + Z_{(aq)}^{2+}$ ✓1

c)$E^{\theta}cell = E - E$

$= 0.08 - (-2.38)$✓1

$= \underline{+ 3.18}$

12. Mass of due to $C = \frac{12}{44} \times 4.2 = 1.145$✓½

Mass of due to H = $\frac{2}{18}$ X 1.71 = 1.889✓½

Moles of C = $\frac{1.145}{12}$ = 0.095✓½

Moles of H = $\frac{0.1889}{1}$ =0.1889✓½

Moles ratio c: r

0.095: 0.1889✓½

1: 2

E.F = CH_2✓½ (accept alternative method)

13. 96,500 coulombs 1 faraday

144,750 ,, ⟶ ?

$\frac{144,750}{96,000}$ faraday✓½

= 1.5 faradays✓½

Copper (II) ions = 2 faradays (penalize ½ mk for missing/wrong units)

2 faradays yield = 64g of copper

1.5 faradays yield = ?

= $\frac{1.5}{2}$ x 64g✓½

=48g of copper was obtained✓½

14. Physical difference:-

Na_2O_2 – yellow while Na_2O is white

Chemical difference:-

N_2O_2 reacts with water to form NaOH and O_2 while ✓ 1

Na_2O reacts with water to form NaOH only ✓ 1

15. (a) $Pb(NO_3)_2$

(b)

(c) $Mg_{(s)} / Mg^{2+}{}_{(aq)} // Pb^{2+}{}_{(aq)} / Pb_{(s)}$

16. (a) MnO_4 is reduced;

Oxidation number of Mn is reduced from +7 to +2

(b) $5Fe^{2+}{}_{(g)} \longrightarrow 5Fe^{3+}{}_{(aq)} + 5e.$;

17. i) 2 $Cr_{(S)}$ _____ $2Cr^{3+}{}_{(aq)} + 6e$

$3Fe^{2+}{}_{(aq)} + 6e$ _____ $3Fe_{(g)}$

$2Cr_{(g)} + 3Fe^{2+}{}_{(aq)}$ _____ $2Cr^{3+}{}_{(aq)} + 3Fe_{(g)}$ ✓

ii) 0.30 = - 0.44 - E^{ϕ}_R

E^{ϕ}_R = - 0.44 – 0.30

= - 0.74V ✓

18. (a) – Filtration of air/electrostatic precipitation/purification ✓ ½

- Passing through sodium hydroxide/potassium hydroxide to absorb Carbon (IV) oxide gas
- Cool to remove water vapour as ice ✓ ½
-Cool remaining air to liquid by repeated compression and expansion of liquid air 1
- Fractional distillation of liquid air- Nitrogen collected at -196°C 1

(b) (i) Nitrogen (II) Oxide

(ii) Oxidation

$$\underset{-3}{NH_{3(g)}} + CuO_{(s)} \rightarrow \underset{0}{N_{2(g)}} + H_2O_{(l)} + \underset{0}{Cu_{(s)}}$$

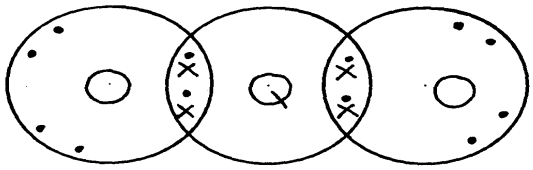
$\overbrace{\quad\quad}^{+2}$ Reduction

OR - Oxidation number of N_2 in NH_3 increases from -3 to 0. Oxidation number of reducing agent increases or oxidation number of Cu in CuO decreases from +2 to 0 hence is a reducing agent

(iii) NH_4NO_3 $N_2O + 2H_2O$
(iv) Fertilizer/expose
(c) (i) G or G
(ii) $E^{2+}_{(aq)} + 2OH^-_{(aq)} \longrightarrow E(OH)_{2(s)}$

19. a) i) G// $G_{2(g)}$ Not G^-
It has the highest potential OR highest reduction potential √1 mark
ii) G and N or $G_{2(g)}$ // $N_{(g)}$ √1 mark

iii)



20. a) (i) Cathode – steel
Anode – Carbon / graphite
(ii) To lower the melting P^+ hence reducing cost of heating the salt.
(iii) To prevent the two products from recombining.
(iv) Cathode

$$Na^+_{(l)} + e^- \longrightarrow Na_{(l)}$$

Anode

$$2\,Cl^-_{(l)} \longrightarrow Cl\,2_{(g)} + 2\,e^-$$

(v) less dense than electrolyte/ has low density
b) (i) quantity = 6.42 X 10 60 = 3852
(ii) 3852c province 2.74
2X 96000 " (2 X 96000) X 2.74 / 3852
= 136.58

21. .a) i) $H^+_{(aq)} + e^- \rightleftharpoons ½\ H_2$

ii) E cell = 0.76 + 0.54 = +1.3 volts

iii) I. Fe^{3+}
II. Zn
IV. Fe^{3+} ion
$2\,Fe^{3+} + 2\,e^- \longrightarrow 2\,Fe^{2+}$ $E^0 = +0.77$
$2\,I \longrightarrow I_{2g} + 2e$ $E^0 = -0.54$

$2\ Fe^{3+}_{(aq)} + 2I^-_{(aq)} \longrightarrow 2Fe^{2+}_{(aq)} + I_2\ \ E^0 = +0.23$

22. a) i) Chlorine Has a higher reduction potential
ii) +1.36 2.36 = +3.72

b) i) P and S
ii)
iii) +1.50 – 0.44 + + 1.94

c) Q = 4 X a6 X 60 = 3840C
1.17g _____ 3840
59 g _____ $\frac{59 \times 3840}{1.174}$ = 192981.261 C
If 96,500c _____ IF
192891.261 _____ $\frac{192981.261 \times 1}{96500}$
Charge of X = +2
Formula $X(NO_3)_2$

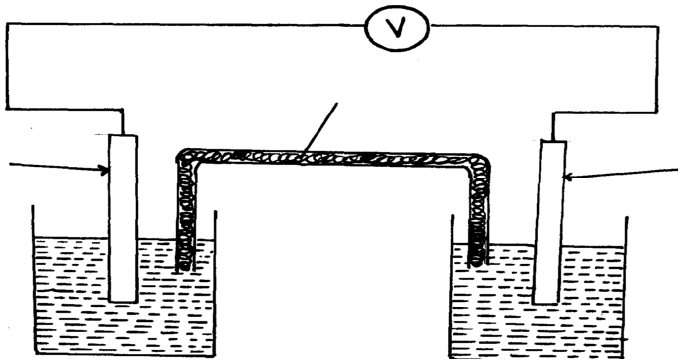
23. (a) B – Copper metal
C – Chlorine gas
D – Ammmonia gas
E – Zinc
(b) (i) $Cu^{2+}_{(aq)} + 2e^- \longrightarrow Cu_{(s)}$
(ii) $CuSO_4 + Zn_{(s)} \longrightarrow ZNSO_4 + Cu_{(s)}$
$Cu^{2+} + Zn_{(s)} \longrightarrow Cu_{(s)} + Zn^{2+}_{(aq)}$

(c) – Water treatment
-Manufacture of hydrochloric acid
(d) Tetra mine copper (II) ions

24. (a) (i) $E^\theta = 1.13V$

(ii) T_2 because it's standard electrode potential is zero. i.e. point of reference.

(iii)



(iv) E.m.f = + 1.23 - - 0.76 = 1.99 V

(b) (i) x - Oxygen
y – Hydrogen

(ii) $4OH^-_{(aq)} \longrightarrow 2H_2O + O_2 + 4e$

(iii) Reduction takes place at electrode Y. H^+ ions gain electrons to form hydrogen gas.

(iv) Platinium / graphite/ Nickel because it is inert.

25. (i) $Zn^{2+}_{(aq)} + 2OH^-_{(aq)} \longrightarrow Zn(OH)_{2(s)}$

$Zn(OH)_{2(s)} + 4NH_{3(aq)} \longrightarrow \left[Zn(NH_3)4\right]^{2+}_{(aq)} + 2OH^-_{(aq)}$

(ii) The mixture consists of a soluble compound and an insoluble compound.
(iii) Evolution brown fumes of NO_2 gas
(iv) CO_3^{2-} - Because its reaction with HNO_3 produces CO_2 gas or $2H^+_{(aq)} + CO_32-_{(aq)}\ H_2O_{(l)} + CO_{2(g)}$
(v) Pb^{2+} ion
(vi) Lead (ii) Carbonate
Zinc (II) Nitrate

26 A (i) Process by which an electrolyte is decomposed by passing an electric current through it.
(ii) Anode – left pt rod
Cathode – right pt rod
(iii) – Blue /pale green colour fades
- P solution becomes acidic

B (i) a. – D^{2+}
b. – D^{2+}
(ii) C

$E_{cell} = E_{ordn} - E_{ordn}$

$= +0.34 - (-2.92) = +3.26V$

(iii) $B_{(s)} / B^{2+}_{(aq)} // D^{2+}_{(aq)} / D_{(s)}$; $E = +3.26V$

27 $Q = 40000 \times 60 \times 60 = 144000000c$

$\text{Mass of Al} = \frac{144000000 \times 27}{3 \times 96500}$ ✓1

$= 13.43kg$ ✓1

28. a) Strip of copper metal dissolved forming blue solution. ✓½

b) Copper displaces ions ✓½ *of Q from solution since copper is more electropositive* ✓½ *than Q.*

c) E.m.f of cell = (0.80 - 0.34)V ✓½

$= 0.46V$ ✓½

29 (a) (i) Carbon (IV) Oxide gas evolved was lost to the atmosphere
(ii) Concentration of reactants higher between O and R
Reaction rate faster
(iii) Grinding the marble chips
(iv) Calcium sulphate
(v) Plaster of Paris

(b) (i) Hydrogen ions discharged;
It takes less energy than calcium ions
(ii) $2Cl^-_{(aq)} \longrightarrow Cl_{2\ (g)} + 2e$
(iii) Q = 1t = 4 x 1 60 x 60 (½ mk)
= 14400C
2 x 96500C = 2 x 35.5(½mk)

$14400C = \frac{14400 \times 2 \times 35.5}{2 \times 95600}$ *= 5.297g (½mk)*

30. a) the bulb light√ ½
Hydrogen chloride gas ionized in water to give H^+ and cl^-(aq) that are responsible for conduction of electric current√1
b) $2H^+(aq) + 2e^- \longrightarrow H_2(g)$√1

31. Q = it IF = 69500C 2F _____ 206g of Pb
= 40x(5x60) = 1200x1 F = 0.01243 x 206
= 1200 C 96500 2F
= 0.01245 F = 1.280g

b) I $K_{(s)}$ _____ $K^{2+}{}_{(aq)} + 2e^-$

$Na + 2e$ _____ $N_{(g)}$

II 1. Salt bridge

2. Complete the circuit
Balance the ions in each half cell

III

IV E cell = E Red – E oxd
= +1.16 – (-0.17) = +1.33V

32. (a) (i) Zinc sulphate / Zinc chloride / Zinc nitrate solution
(ii) Copper
(iii) $Zn_{(s)} + Cu^{2+}{}_{(aq)} \longrightarrow Zn^{2+}{}_{(aq)} + Cu_{(s)}$
(iv) E = 0.34 + 0.76
= 1.0V

. (b) (i)Concentrated sodium chloride solution
(ii) $2\,Cl^-(aq) \longrightarrow Cl_{2(g)} + 2e$
$Na^+(aq) + e\ N_{(l)}$
(iii) Sodium amalgam is flown into water. It reacts forming sodium hydroxide solution

33. Quantity of electricity = (40,000 X 60 X 60) Coulumbus √½ mark
3 x 96,500 Coulumbus produce 27g of Al

∴ $\frac{40{,}000 \times 60 \times 60 \times 27}{3 \times 96{,}500 \times 1000}$ Kg √½ mark √½ mark
= 13.43Kg √½ mark
Subtract ½ mark if units missing or wrong
[Total 12 marks]

34. i) Increased yield of NO/ √1 mark Equilibrium shifts to the right // favours the forward reaction// reduced pressure favours forward reaction// increased volume number of molecules

ii) It will not affect the yield // remains the same
Catalyst do not affect position of Equilibrium

35. a) R
b) T
c) i) $T_{(g)}$ and $S_{(g)}$

ii) Half cell one Half cell two
T(s) – 2e-____ T2+ S2+(aq) + 2e _____ S(s)

OR: $T(s)$ ____ $T2+_{(aq)} + 2e-$

iii) $T_{(s)}$ _____ $T^{2+}{}_{(aq)} + 2e$, $E = +0.74V$

iv) From T(s)/ T2+ half cell to S2+/ S(s) half cell through conducting wires

d) i) $Q = It$
$= 2.5 \times (15 \times 60)$
$= 2250C$

ii) $RAM = \frac{mass \times valency \times 96500}{Q}$
$= \frac{0.74 \times 2 \times 96500}{2250}$
$= {}^{142820}/_{2250}$
$= 63.476$

36. a) R
b) T
c) i) $T_{(g)}$ and $S_{(g)}$

ii)

Half cell one	Half cell two
$T(s) - 2e-$ ____ $T2+$	$S2+(aq) + 2e$ _____ $S(s)$
OR: $T(s)$ ____ $T2+(aq) + 2e-$	

iii) $T_{(s)}$ _____ T^{2+} $(aq) + 2e$, $E = +0.74V$

iv) From T(s)/ T2+ half cell to S2+/ S(s) half cell through conducting wires

d) i) $Q = It$
$= 2.5 \times (15 \times 60)$
$= 2250C$

ii) $RAM = \frac{mass \times valency \times 96500}{Q}$
$= \frac{0.74 \times 2 \times 96500}{220}$
$= {}^{142820}/_{2250}$
$= 63.476$

37. $NH^{+}{}_{4}$✓1, proton donor✓

38. a) - Bubbles of colourless gas at the anode✓½
- Brown deposits at the cathode ✓½
- Blue color of the solution fades — Any 2 ½ mark each

b) The Ph decreases
Removal of OH^- ions leaves an excess of H^+ hence the solution becomes more acidic✓

39. a) Anode. Copper anode dissolves
b) $Q = 0.5 \times 60 \times 64.3 = 1929C$
0.64g of Cu _____ 1929 C
∴ 63.5 of Cu
$\frac{63.5 \times 1929}{0.64}$✓½
$= 191393$ C ✓½

40. ***The grey-black solid changes to purple gas iodine sublimes at low temperature due to weak Van der walls forces***

41. ***(a) The mass of substance liberated during electrolysis is directly proportional to the quantity of electricity passed***

(b) Quantity of electricity = 2 x 2 x 36000 = 14400c(½mk)

Volume of gas evolved = $\frac{14400 \times 22.4}{2 \times 96500}$ = 1.671dm³ (1 ½ mk)

42. ***(a) OH^- √1 (1 mk)***

43. ***(i) ZnS- No mark if the letters are joined***

(ii) SO_2 produced as a by-product is used in contact process to obtain H_2SO_4. This acid is used in making fertilizers e.g. ammonium sulphate

✓1

44. ***(i) CaO is basic and P_4O_{10} is acidic***

(ii) Let the ON of P be x

$$4x + (-2 \times 10) = 0$$

$$\frac{4x}{4} = \frac{+20}{4}$$

✓ ½

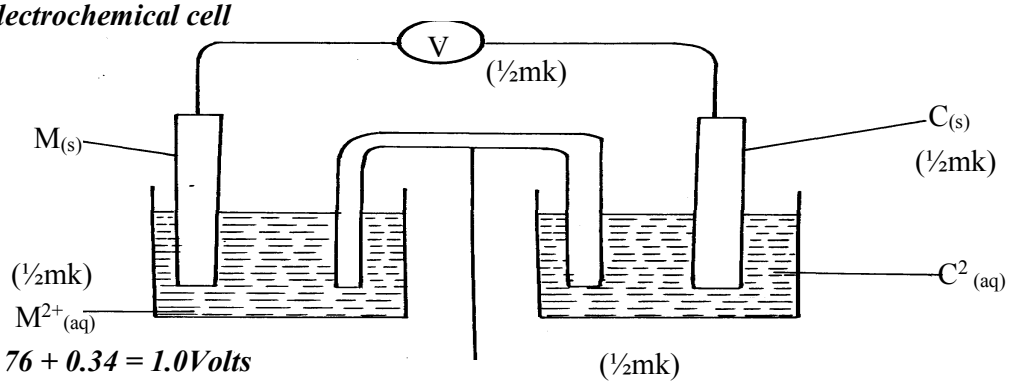
$$x = +5$$

(iii) Used as a fertilizer ✓1

✓1

45. ***Platinum electrode is used, H_2 is bubbled over the pt electrode immersed in 1M H+ i.e 1M HCl. The electrode is coated with finely –divided platinum catalyst***

(b)electrochemical cell



(½mk)

46. ***+ 0.76 + 0.34 = 1.0Volts***

47. ***(a) - Red- Phosphorous***

- White – Phosphorous

(b) Phosphorous is insoluble in water because its non-polar while water is polar. It cannot be stored in oil because oil is non-polar it will dissolve the phosphorous.

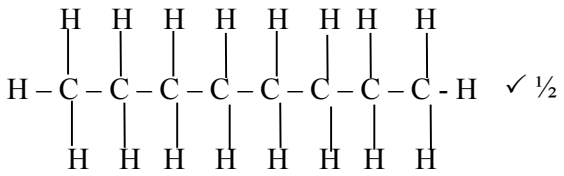
48. ***(a) $2X_{(s)} + 3W(aq) \longrightarrow 2X^{3+}_{(aq)} + 3W_{(s)}$***

(b) $E^{\theta}(X/X^{3+}_{(aq)}$ + - 0.44 = 0.3V

$E^{\theta}(X_{(s)}/X^{3+}_{(aq)} = +0.74V$ ✓

$E^{\theta}(X^{3+}_{(aq)}/X_{(s)} = -0.74V$ ✓

✓ ½



✓ ½

Salt bridge

49. ***Electrode - E_1 is the anode***

Dilute electrolyte – OH^- ions are discharged.

$4\,OH^-_{(aq)} \longrightarrow 2H_2O_{(e)} + O_{2(g)} + 4e^-$

Oxygen gas is produced.

Discharge of hydroxyl ion increases the concentration of sodium chloride.

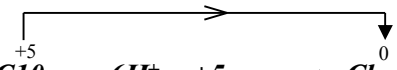
Chloride, Cl^- are then discharged.

Chloride, Cl-, are then discharged

Chloride gas is produce

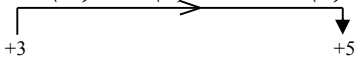
$2Cl^-_{(aq)} \longrightarrow Cl_{2(g)} + 2e^-$

50. a) ClO_3^- (=) Cl + 3(-2) = -1(=)Cl -6 =-1,Cl= + 5



$ClO_3^-{}_{(aq)}\ 6H^+_{(aq)} + 5e^- \longrightarrow Cl_{2(g)} + 3H_2O_{(l)}$

b) NO^-_2 (=) N+2 (-2) = -1(=) N-4 = -1 (=) = N+ 3



$NO^-_2 + H_2O_{(l)} \longrightarrow NO^-_{3(aq)} + 2H^+_{(aq)} + 2e^-$

51.

Half Cell E^θ/V	E^θ/V using iron ref - electrode
$Al_{(s)}/Al^{3+}_{(aq)}$ - 1.66	- 1.22
$Zw_{(s)} / Zn^{2+}_{(aq)}$ - 0.76	+0.32
$Fe_{(s)}/Fe^{2+}_{(aq)}$ - 0.44	0.00
$Ni_{(s)}/Ni^{2+}_{(aq)}$ - 0.25	+ 0.19

52. $\theta = 1.5 \times 60 \times 15 = 1350$

$J^{3+}_{(aq)} + 3e^- \longrightarrow J_{(s)}$

$3F = 3 \times 96500 = 289\ 500C$

$289500C$ deposit $= 52g$ of $J_{(s)}$

$= 1350$ C deposit $= \frac{1350 \times 52}{289500} = 0.2\ 2425g$

53. Tin (Sn) its oxidation potential is +0.144V. It is the least likely to combine/ react with elements of weather

5. Metals

1. a) chlorine gas would react with steel anode

b) Hood and steel gauze prevent chlorine sodium, from anode and cathode from mixing and reacting. 11 Na Na

- Sodium metal is less dense, floats on motten brine where it is siphoned out.

c) -To Whom It May Concern: melt the ore, rock salt

- For electrolysis of the molten ore

2. a) $SO_{2(g)}$ is produced as a by- product, this mixes with rain water producing acid rain which may corrode buildings and affect plants √ ½

$SO_{2(g)}$ is poisonous when inhaled √ ½

b) - H_2SO_4 manufacture – to make use of $SO_{2\,(g)}$

- Manufacture of dry cells – make use of zinc

- Production of iron sheets which are galvanized using zinc (Any one with an explanation)

c) Low density, does not corrode easily, duchle, malleable (Any 2 each ½ mark)

3. Aluminium is lighter/low density. (any) ✓1

It is a good conductor of electricity ✓ ½

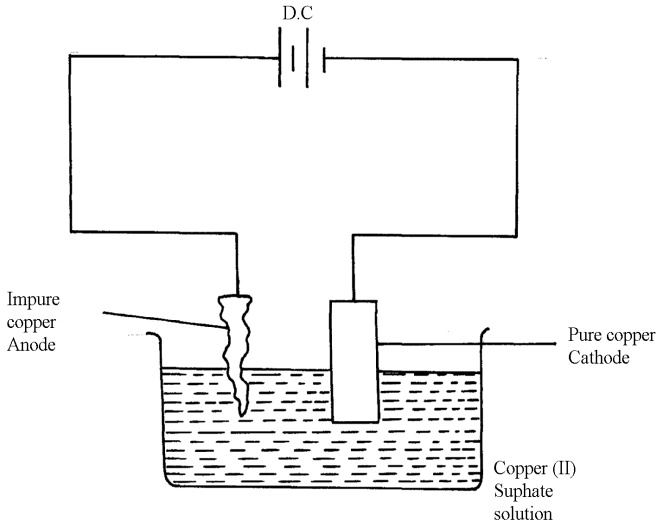
4. Stage 1 – oxidation; Coke is oxidized to CO ✓ ½

Stage 2 – Reduction: zinc is reduced to Zinc metal ✓ ½ ✓ ½

Stage 3;- Recycling stage; CO_2 is reduced to regenerate CO

5. a) Q is sulphur (IV) oxide $SO_2(g)$. √1

b)



- Impure copper is the while pure copper is cathode. During electrolysis impure copper is purified and pure copper deposited on the cathode as shown in the half electrode reaction below;

<u>CATHODE EQUATION:</u>

$Cu^{2+} + 2e \longrightarrow Cu(s)$ √½

- The cathode is therefore removed and replaced after an interval.

6. (i) I-I-I-tetrachloromethane /Tetrachloromethane
(ii) Chloric (I) acid 1

7. Oxide of W has simple molecular structure while that of Z has giant ionic structure

8. (a) Froth floatation. √1 (1 mk)
(b) $PbCO_{3(s)} \longrightarrow PbO_{(s)} + CO_{2(g)}$ (1 mk)
(c) Making of pipes/lead acid accumulators. √1 (any one) } ***3***

9. a) bauxite✓
b) Copper pyrites ✓

10. i)
ii) I It's uneconomic// Expensive// a lot of energy is required to produce this high temperature
II Addition of cryolite √½ mark

iii) The melting point is below 800 C √½ mark

11. (a) (i) Bauxite
(ii) Iron (III) Oxide 1
Silica (any one)
(b)(i) On the diagram
(ii) It is expensive /a lot of energy will be used✓ 1
(iii) The ore is dissolved in cryolite ($NaAlF_6$)✓ 1

12. (i) Bauxite – $Al_2O_3.H_2O$
(ii) Iron II oxide

- Silica

(iii) Being ionic, it is only an electrolyte in its molten state. Heating helps to melt it.

(iv) (a) – The two rods represent the anode.

- Cathode is the inner lining of the wall.

(b) As an impurity, lowering the melting point of aluminium oxide.

(c) Anode $2O_2$-(l) $O_{2(g)} + 4e^-$

Cathode $Al^{3+} + 3e^- Al_{(l)}$

d) – manufacture of household utensils

- making cables for electricity transmission

- making foils used as wrappers

- extraction of some metals e.g. manganese

- Making aeroplane parts

Describe how you would establish the presence of copper in the ore

13. (a) $CuFes_2$

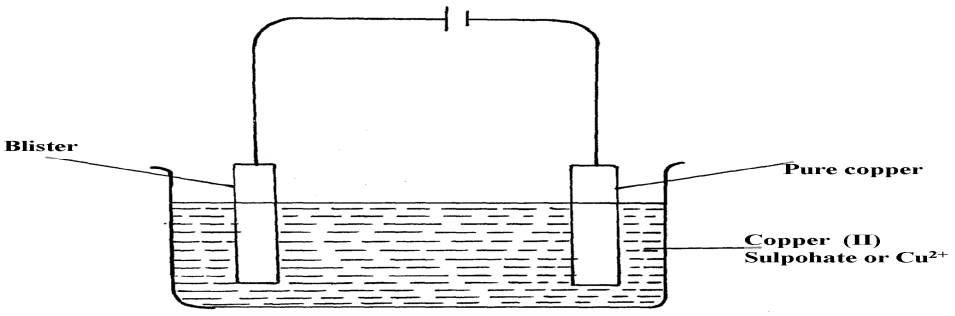
(b) Froth floatation

(c) $2CuFeS_{(s)} + 4O_{2\ (g)} + Cu_2S + 2FeO_{(s)} + 3SO_{2\ (g)}$

(d) Silica is added which reacts with iron (II) Oxide to form iron (II) silicate which forms part of slag or SiO_2 is added

(e) Anode $Cu_{(s)} \longrightarrow Cu^2{}_{+(aq)} + 2e^-$

Cathode $Cu^{2+}{}_{(aq)} + 2e- Cu_{(s)}$



(g) – Add HNO_3 to the ore

- Filter and place small portion of the filtrate into a test tube

Add NH_4OH until in excess – deep blue solution confirms the presence of Cu^{2+}ions

14. (a) (i) Gas Q- Carbon (II) Oxide

(ii) Liquid R- dilute sulphuric acid

(iii) Residue S – excess Zinc metal

(b) Zinc blende

(c) (i) To increase percentage of Zinc in the ore

(ii) The ore is crushed, mixed with water and oil and then air is blown into the mixture.

(d) (i) $2ZnS_{(s)} + 3O_{2(g)} \longrightarrow ZnO_{(s)} + 2SO_{2(g)}$

(ii) $Zn_{(s)} + H_2SO_{4(aq)} \longrightarrow ZnSO_{4(aq)} + H_{2(g)}$

(e) (i) - Lead (II) sulphate //Pbs

- Silica //silicon (IV) oxide// SiO2

(ii) Lead (II) sulphide

$2PbS_{(s)} + 3O_{2(g)}\ 2PbO_{(s)} + 2SO_{2(g)}$

(f) (i) $\frac{45}{}$ x 250000

100
= 112,500g of ZnS

(ii) Rmm of ZnS = (65.4 + 32) – 97.4g
From the equation
The mole ration of Zn of ZnS: SO_2 = 1:1
97.4g of ZnS = 24dm^3 of SO_2 at r.t.p
112,500g of ZnS = $\frac{112,500}{97.4}$ x 24
= 27,720. 73920dm^3 of SO_2

15. a) i) Zinc Blende (Penalize for formula only)
ii) Lead II Sulphide

b) It is concentrated by froth floatation where the ore is crushed or ground, a detergent added and the mixture agitated. Zinc sulphide floats and is collected

c) $2ZnS_{(g)} + 3\ O_{2(g)}$ _____ $2\ ZnO_{(g)} + 2SO_{2(g)}$

d) Zinc oxide is reduced by both carbon and carbon (ii) Oxide to zinc vapour. Lead (ii) Oxide is also reduced by both carbon and carbon (ii) Oxide to lead liquid

Accept equations
$ZnO_{(g)} + C_{(s)}$ _____ $Zn_{(g)} + CO_{(g)}$

$ZnO_{(g)} + CO_{(g)}$ _____ $Zn_{(g)} + CO_{2(g)}$

$PbO_{(g)} + C_{(s)}$ _____ $Pb_{(L)} + CO_{(g)}$

$PbO_{(s)} + CO$ _____ $Pb_{(L)} + CO_{2(g)}$

e) W = Sulphur (vi) Oxide // $SO_{3(g)}$
M= Conc. Sulphuric (Vi) acid // $H_2SO_{4(L)}$

f) $H_2S_2O_{7(L)} + H2_{O(L)}$ _____ $2H_2SO_{4(L)}$
g) The process is highly exothermic and heat produced boils the acid leading to acid mist which cannot be condensed easily because it is highly unstable
h) The sulphur (iv) Oxide dissolves in water to form acid rain which corrodes buildings and affects aquatic life

16. (a) Purification and concentration.
(b) (i) Bauxite
(ii) Iron (III) Oxide /Silicon (IV) Oxide
(c) On diagram
(d) Lowers the melting point of the ore from 2015^0c – 900^0c.

17.) Q = It = 3 x 10 x 60 = 1800
3F = 3x 96500c = 27g
∴1800c = $\frac{1800 \times 27}{3 \times 96500}$
= 0.16788g

18. a) Zinc blende

b) i)

I- carbon IV oxide
II – Dil sulphuric acid
III – unreacted zinc

ii) To reduce zinc oxide to zinc metal

iii) Silica

iv)

I $2ZnS + 3O \_\_\_\_\_ 2ZnO(s) + 2SO_2(g)$

II $2ZnO(q) + C(g) \_\_\_\_\_ 2Zn(q) + CO2(g)$

v) $Zn(g) + H2SO4(aq) \_\_\_\_\_ ZnSO4(aq) + H2(g)$

vi) $45/100 \times 250 = 112.5 \times 1000 = 112500g$
$= 112.5\ Kg$

vii) – Used to make brass
- Used to make electrodes in dry cells
- Galvanize iron sheets

19. a) i) *- Effervescence, a colorless gas is produced*
- Grey solid dissolves, a colorless solution is formed

ii) Nitric acid is a strong oxidizing agent. It will oxidize the hydrogen gas formed to form water instead

iii) I $Zn_{(g)} + 2HCl_{(aq)} \_\_\_\_\_ ZnCl_{2(aq)} + H_{2(g)}$

II Moles of Zn $= \frac{0.5g}{65.0} = 0.007692$

Moles of HCL $= 0.007692 \times 2 = 0.015384$

3 moles of HCl has $1000\ cm^3$

0.015384 moles has $\frac{0.015384 \times 1000cm^3}{3}$

$= 5.182cm^3$

20. (a) *P – Chlorine (½)*
Q – Sodium (½)

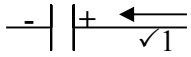
(b) Prevent reaction between sodium and chlorine

(c) $Na^+_{(l)} + e^- \rightarrow Na_{(l)}$

21. (a)

(b) $Pb^{2+}{}_{(l)} + 2e^- \longrightarrow Pb_{(s)}$ B.E ✓ ½ S.S ✓ ½

(c)



✓1

22. *a) zinc blende✓½*
Calcium ✓½

b) $2ZnS_{(s)} + SO_{2(g)} \longrightarrow 2ZnO_{(s)} + 2SO_2(g)$ *✓1 (penalize ½ if states are missing)*

$ZnCO_3(s) \longrightarrow ZnO_{(s)} + CO_{2(g)}$ *✓1 (penalize ½ if states are missing)*

23. *a) Iron III hydroxide*

b) Concentrated sodium hydroxide is added at 4 atm pressure to the Bauxite at 160C
AL_2O_3 dissolves in the sodium hydroxide leaving the iron III oxide as a solid

24. a) i) The oxygen produced at the anode reacts with hot carbon to form carbon (iv) oxide hence corrodes it therefore needs replacement
ii) Graphite is inert and a poor conductor of heat hence helps to conserve heat

b) Aluminum has more number of valency electrons which are delocalized

Organic chemistry II (alkanoic acids and alkanols)

1. (i) Ethylbutanoate
(ii) $CH_3CH_2CH_2$ $C - O - CH_2 - CH_3$ (with $C=O$)
(iii) Esters

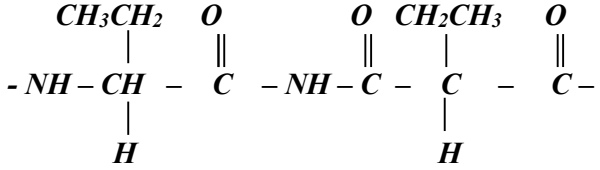
2. a) –CH- CH- CH_2 – CH– CH_2- CH – CH_2 - CH
b) Polypheny/ ethane

3. Plastics may contain chlorine or fluorine compounds apart from hydrogen and carbon when burnt, fluorine and chlorine compounds are released into the air destroying Ozone layer

4. $(NH_4)_2\ CO_{3(s)} \longrightarrow 2NH_{3(g)} + CO_{2(g)} + H_2O_{(l)}$

5. The first amount of soap precipitates $Ca^{2+}_{(aq)}$ and $Mg^{2+}_{(aq)}$ ions and soften water.
Then additional soap dissolves oil from the fabric.

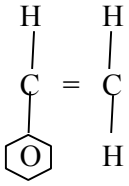
6. a)



b) 0.00005mol. P = 0.515 g of monomer.
= 1.0 mole of poly mer = $\frac{1X\ 0.515}{0.0005}$ = 10300 g
RFM ($C_4H_9ND_2)n$ = 48 + 9 + 32 = 103
= ($C_4H_9NO_2$) = 10300
103n = 10300
∴n = 100 molecules

7. Agent A – magnesium salt formed is soluble hence doesn't form scum

8. (a) Styrene/Phenylethene



(b)Addition polymerization
(c) – can be made into different shapes easily
- are cheaper
- are not corroded by acids, alkalis or air
- are stronger and long lasting
- are water-proof
} Any 1 correct

9. – Add water to the mixture and shake where ethanol dissolves in water while pentane is immiscible.

****MAT***
- Transfer the mixture in a separating funnel and allow it to settle when pentane floats on top of water-ethanol mixture.
****MAT***
- Turn on the tap to collect water-ethanol mixture while pentane remains in the separating funnel.

- Separate ethanol from water by fractional distillation based on the differences in boiling points.

10. *(a) Is 100% ethanol/is pure ethanol without water in it*
(b) 30°C and yeast
✓ 1

11. *(ii)* $R = \frac{\Delta y}{\Delta t}$

$= \frac{43 - 40.5}{180 - 150}$

$= \frac{25}{30}$

$= 0.0833 cm^3/s$

(ii) 57seconds

(iv) $2H_2O_{2(l)} \xrightarrow{MnO_2} 2H_2O_{(l)} + O_{2(g)}$

(b) (i) To oxidize H_2 produced to water
(ii) Z
(iii) Q = 1t
= 0.1 x 30 x 60
= 180C
96500c = 1F
180cc = $\frac{180 \times 1}{96500}$
= 0.001865F
$Zn_{(s)} \longrightarrow Zn^{2+}_{(aq)} + 2e^-$
2F = 65g
0.001865F = $\frac{0.001865 \times 65}{2}$
= 0.0606g of Zn was consumed

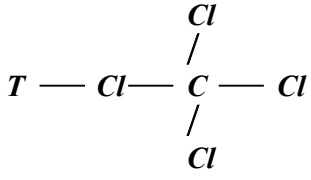
12. *(a) (i) Ethylethanoate.*
(ii) 2 – bromobut – l – ene

(b) (i) P – $CH_3COOCH_2\ CH_3$
S – CH_3CHONa

(ii) I. Step I -Type – dehydration.
Reagent – Concentrated sulphur acid.

II. Step II- Type – Oxidation
Reagent – acidified potassium magnate VII/ Potassium dichromate (VI)

III. Step III- Type – Hydrogenation
Reagent – Hydrogen
(iii) R – Soda lime
(iv)



Tetrechloromethane

(v) I – U – Polythene/Polyethene

$II - 28n = 42000$

$n = \frac{42000}{28} = 1500$

(c) – It is unsaturated.

13. *a) - The length of the chain*
- Intermolecular forces
- Cross linking of the molecules (Any two correct = 2 marks)

b) Sodium propoxide

c) i) I – T is ethane
II – K is polypropene
ii) has a sweet smell
iii) Neutralization
iv) - Used to make ropes ✓1 mark
- Used to make crates of bottles
- Used as surface for all weather football and hockey pitches (Any correct use)

v) $CH_3CH_2CH_3 + SO_2$ _____ $3CO_2 + 4H_2O$
(N.B ignore state symbols)

vi) React a small sample of each of the two substances with sodium carbonate separately. Bubbles// efferrescence are observed with CH_3CH_2COOH *and no reaction with* $CH_3CH_2CH_2OH$

vii) RMM of monomer = 42 ✓½

$42n = 12600$

$N = \frac{12600}{42} = 300$ ✓½

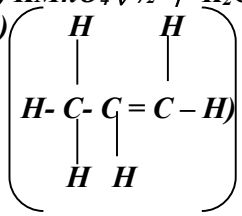
14. *a) i) Propene √1*

ii) $2CH_3CH_2COOH + Na_2CO_3$ √½ $\longrightarrow 2CH_3CH_2COONa + CO_2 + H_2O$

b) Making packing materials √1

c) $KMnO_4$ √½ / K_2CrO_7

d)



√1 = 4200

n

$42n$ ✓ $= 4200$

$n = 4200/42$

$= 100$ ✓

e) Esterification √1

f) Conversion of oils to fats. √1

g) Propane burns with a clear falme √1 while propyne burns with a sooty flame √1because propyne has a higher √1 C : H ration than propane.

h) $C_2H_4(g) + 3O_2(g) \longrightarrow 2CO_2(g) + 2H_2O(l)$ *√1*

1 Vol. 3 vol

1 Vol. = 1000 cm^3 √½

Vol of O_2 required = 3 x 1000 cm^3 = 3000 cm^3 ✓½

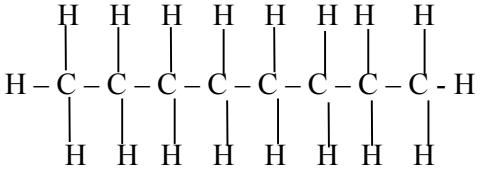
Vol of air required = $\frac{100}{20}$ x 3000 cm^3

= 15,000 cm^3 ✓½

15. ***(a) (i) Q - CH_3CH_2COOH (accept name (propanoic acid)***
R – CH_3CH_2COOH (Propanoic acid)
P- Hydrogen ✓1

(ii) Step I Esterification ✓1
Step 4 – Oxidation ✓1

(iii)



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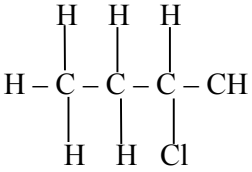
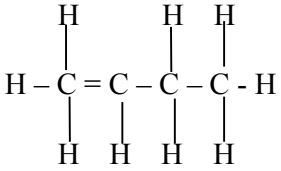
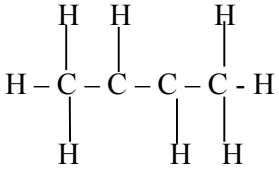


(iv) Condition – 180 – 250° ✓½
reagent – Conc. H_2SO_4 ✓½





16. ***(a) (i) M: Ethan – 1, 2- diol***
L: Ethanoic acid
(ii) Polymerisation
Hydrogenation
(iii) Concentrated sulphuric acid
Ethanoic acid

17. ***a)*** ***i) Butan – 1 – 01// 1- Butanol// n-Butanol***
ii) Propanoic acid
iii) Ethylethanoate

18. ***i) Step I: Hydrogen***
Step II: Hydrogen chloride gas// HCL
Step III: Sodium hydroxide/ NaOH/ Sodalime
ii) $2C_2H_{2(g)} + 5O_{2(g)}$ _____ $4CO_{2(g)} + 2H_2O_{(g)}$

iii) Environmental pollutant
It is not biodegradable/ Not decomposed by bacterial

19. ***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: $FeSO_4 + H_2O$

ii) 6.95g $= {}^{6.95}/_{278}$ $= 0.025$

$\therefore$ 0.05 moles in $250cm^3 = 0.025 \times {}^{1000}/_{250} = 0.1$

Concentration $= {}^{6.95}/_{278} \times {}^{1000}/_{250} = 0.1$

20. i) Step I: Hydrogen

Step II: Hydrogen chloride gas// HCL

Step III: Sodium hydroxide/ NaOH/ Sodalime

ii) $2C_2H_{2(g)} + 5O_{2(g)}$ _____ $4CO_{2(g)} + 2H_2O_{(g)}$

iii) Environmental pollutant

It is not biodegradable/ Not decomposed by bacterial

21. i) Butan – 2 – Ol ✓½

ii) 4 – methylhex – 2- ene ✓

iii) Propyl ethnoate ✓

22. a) Soap less detergent ✓

b) Non- biodegradable resulting in pollution ✓

23. a)

b) Addition

24. (a) A – Sodium ethanoate

B – Acidified $KMnO_4$ or K_2Cr_2O7

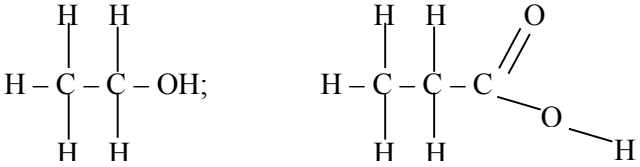
(b) Oxidation

25. (a) $NH_{3(g)} + HNO_{3(aq)} \longrightarrow NH4NO_{3(s)}$

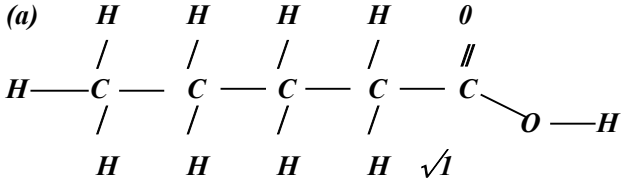
(b) 17kg ammonia ≡ 80kg NH_4NO_3 (½)

$\therefore 5.3kg \equiv \frac{80 \times 5.3}{17} = 24.94Kg$ (1½ kg)

26. (a) A reaction between an ethanol and alkanoic acid to form ester;

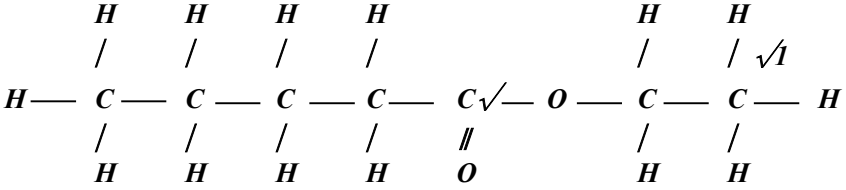


27. (a)



(b)

(i)



(ii) Ethylpentanoate . √1

3

28. i) ethylethanoate✓½

$CH_3 - H_2C - O-C-CH_3$ ✓½

ii) step 2: oxidation ✓½
step 4: esterification ✓½
iii) sodium hydroxide ,or NaoH✓1

29. *a) Hydrogen. ✓1*

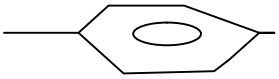
b) (i) A No effervescence takes place. ✓½

(ii)B There is effervescence ✓½ and the gas produced turns lime water into white precipitate.✓½

30. *a) Y ✓1*

b) Z and W ✓1 have same atomic number but different mass number. ✓1

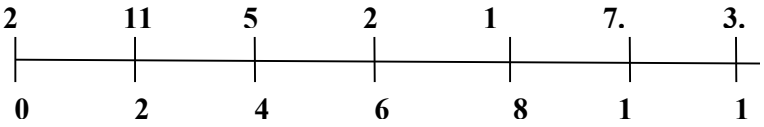
31. *(a) Insulators*
(b) Are non-conductor since they lack delocalised electrons

32. *(a)*  *Soapless detergent*

(b) Non-biodegradable ✓

33. *(a) No. of half –lives (n) = 120 = 6*
20
Y x (½)⁶ = 3.5 ✓ ½
Y = 3.5 x 2⁶ ✓ ½
Y = 224g ✓ ½
(all steps for equation)

OR:



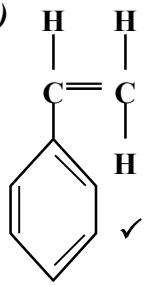
(b) – To study the rate of absorption of fertilizer by plants using radioactive phosphorous ✓1
- Tracing chemical and physiological processes such as photosynthesis ✓1
- Sterilizing equipment (1ny one)

34. *(i) Polypropene*
(ii) $(H_2C= CH – CH_3)_n = 4956$ ✓1
(12 x 3) + (6x1) = 36 + 6 = 42 (molecular mass of 1 unit)
no. of units = 42n = 495 ✓1
42n = 4956
42n = 4956
42 42
n = 118 ✓ 1

35. *i) $RCOONa^+$ Soapy detergent*
R CH_2 OSO_3 Na^+ soap less detergent
ii) RCH_2OSO_3 Na^+ does not form scum. Its calcium and magnesium salts are soluble
iii) Chlorine bleaches by oxidation
SO_2 bleaches by reduction

36. (a) Polyphenylethene

(b)



✓

Radioactivity

1. u= 234 ✓ V = 91✓

2. (a) Nuclear fusion is a process whereby smaller nuclei combine to form a larger one at high temperatures;
Nuclear fission is whereby a large nuclide splits to form smaller one when hit by a neutron

(b) $^{230}_{90}Th \longrightarrow {}^{230}_{91}Pa \quad {}^{4}_{2}He$

3.

$$^{238}_{92}U \longrightarrow {}^{234}_{90}Y + {}^{4}_{2}He \quad \checkmark 1 \quad (1\ mk)$$

$$^{234}_{90}Y \longrightarrow {}^{234}_{91}Z + {}^{0}_{-1}e \quad \checkmark 1 \quad (1\ mk)$$

2

4. (a) Is an atom or atomic nucleus characterized by its atomic number and mass number

(b) $\frac{14}{2} = 7$ ✓1 *from the graph*

∴half –life is 10days ✓1

(c) Destroys physical properties of metals e.g. lower tensile strength ✓1

5. a) nuclear reactions involve the nucleus of an atom but chemical reactions involved valence elections

- *Nuclear reactions are independent of external factors but chemical reactions depend on external factors*
- *In nuclear reactions new elements are formed but no new elements are formed in chemical reactions (any one of them*

b) i)step I-Alpha✓½
II- Beta✓½
ii) Z = 234✓½
A= 92✓½
1st $t^{1/2}$ 2nd $t^{1/2}$

II. 100% ⟶ 50% ⟶ 25%
2t ½ = 48hours
$t^{1/2}$=?

$t^{1/2} = \frac{48}{2} = 24$hours

6. a) Hydrogen. ✓1

b) (i) A No effervescence takes place. ✓½

(ii)B There is effervescence ✓½ and the gas produced turns lime water into white precipitate. ✓½

7. (a) 8 (protons number same as atomic number)

(b) 27 -13 = ✓14

8. (a) No. of half –lifes (n) = $\frac{120}{20} = 6$

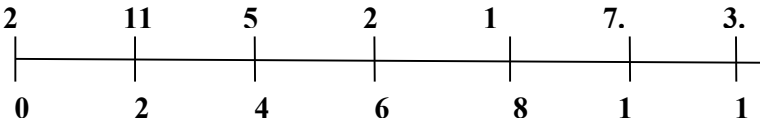
$Y \times (½)^6 = 3.5$ ✓ ½

$Y = 3.5 \times 2^6$ ✓ ½

$Y = 224g$ ✓ ½

(all steps for equation)

OR:



(b) – To study the rate of absorption of fertilizer by plants using radioactive phosphorous ✓1

- Tracing chemical and physiological processes such as photosynthesis

- Sterilizing equipment ✓1 (1ny one)

9. a) $^{14}_{6}Y$ _____ $^{14}_{7}Z + ^{0}_{-1}$

b) carbon dating

10. - Gramma rays are used to sterilize surgical equipment
- Detection and treatment of goiter

11. i) U,V,Y,Z All the 4 or nay 3 exclusively correct penalize ½ mk if wrong answer
ii) YZ is/are included any 2 correct ½ mk

12. No. of t ½ = $\frac{90}{15} = 6$

Remaining Fraction = $(½)^6 = {}^1/_{64}$

Mass left = ${}^1/_{64} \times 2 = 0.03125g$

13. a) -1 C

b) 100-50 -25 – 12.5

3t ½ = 15.6

T ½ = $\frac{15.6}{3}$

= 5.2 years

KAKAMEGA CENTRAL DISTRICT

QUESTION 1 .

Table 1.

Titre number	*I*	*II*	*III*
Final burrette reading (cm^3)	*22.0*	*44.1*	*26.9*
Initial burrette reading (cm^3)	*0.0*		
Vol. of soln. K used cm^3	*22.0*	*22.1*	*21.9*

CT = 1
OP =1
AC =1
PA =1
FA = 1
5

(a) $\frac{22.0 + 22.1 + 21.9}{3} = 22.0cm^3$

Marking points
Complete table (CT) …….
The table should be completed.
Penalize the following errors if any occurs.

- ***Arithmetic error in subtraction.***
- ***- Values recorded beyond 50cm3***
- ***- Inversion of table***
- ***Penalize ½ mk only on any one of these errors.***

Decimal point (d.p) 1mk
All values to be recorded to 1d.p or
All values to be recorded to 2dp second decimal value being 0 or 5 only
Award 0-mark if whole numbers used or 2dp are used.

Accuracy mark (AC)…
Consider any one candidates' titre if within ± 0.10cm^3 of school value award 1mk.
If it is ± 0.11 to 0.20 award ½ mk. If beyond 0.20 award 1mk
Averaging principle (.A)….
Three titres to be averaged if within ±0.1cm^3 to one another.
Two titres can only be arranged if they are consistent.
N/B- If a student averages two titres when three are consistent award 0mk.
Final answer (F. A)…..
If averaged titre is within 0.0 to 0.10cm^3 of S.V award 1mk
0.11 to 0.2cm^3 of s.v award ½ mk
If beyond 0.20cm^3 award 0mk.
Summary
Complete table (CT) = 1mk
Correct use of decimals(dp) = 1mk
Accuracy (AC) = 1mk
Averaging (PA) = 1mk
Final answer (FA) = 1mk)
5mks
N/B – school vale (SV) teacher to perform practical to obtain school value.

Calculations
(b) 100cm^3 has 0.02moles
22.0cm^3 has- $\frac{22x\ 0.022}{1000}$ 1 ½ mk

= 0.00044moles ½ mk

(c) (i) mole ratio $MnO_4 : Fe^{2+} = 1:5$

1 mole MnO_4= 5 mol Fe^{2+} ½ mk

$= \frac{0.00044 \times 5}{1}$

= 0.0022mol ½ mk

(ii) $25cm^3$ has 0.00022mol

$1000cm^3$ has $= \frac{1000 \times 0.00022}{25}$

$= 0.088moldm^{-3}$

(d) (i) RFM of soln has 8.5g

$1000cm^3$ soln $= \frac{1000 \times 0.85}{250}$ ½ mk

$= 34gdm^{-3}$ ½ mk

$(NH_4)_2\ SO_4.\ FeSO4.\ nH_2O = 386.4$

$2(14+1x4) + 32 + 16x4+56 + 32 + 16 \times 4 + n(1x2+16) = 386.4$

$36 + 32 + 64 + 56 + 32 + 64 + 18n = 386.4$

$284 + 18n = 386.4$

$28n = 386.4 - 284$ ½ mk

$n=\frac{102.4}{18}$ ½ mk

$N=5.6 \approx 6$ ½ mk

ii) $(NH_4)_2SO_4.\ FeSO_4.\ 6H_2O$

(iii) R.F.M of J $= \frac{\text{conc. in } gdm^{-3}}{\text{Molarity}}$

$= \frac{3.4gdm^{-3}}{0.0088mol}$ ½ mk

= 386.4 ½ mk

Question 2

Table II

Marking points

Complete table (T) ……. 2 ½ mk

Award 1.2 mk for each correct to up to 3 s.f otherwise award 0

Experiment	Time (sec)	$^1/_{time}$
1		
2		
3		
4		
5		

CT = 2 ½

DP = ½

AC = ½

Tr = ½
4

Decimal point (dp)…… (½ mk)

All values of time (t to be whole number or to 1d.p or 2d.p consistently otherwise award 0mk.

Accuracy (AC)…… ½ mk

Consider time for experiment only if 3 sec of school value (SV) award ½ mk if beyond 0mk.

Trend (Tr)…… ½ mk
Values of t to be increasing if otherwise 0mk
Summary
Complete table CT = 2 ½
Decimal point DP = ½
Accuracy Ac = ½
Trend Tr = ½
4mk

(a) Graph
Labeled axes with correct units = ½ mk
Scale to cover ½ or more of space = ½
Plotting done correctly = 1
Straight line through 3 point = 1
3mks

(b) Straight line graph
Increase in concentration; there are more collisions leading to increase in rate of reaction
(c) To read correct value of 1/t from graph
T=1/t ½ mk = ans. ½ mk
Question 3

	Observation	Inference
(a) (i)	Dissolves colourless solution ½ mk	Coloured ions absent, polar substance ½ mk
(ii)	White ppt forms ½ mk soluble in excess ½ mk	Al^{3+}, Pb^{2+}, Zn^{2+} present 3 ions 1mk 2 ions ½ mk 1 ion 0mk
(iii)	No white forms ½ mk Insoluble in excess ½ mk	Al^{3+} or Pb^{2+} present ½ each if Zn^{2+} absent ½ mk
(iv)	No white ppt forms 1mk	Pb^{2+} absent pr Al^{3+} present 1 for any
(v)	White ppt forms 1mk	Cl-, SO^{2-}_4, SO^{2-}_3, SO^{2-}_3 4 ions 1mk 3 ions ½ mk 2 or 1 ion 0mk
(b) (i)	Melts, ½ mk Burns with non-smoky flame ½ mk	Saturated compounds ½ mk $\diagdown\!\diagup C = C \diagdown\!\diagup$, or $-C \equiv C-$ Absent ½ mk
(ii)	Dissolves colour solution ½ mk	Polar organic compound ½ mk
(iii)	Solution has pH = 4 or 5 ½ mk	Weak acid -COOH present ½ mk
(iv)	Effervescence evoled ½ mk	-COOH present ½ mk
(v)	Decolourization occurs ½ mk	-COOH present ½ mk

N/B – Penalize for any contradictory ion ½ mk

2. (a) Working out average
Penalties
Wrong arithmetic penalize (- ½ mk)
Correct answer but no working shown (- ½ mk)
- ***Value rounded up to 1 d.p (- ½ mk)***
- ***Accept rounding off of answer to 2d.p***

(b) moles Na_2CO_3 = 0.05 x 25 = 0.00125 (½ mk)

1000
Moles HX = 2x 0.00125 = 0.0025 (½ mk)
Molarity of HX = 0.0025 x 1000 (½
Titre volume (Av.)
= ……

Table 2 and averaging
(c)To be marked as in table 1 bove 5mks
(d) (i) moles B = molarity of HX above x titre volume B
Moles C = moles B
Molarity of C = $\frac{\text{moles C x 1000}}{25}$
(ii) Molarity in d(i) x 56g

(c) Grams KOH in 250ml solution
= ans. In d(ii) ÷ 4…….x
Mass KCl in 2.1g = 2.1 – ans. In d(ii) 4
% KCl = $\frac{2.1 - x}{21}$ X 100

2. (a) TABLE
Constant temperature upto 1 ½ min
Then temperature rises slowly to a maximum.
Then remains constant
Lastly it drops slightly

(b) (i) Graph – scale 1mk (½ for each axis)
Plot 1mk (for all correct)
For more than ½
Correct (½ mk)
Curve 1mk

(ii) Read from graph
(c) Quantity of heat = $\frac{\text{40 x 4.2 x temperature change}}{1000}$
= ….KJ
(d) (i) $Cu^{2+} + Zn_{(s)}$ $Zn^{2+}_{(aq)} + Cu_{(s)}$
(ii) Moles Cu^{2+} = $\frac{0.2 \times 40}{1000}$ = 0.8
= 0.008moles
(iii $\frac{\text{Ans. in c x 1}}{0.008}$
(iv) Some heat is lost into the environment by conduction and convection
Question 3.
I
(a)- Jelly solid changes to white solid (½)
Gas evolved that puts off burning splint (½)
P is deliquesent (½
(b) (i) White ppt insoluble 1mk
Mg^{2+} or Ca^{2+} may be present ½
(ii) White ppt formed ½
Ca^{2+} present
(iii) No white ppt
Absence of SO^{2-}_4 or SO^{2-}_3 (½

(iv) White ppt ½
Cl^- present ½

(c) (i) Effervescence occurs/ bubbles (1) and hissing sound
Presence of CO^{2-}_3 ½
(ii) White ppt insoluble in excess ½
Mg^{2+} or Ca^{2+} present ½

II

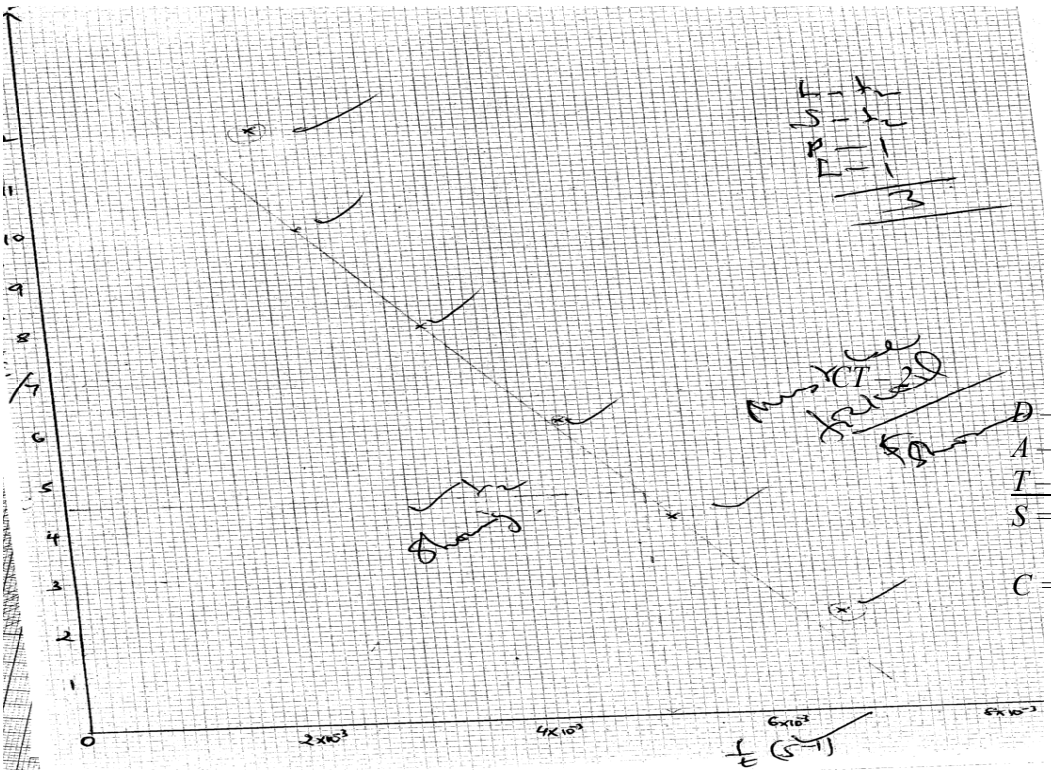
(a) Burns with yellow lame ½
Inflammable substance or organic
(b) (i) pH is 5-6
Weak acid (H^+ ions in)
(ii) Effervescence
- H^+ ions in Q

MIGORI –NYATIKE DISRTICT

1. (a)

Table 1

Piece of Magnesium added	*1*	*2*	*3*	*4*	*5*	*6*
Length of Magnesium added (cm)	*2*	*4*	*6*	*8*	*10*	*12*
Time taken t (second)	*150*	*190*	*225*	*295*	*430*	*500*
Reciprocal of time $\frac{1}{t}$ (S^-)	*0.00667*	*0.00526*	*0.00444*	*0.0033*	*0.00233*	*0.002*



D – 1
A – 1
T – 1
S = ½
P = 1
C = 1

(ii) $\frac{1}{t}$ = 0.00510 √½ From the graph and must be shown. Showing. √½

$t = \frac{1}{0.00510}$ √½ = 196.5 seconds. √½ ____

(iii) $Mg_{(s)} + H_2SO_{4(aq)} \longrightarrow MgSO_{4(s)} + H_{2(g)}$ √½
1 : 1 With correct physical state.

(iv) Moles of Mg = $\frac{0.12}{24}$ √½ = 0.005 moles √½ ____ **1mk**

Moles of H_2SO_4 used = 0.005 moles *(1 : 1)*

(v) Increase in length of M of ribbon results in decrease in $\left[\frac{1}{t}\right]$ √½

This is done to gradual decrease in the concentration of the acid. √½ ____

Table II

Titration	*I*	*II*	*III*
Find burette reading (cm^3)	*15.3*	*30.5*	*45.7*
Initial burette reading	*0.0*	*15.3*	*30.5*
Volume of solution B used (cm^3)	*15.3*	*15.2*	*15.2*

CT = 1
D = 1
AC = 1
PA = 1
TA = 1
5

(c) (i) $\frac{T_1 + T_2 + T_3}{3}$ √½ = C.A √½ 1 fall are consistent

OR

i.e $\frac{15..3 + 15.2 + 15.2}{3}$ √½ = 15.233 cm^3 √½

(ii) Moles of sodium hydroxide = $\frac{15.233}{1000}$ x 0.5 = 0.007617

i.e. Ans in $\frac{c\ (i)\ x\ 0.5}{1000}$ √½ = C.A. √½ ____ **1 mk**

(d) (i) Ans in $\frac{c\ (ii)}{2}$ √½ = C.A. √½ i.e. 0.007617 = 0.003809 moles ____ **1 mk**

(ii) Ans. in d (i) x 4 = C.A. ____
i.e o.003809 x 4 = 0.015236 moles. **1 mk**

(e) Ans in b (iv) + Ans. d(ii) √½ = C.A
0.005 + Ans. d (ii) = C.A ____
i.e. 0.005 + 0.015235 = ***0.020236 moles.*** **1 mk**

(f) Ans. in $\frac{e\ x\ 1000}{50\ cm^3}$ cm^3 = C.A.
i.e. $\frac{0.020236\ x\ 1000}{50}$ = ***0.40472 M***

2. (a)

Observations	Inferences
Dissolves to form colourless solution	. √½ Soluble salt or absence of coloured irons i.e Fe^{3+}, Fe^{2+}, Cu^{2+} √½

1 mk

(b) (i)

Observations	Inferences
No white ppt. √½ (½ mk)	Pb^{2+}, Al^{3+} or Mg^{2+} absent Or NH^{+}_{4}, Na^{+}, or K^{+} may be present. √½ (½ mk)

(ii)

Observations	Inferences
No white ppt. √½ (½ mk)	NH^{+}_{4}, Na^{+} √½ or K^{+} possibly present. √½ Or Pb^{2+} Al^{3+}, Zn^{2+} absent (1 mk)

1 ½ mks

(iii)

Observations	Inferences
White ppt. formed. √½ (½ mk)	CO_3^{2-}, SO_4^{2-} Or Cl^{-} present. √1 (1 mk)

½ mks

(iv)

Observations	Inferences
White ppt. √½ dissolves in excess ammonia √½ solution to form colourless solution.	Cl^{-1} present. √1 (1 mk)

2 mks

(v)

Observations	Inferences
Golden yellow flame. √½ (½ mk)	Na^{+} present. √1 (1 mk)

1 ½ mks

3. (a)

Observations	Inferences
Burns with yellow flame sooty /smoky flame. √½	- Long chain hydrocarbon - Unsaturated organic compound. √½ Or - Hydrocarbon with high C – H ratio or / C = C \ or — C ≡ C —

(b)

Observations	Inferences
Dissolves to form colourless solution. √1 (1 mk)	Polar organic compound/ soluble salt/ soluble comp. √1 (1 mk)

2 mks

(c) (i)

Observations	*Inferences*
Effervescence /bubbles /fizzing. √½ *(½ mk)*	*Presence of H^+ / H_3O^+ - COOO. √½* *(½ mk)*

1 mk

(ii)

Observations	*Inferences*
Orange colour remains the same / persists i.e does not change green. √½ *(½ mk)*	*Absence of R –OH. √½* *(½ mk)*

1 mk

(iii)

Observations	*Inferences*
$KMnO_4$ decolourized i.e changes from purple to colourless √1 *(1 mk)*	*$>C=C<$ Or - C ≡ C – Or Unsaturated organic compound. √1*

NYAMIRA DISTRICT

1. (a)

Time (min)	*0*	*½*	*1*	*1 ½*	*2*	*2 ½*	*3*	*3 ½*	*4*
Temperature (^oC)	*19.0*	*19.0*	*19.0*	*19.0*	*X*	*16.0*	*15.0*	*15.0*	*15.0*

C.T = 1
D.C = 1
A.C = 1
Tr = 1
4mks

Complete – 1mk
- *8 readings – 1mk- penalize – ½ of space not filled*
- *½ for unrealistic values T 100 or 40*
- *½ all constant t = 0 to t = 4*
- *½ if T(T(2 ½)*

Decimal place – 1mk
- Accept whole number or to 1d.p of 0.5 or 0.0

Accuracy – 1mk S.V ± 2units

Trend – 1mk

Award ½ - where t = 0 – t – 1 ½ min = all constant
t = ½ - t ½ min – constant
Award ½ - t – 2 ½ to 4min –show a drop

(b) Graph
Ans – ½ - both axis correctly labelled
Scale = ½ - use more than ¾ big squares in both axis
Plotting -1
Labeling -1
3 mks
Penalize ½ inverted and scale to accommodate all plots
Plotting – all 8 points award 1mk
- 6pts & 7 award
- ≤ 5 award 0mk
Labelling – Award ½ for two straight lines.

- ½ for extrapolation

(b) (i) T = correct reading

(ii) Heat of solution = MCΔT

= 50g x 4.2Jg-1K-1 x 4.5K

= -50 x 4.2 x 45J

$$= -\frac{50 \times 4.2 \times 4.5}{1000}\ KJ$$

ΔHsoln = ?

$$0.0238 moles = \frac{-50 \times 4.2 \times 4}{1000} JKJ$$

1mole= ?

$$= \frac{-50 \times 4.2 \times 4.5}{1000 \times 0.0238}\ KJ/mol^{-}$$

= -Ans

Penalized if ΔH – sign is + and not –ve (total 3mks)

TABLE 2

Titre	***I***	***II***	***III***
Final burette reading	***24.4***	***24.5***	***24.3***
Initial burette reading	***0.0***	***0.0***	***0.0***
Volume of solution H used (cm^3)	***24.4***	***24.5***	***24.3***

Conditions:- A complete table ...

3 consistent titrations 1ms

2 titrations done and are consistent...1mk

3 inconsistent titrations done and averaged 0mk

only 1 titration done.....0mk

C.T = 1
D.C = 1
AC = 1
PA = 1
GFA= 1
5mks

Penalty:

(i) Penalize ½mk for inverted table.

(ii) Penalize ½mk to unrealistic titre values e.g. volume cm3 unless explained.

(iii) Penalize ½mk for wrong arithmetic.

B- Use of decimals 1mk

(Tied to 1st and 2nd rows)

Conditions

(i) Accept 1 decimal place / point if used consistently.

(ii) Accept 2 decimal points , however the 2nd decimal point must be either 0.0 or 5.

Penalty

(i) Penalize fully if decimals are not used consistently

(C) Accuracy 1mk

(i) Conditions (i) If any of the volume used is within ±0.1cm^3 of the school value (S.V)...

(ii) If there is one value within ±0.2cm^3 of the school value (S.V)... (½mk)

(D) Principles of averaging.....1mk

Conditions

(i) If 3 titrations done are consistent and averaged....

(ii) If 3 titrations done and 2 are consistent and averaged 1mk

(iii) If 2 titrations done and are consistent and averaged....1mk

(iv) If titration done ...1mk

(v) If 3 titrations done and are inconsistent and averaged 0mk

(vi) If 2 consistent titrations averaged...0mk

(vii) If 3titrations are done and are consistent but are averaged 0mk

(E) Final answer 1mk

Conditions

(i) If the answer of the titre value is within ±0.1cm³ of the school value (S.V) award....1mk

(ii) If the answer of the titre value is within ±0.2cm³ of the school value .... ½mk

(iii) If the answer is not within ±0.2cm³of the school value (S.V) award....0mk

(e) Average volume of solution H used

$\frac{24.5 + 24.4 + 24.3}{3} = 24.4$ ✓½ ✓½

II. $\frac{24.4 \times 0.04}{1000} = 0.000976$ ✓½

III. $^5/_2 \times 0.000976 = 0.00244$ ✓½ ✓½ *(penalize ½ for wrong units)*

IV. $\frac{3}{\frac{250}{25} \times 0.00244}$ ✓½

$= \frac{3}{0.0244} = 122.95$

= 123(no units) penalize for units

(f) *123-90 = 33* ✓½

16 + (2x1) = 18x = 33

$x = {}^{33}/_{18} = 1.833$

$x = 2$ ✓½

2. (a) (i)

Observation	*Inference*
- Solid dissolves, yellowish solution. *- Colourless fumes/vapour are produced.* *- boiling tube becomes warm.(1 mk)*	*- Soluble compound.* *- Mix with water is exothermal heat is produced. (1 mk)*

(ii)

Observation	*Inference*
- Blue litmus turns red. *- No effect on litmus paper.*	*- Presence of H^+/H_3O in the solution.* *- Solution is acid (1 mk)*

(iii)

Observation	*Inference*
- White ppt. soluble in excess. (1 mk)	*- Pb^{2+}, Zn^{2+}, Pb^{3+} present. (1 mk)*

(iv)

Observation	*Inference*
- White ppt. persisted insoluble in excess	*- Al^{3+} or Pb^{2+} probably present*

(v)

Observation	*Inference*

- Mixture remains colourless/ No yellow ppt. seen. (1 mk)	*- Pb^{2+} absent (1glim).* *- Al^{3+} present*

(vi)

Observation	*Inference*
- White ppt. seen. (1 mk)	*- SO_4^{2-}, CO_3^{2-}, SO_3^{2-} absent* *- Cl- is present (probably present)*

(B(b)

Observation	*Inference*
- Solid melts forming a colourless and ignites /burns with *Smoky / sooty flame. (1 mk)*	*- Low compound organic compound/presence of* *or –C≡C–* *(accept absence of saturated organic compound). (1 mk)*

(c) (i)

Observation	*Inference*
- Dissolves in water forming colourless solution	*- Solution compound /polar compound*

(ii)

Observation	*Inference*
- Effervescence/ fizzling/bubbles of a colourless gas. *- No effect on litmus paper.*	*Presence of – COOH/ H^+/H_3O^+ ions.* *Solution is acid . (1 mk)*

Observation	*Inference*
- The solution remained orange.	*- Absence of R-OH. (1 mk)*

(iii)

Observation	*Inference*
Solution turns from purple to colourless solution is decolourised (1 mk)	*- Presence of of –C≡C-*

SOIK DISTRICT

1. TABLE I

a)Complete table penalize ½ for inverted table and arithmetic errors
b) Use of decimal tied to the 1st and 2nd rows
c) Accuracy ±0.2 s.v ✓½ ± 0.1 sv✓1
d) Principles of averaging as shown below
e) Final answer ± 0.2s.v ± 0.1 s.v✓1

a) $\frac{T_1+T_2+T_3}{3}$ *✓½*
= correct answer✓½ (2d.place) (transferred to the table)

b)i) $\frac{5}{40}$ *✓½*
=0.125 moles per litre

ii) $COOHCOOH_{(aq)} + 2\ NaH_{(aq)} \longrightarrow COONaCOONa_{(aq)} + 2H_2O_{(l)}$ *✓½ balanced*

OR

$C_2H_2O_{4(aq)} + 2\,Na_2O_{4(aq)} + C_2Na_2O_4(aq) \longrightarrow 2H_2O(l)$

iii) Moles of NaOH = $\frac{25X0.125}{1000}$ √

= 0.003125

Moles of $C_2H_2O_4$ = $\frac{0.003125\ X\ 1}{2}$

= 0.0015625

Ans in (a) ⟶ 0.00015625

∴1000cm³ ⟶ 1000x0.0015625 √½
Ans in (a)

= Correct answer √½

V) $C_2H_2O_4 \cdot X H_2O$ = answer in (iv) √½

18x = Ans (iv) - 90√½

x = $\frac{\text{Ans (iv)} - 90}{18}$ √½

= Correct answer √½ (whole number)

2. Table 1
   - ½ mk each correct entry
   - Penalize 1 mk if 1 d. place is not used consistently in the last row.
   - Penalize ½ mark for temperature below 400c and 1000c to a maximum of 1mark.
   - Penalize 1 mark if there is no trend.

(ii) Graph
- Labeling (½ mark) – Title, axes, correct units.
- Scale (½ mark) – more than on both axes.
- Plotting (1mark) – All points plotted correctly.
  - Curve(1mark) – Smooth curve passing through at least 3 correctly plotted points.

(iii) ½ mark
(a) 1 mark
(b) 1mark
(c) 1 mark
} Read from candidates graph and credited only if within ±0.1 the S.V

3. (a)

Observations	Inferences
- Black residue √½ - Colourless solution as filtrate √½	X
(b) - Blue solution formed √½ - No effervescence √½	CU^{2+} may be present √½ HCO_3^-, CO_3 √½ absent the two
(c) - Blue ppt √½ - Insoluble in excess √½	CU^{2+} may be present √½
(d) - Blue ppt √½ - Soluble to give a deep blue solution √½	CU^{2+} Present
(e) – No white ppt √1	Ag^+, pb^{2+} absent (for two) CO_3 HCO_3^-
(f) – White ppt √½	Cl^-, SO_4^{2-} may be present √1

(g) – White ppt √½	*SO_4 present √½*
(h) – White ppt √½ *- Soluble in excess √½*	*Zn^{2+} Al^{3+} may be present*
(i) – White ppt √½ *- Soluble in excess*	*Zn^{2+} Present.*

UGENYA – UGUNJA DISTRICT

Q.1. ***a) Table 1***

	I	*II*	*III*
Final burette reading (cm^3)	*20.0*	*40.0*	*20.0*
Initial burette reading (cm^3)	*0.0*	*20.0*	*0.0*
Volume of solution M used (cm^3)	*20.0*	*20.0*	*20.0*

Complete table – 1 mk
Decimal - 1 mk
Accuracy - 1 mk
Principle of averaging – 1 mk
Final Answer - 1 mk

b) Average volume of solution M used $V_1 = \frac{(20.0 + 20.0)}{2}$ cm^3

$= 20.0$ cm^3

c) $\frac{\text{Mass per litre}}{\text{Molar mass}} = \frac{23.5}{392}$ √½ $= 0.0599$ √½

d) $\frac{25}{1000} \times$ Answer (c) $= \frac{25}{1000} \times 0.0599$ √½

$= 0.0014987$ √½

e) 20 cm^3 of solution M contains $\frac{\text{Answer in (d)} \times 1}{5}$ moles of MnO_4^-

$= \frac{0.0014987}{5} \times 1$ √½

$= 0.0002997$ moles. √½

∴ 1000 cm^3 of solution M contains $\frac{1000}{20} \times \frac{\text{Answer in (d)}}{5}$

$= \frac{1000}{20} \times 0.0002997$ √½

$= 0.014985$ moles √½

f) Table II

	I	*II*	*III*
Final burette reading (cm^3)	*19.4*	*38.8.*	*19.4*
Initial burette reading (cm^3)	*0.0*	*19.4*	*0.0*

Volume of solution M used (cm^3)	*19.4*	*19.4*	*19.4*

Complete table – 1 mk
Decimal - 1 mk
Accuracy - 1 mk
Principle of averaging – 1 mk
Final Answer - 1 mk

g) Average volume of solution M used, V_2 = $\frac{(19.4 + 19.4 + 19.4)}{3}$ cm^3
= 19.4 cm^3

h) $\frac{\text{Average volume}}{1000}$ x Answer in (e)
$\frac{19.4}{1000}$ x 0.014985 √½ = 0.0002907 √½

i) 1 Mole of MnO_4 reacts with 2.5 moles of S.
∴ Moles of MnO_4 in (h) reacts with 2.5 x moles in (h) of S.
∴ 25 cm^3 of S will contain 2.5 x 0.0002907 √1 = 0.0007267 √1

j) $\frac{1000}{25}$ x Answer in (i)
$\frac{1000}{25}$ x 0.0007267 √½ = 0.029068 M √½

k) Answer in (j) ⇒ 5.0g
1 Mole of S = $\frac{1 \times 5.0}{\text{Answer in (j)}}$
= $\frac{1 \times 5.0}{0.029068}$ √½
= 172.0g √½

$H_2X \bullet 2H_2O$ = 172.0
2(l) + X + 2(18) = 172.0 √1
X + 38 = 172.0
X = 172.0 – 38 √½
= 134.0 √½

Q. 2. a)

Observations	*Inferences*
- Colourless vapour condenses on the cooler parts of the test tube *- Moist blue litmus paper remains blue and red litmus paper remains red.* *- White powder.* *Any 2 = 1 mk*	*Hydrated salt / water crystallization √1* *$/OH^-$*

b)

Observations	*Inferences*
Dissolve √½ to form a	*Soluble salt / substance / compound. √½*

colorless *√½ solution.*

i)	*Observations*	*Inferences*
	White precipitate √½ *Insoluble √1 in excess*	*Ca^{2+}, Mg^{2+}, Ba^{2+}* *3 = 1 mk* *2 = ½ 1 = 0 mk*

ii)	*Observations*	*Inferences*
	White precipitate √1	*Ca^{2+}, Ba^{2+} 2 = 1 mk* *1 = ½ mk*

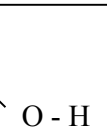
iii)	*Observations*	*Inferences*
	No white precipitate. √1	*SO_4^{2-} √1 absent*

iv)	*Observations*	*Inferences*
	White precipitate dissolves √½ *on boiling and re-appears √½ on cooling*	*Cl^{-1} √1*

Q.3 a)	*Observations*	*Inferences*
	Burns with yellow √1 smoky/ sooty flame	*C = C or -C≡C-, Long chain hydrocarbon, unsaturated organic compound, hydrocarbon with high C : H ratio. Any 1 = 1 mk*

b)	*Observations*	*Inferences*
	Dissolves √1 to form a colourless solution.	*Polar organic √1 compound / polar substance*

i)	*Observations*	*Inferences*
	$KMnO_4$ √1 decolorized / changes from purple to colourless.	*C = C -C ≡C-* *2 = 1 mk 1 = ½ mk*

ii)	*Observations*	*Inferences*
	Methyl Orange turns √1 pink / red.	*√1 H^+ / H_3O^+ / -* 

Question 1.

Table 1

Distributed as follows:

(i) Complete table

Values must be ±0.2 of each other

(ii) Decimal place

Values should be n 1d.p or 2d.p consistently used.

(iii) Accuracy

Compare the school value to any of the readings and award as follows:

If ±0.1 award 1mk

± 0.2 award ½mk
Outside 0.2 award 0mk
(iv) Principle of averaging
- *Award 1mk for consistent value only.*
- *Penalize ½mk for rounding of the answer to 1d.p unless it divides exactly.*
- *In consistent values averaged award 0mk*

(v) Final answer value to the school to compare the average value to the school value:-
If ±0.1 award 1mk
If ±0.2 award ½mk
If outside award 0mk

Calculations

(a) $\frac{\text{Titre 1 + Titre II + Titre III}}{3}$ = Answer

(b) $NaOH_{(aq)} + HCl_{(aq)} \longrightarrow NaCl_{(aq)} + H_2O_{(l)}$
Mole ratio 1 :1
0.5M 0.5M

$\frac{25 \times 0.5}{1000}$ = 0.0125 moles

(c) Mole ratio
NaOH : HCl = 1 :1
∴Molarity of NaOH is 0.5M

Table II
Marking should be done as in table 1.
Calculations

(a)) $\frac{\text{Titre 1 + Titre II + Titre III}}{3}$ = Answer

(b) 1000 = 0.5moles
100cm³ = ?
$\frac{100 \times 5}{1000}$ = 0.05moles
100cm³ = 0.05moles
∴25cm³ = ?
$\frac{25 \times 0.05}{100}$
= 0.0125moles
(c) mole ration 1:2
∴Moles of carbonate = ½ x 0.0125 = 0.00625moles
(d) 125

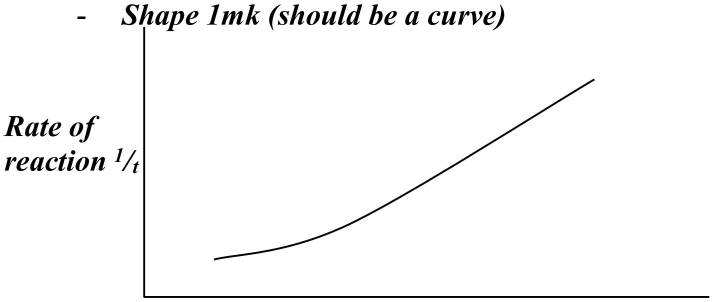
Question 2
Table III
Marks should be distributed as follows :
(i) Complete table
- Incomplete table with more than 5value ½mk
(ii) Decimal
- *Accept whole numbers for time*

- $^1/_t$ must be decimals not fractions
(iii) Trend in time
- *Accept reducing values for time*

(iv) Trend in $^1/_t$

(b) The value given must shown on the graph
- Conversion of 318K to °C is very important before reading form the graph.
GRAPH

- *Labeleling ½ mk for both axes*
- *Scale ½ k (at least ¾ pg)*
- *Plotting 1mk*
- *Shape 1mk (should be a curve)*



(c) As the temperature is increased the time taken for the reaction to take place is reduced due to high collision of particles hence the rate of reaction will be high.
Rate of reaction is directly proportional to increase in temperature.

Question 3

Procedure 1

White precipitate	*Ba^{2+}, Pb^{2+}, Ca^{2+} present* *N/B (i) All 3 ions award 1mk* *(ii) Any 2 ions award ½ mk* *(iii) Only 1 ion given award 0mk*
No white precipitate	*Ba^{2+}, Ca^{2+} present* *(i) Award 1mk for 2 ions* *(ii) Award ½ mk or any ion of the two given*
Pink solution s formed	*OH^- ions present* *Reject- solution is basic or allealine or a base*
Brick- red flame	*Ca^{2+} confirmed* *N/B – Award 1mk if it appears in either (a) or (b) above otherwise give zero.*

Procedure 2

(a) Effervescence of bubbles of gas	*H^+ present* *R – COOH present*
(b) Purple colour gets decolourized	$>C = C<$ or $– C \equiv C -$ *Present*
(c) Fruity or sweet smell	*R – COOH confirmed*

MUMIAS DISTRICT

TABLE 1,,, (5 mks)
Distributed as follows:
i) Complete table (1 mk)
Values must be $\pm$ 0.2 of each other.

ii) Use of decimal (1 mk)
Values should be in 1d.p or 2d.p consistently used

iii) Accuracy (1 mk)

Compare the school value to nay of the readings and award as follows
IF± 0.1 award 1 mk
IF ± 0.2 award ½ mk
Outside± 0.2 award 0 mk

iv) Principle of averaging (1 mk)
- ***Award 1 mk for consistent values averaged***
- ***Penalize ½ mk for rounding off the answer to 1d.p unless it divides exactly***
- ***Inconsistent values averaged – award 0 mk***

v) Final answer 1mk
- Compare the averaged value to the school value
If ± 0.1 award 1 mk
If ± 0.2 award ½ mk
If outside ± award 0 mk

CALCULATIONS

a) $\frac{\text{Titre 1 + Titre II + Titre III}}{3}$ = Answer

b) RFM of acid = 2 + 2 912) + 4(16) + 2(2 + 16)
= 126

If 500cm3 contains 6.3 g
1000cm3 contains ?
6.3 x 1000 = 12.6dm3
Concentration = 12.6g/dm3
Or 0.1 M

c) Molarity of solution C

Acid	:	Alkali
1	:	2

If 1000cm3 contains 0.1 moles
25cm3 contains ?

$$\frac{25 \times 0.1}{1000} = 0.0025 \text{ moles}$$

From mole ratio: 25cm3 of alkali contains
0.0025 x 2 = 0.005 moles
If 25cm3 alkali contains 0.005 moles
100cm3 alkali contains $\frac{0.005 \times 1000}{25}$

= 0.2 moles
Molarity = 0.2 M

Procedure 2
TABLE 2
Marking should be done as in table 1

CALCULATION

a) $\frac{\text{Titre I + Titre II + Titre III}}{3}$ *= answer*

b) 25cm3 of NaOH contains 0.005 moles
Mole ration 1 : 1
Moles of acid = 0.005 moles
If Titre in (a) of solution D contains 0.005 moles
1000cm3 of solution D contains:

$\frac{0.005 \times 1000}{\text{Titre in a}}$ *= answer in moles*

c) 10cm3 of A contains moles in (b) above
1000cm3 of A contains

$\frac{\text{Ans in b} \times 100}{10}$ *= Answer*

NB This answer should be close or equal to 4.0M

Question 2
TABLE 3 (5 mks)
Distributed as follows
i) Complete table (1mk)
- Award 1 mk for completely filled table (at least 8 values)

ii) Use of decimals (2 mks)
- *Use of decimals for temperature readings award 1 mk*
- *Use of correct decimals for time readings award 1 mk*

NB Penalize ½ mk if i/t is given as fraction

iii) Trends
Trend for temperature 1mk (i.e. should be decreasing)
Trend for time 1 mk(should be increasing)

GRAPH
Should be distributed as follows:
- *Labelling the axes ½ mk for both axes*
- *Scale ½ mk (at least ¾ pg)*
- *Plotting I mk*
- *Shape (accept a curve and award 1 mk)*

Question 3
Test for solid K

	Observations	*Inferences*
a)	*- colorless liquid condenses at the cooler parts of the test tube* *- Cracking sound produced*	*- Presence of hydrated substance* *- Contains water of crystallization*
b)i)	*- White precipitate soluble in excess*	*- Al3+, Zn2+ or Pb2+ ions present* *3 stated 1mk, 2 stated ½ mk*
ii)	*No white precipitate formed*	- *Presence of AL3+ and Zn2+* - *NB must have been correctly inferred in part b(i)*
iii)	*White precipitate formed*	*Presence of SO2-4 or CL-*

	Test for solid F	***Award 1 mk for any 2*** ***Award ½ mk for any 1 10n given***
c)	***Effervescence or bubbles produced***	***Presence of H+, H3O+, R-COOH***
d)	***Decolorises acidified KMnO4 or turns KMnO4 to colourless***	***Presence of reducing agent*** ***C = C – C = C-*** ***Or ROH, SO3***
e)	***Fruity or sweet smell***	***R- COOH confirmed***

KISUMU DISTRICT

1.

	1	***2***	***3***
Final burette reading (cm^3)			
Initial burette reading (cm^3)			
Vol. of sol. C used (cm^3)	***22.9***	***22.9***	***22.9***

. ***(i) C. T***
(ii) D.P ½ mk
(iii) Ac 1mk
(iv) AV1mk
(v) F ½ mk
(a) (i) Average volume of B (above
(ii) Moles of NaOH solution C = $\frac{25 \times 0.4}{1000} = 0.01$
(iii) Moles of HCl solution B
$NaOH + HCl \longrightarrow H_2O + NaCl$
Ratio base : acid = 1: 1
HCl = 0.01

(ii) Molarity of HCl
= $\frac{0.01 \times 1000}{\text{ans}}$, (a(iv)
Ans (a) (i)
Table 1
(b) (i) $\frac{1.2 + 12 + 12}{3} = 12$ (above)
(c) (ii) Moles of NaOH solution C
$\frac{\text{Ans (b) (i)} \times 0.4}{1000}$ = ans b(ii)
iii) Calculate the number of moles of hydrochloric acid in 200cm^3 solution D
$NaOH_{(aq)} + HCl_{(aq)} \longrightarrow NaCl + H_2O$
Mole ratio Acid: base = 1:1
In 25.0cm solution of HCl = Ans b(ii)
Moles of hydrochloric acid solution B contained in 25.0cm^3 of B
$\frac{200 \times \text{ans (ii)}}{25}$ = ans (iii)
iv) Moles o hydrochloric acid solution B contained in 25.0cm3 of B= $\frac{25 \times \text{ans a(iv)}}{1000}$
= ans. (b)(iv)
v) Moles of HCl that reacted with Calcium Carbonate
= ans (b) (iv) – ans (b)(iii) (½ mk)

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

Mole ratio Carbonate: acid = 2:1 ½mk

Mole of calcium carbonate = $\frac{\text{ans.(b)(iv) – ans. (b) (iii)}}{2}$ (½ mk)

= ans. (b)(v)

(vi) RMM = 100g

Mass in mixture = 100 x ans (b) (v) ½

= ans. (b) (vi) (½ mk)

vii) % of calcium carbonate in the 2g mixture = $\frac{\text{ans (b) (vi) x 100}}{2}$ ½

= ans. (vii) ½

2.

Volume of T added (cm^3)	0	5	10	15	20	25	30	
Volume of S + T (cm^3)	20	25	30	35	40	45	50	
Temperature of mixture (^oC)								

CT 1mk

DP1 1mk

AC 1mk

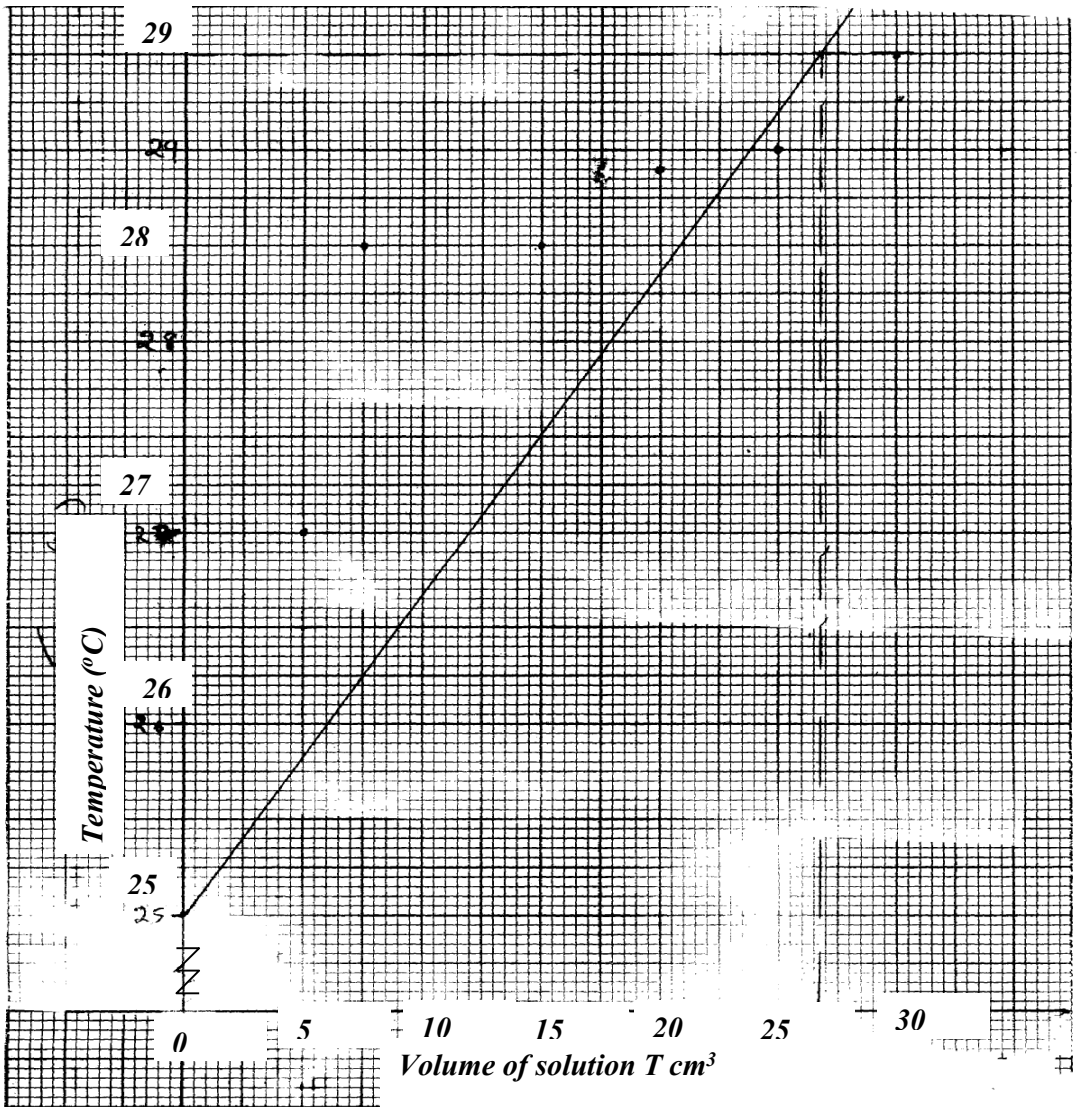
(b) Graph

Label of axes ½

Scale ½

Plot 1 ½

Shape ½]



c) (i) from graph ½

(ii) Highest temp- lowest temp (from graph)

(d) 50x{[ac(ii)] x 4.2 = ans. D

(e) No. of moles of T used = $\frac{c(i) \times 1}{1000}$

= ans. (e)

(f) No. of moles used

$NaOH + HCl \longrightarrow NaCl + H_2O$

Mole ratio 1:1

= ans (e) = ans (f)

(g) and (f) moles liberate (and d) J

$\left(\frac{1 \text{ mole and (d)} \times 1}{\text{Ans (f)} \times 1000}\right)$

= -Ans (g) KJmole-1

3.

Observation	*Inference*
(a) Brown gas formed ½ *Blue litmus paper turns red/red litmus paper remains red*	*NO_3^- present ½*
(b) Partly dissolves/blue ppt do not dissolve ½	*Soluble and insoluble salt*
(c) (i) Partly soluble in excess *(ii) Yellow ppt*	*Al^{3+} / Pb^{2+}/Zn^{2+}* *Pb^{2+}*
(d) (i) Effervescence *(ii) Blue ppt, insoluble in excess ½*	*CuO_3^{2-} suspected* *Cu2+ suspected*
(e) Blue ppt, dissolves ½ *Deep blue solution ½*	*Cu2+ confirmed*

RACHUONYO DISTRICT

1. a) Moles of Hcl present in $50cm^3$ = $\frac{50x1}{1000}$ = 0.05 moles

i) Complete table (1 mark)

- *3 titrations done-*
- *2 titrations done*
- *1 titration done*

NB: Penalise ½ mark to a max of ½ mark for;

- *inverted table*
- *wrong arithmetic*
- *burette readings beyond 50 cm_3 except where explained*
- *Unrealistic (below 1 cm3)*

ii) Use of decimals (1 mark)

- 1d.p or 2 d.p throughout
- for 2 d.p the 2nd digit is either 0 or 5 otherwise penalize fully

iii) Accuracy (1 mark)
- Compare to teachers values. If any is within;
0.1 of teachers value
0.2 0f teachers value
Beyond 0.2 of teacher value

iv) Averaging
If 3 averaged within 0.2 of each other
If 2 averaged within 0.2 of each other
If 3 or 2 averaged but outside 0.2 of each other

v) final answer (1 mark)
Compare to teachers average title. If within;
0.1 of teachers value
0.2 of teachers value
Beyond 0.2 of teachers value

c) i) Volume of NaOH = $\frac{\text{Title x 250}}{25}$
= correct ans ½

ii) Moles of NaOH = $\frac{\text{Ans c (i) x 0.1}}{1000}$
= correct ans ½

d) NaOH (aq) + HCL (aq) ⟶ NaCL (aq) + H2O (s)

e) NaOH: Hcl = 1:1
Moles of HCL = Moles Of NaOH = Ans in C (ii)

f) Moles of HCl that reached with CO_3^2 = 0.05 – Ans ©, ½ mark
Correct aswer ½ mark

OR
Ans (a) – Ans (e) = correct Ans

g) i) $CO_3^{2-}{}_{(aq)}$ + 2H+ Aq $Co_2 + H_2Oi$

ii) Moles of CO_3^{2-} = $\frac{\text{Ans (f)}}{2}$
= correct Ans

iii) Molar mass = $\frac{1.5}{\text{Ans g (ii)}}$ = correct answer

2. a) Table 2 (6 marks)
i) Complete table
ii) Accuracy 2.0 c of the teachers 1st value ½

iii) Use of decimals
Accept to 1 d.p or whole number for temp reading for ½
Award o mk if the 2nd decimal point is not zero or 5. Reject 2 d.p

iv) Trend- Temperature readings to decrease continuously
Time to increase continuously

b) Graph (3 marks)
i) Labelled axes ½
ii) Scale ½
NB Area occupied by the actual plots should be at least ½ of the total big squares along the horizontal axis by at least ½ of the total big squares along the vertical axis

iii) Plots
iv) Curve
c) From the graph
d) From the graph

e) The higher the temperature the higher the rate of reaction

3 a)

Observation	***Inferences***
White powder ½	***Fe^{2+}, Fe^{3+} and Cu^{2+}***

b)

Observation	***Inferences***
	Mixture of soluble and insoluble salt

i)

Observation	***Inferences***
No white precipitate ½	***Zn^{2+}, Al^{3+}, Pb^{2+}, Mg^{2+},, Ca^{2+}***

ii)

Observation	***Inferences***
Yellow flame	***Na^{+} ½ present***

iii)

Observation	***Inferences***
White precipate	***SO_4^{2-} present***

c)

Observation	***Inferences***
- Effervescence/ hissing sound ½	
- Colorless gas forms white precipitate with calcium hydroxide ½	***CO_3^{2-} present ½***
- Solid dissolves to give colourless solution	

d) i)

Observation	***Inferences***
White precipitate ½ soluble in excess	***Pb^{2+}, Zn^{2+} or Al^{3+}***

ii)

Observation	***Inferences***
White precipitate insoluble in excess	***Pb^{2+} or Al^{3+}***

iii)

Observation	***Inferences***
Yellow precipitate	***Pb^{2+} present***

KAKAMEGA NORTH DISTRICT

Procedure;
TABLE A;

Initial temp of CuSo4(c)	***25.5***
Final temp of CuSO4	***31.0***
Temp change T(C)	***5.5***

TABLE B;

Initial temp of CuSo4(c)	*25.5*
Final temp of CuSO4	*48.0*
Temp change T(C)	*22.5*

a) i) Exothermic// there is temperature rise heat energy is released to the environment
ii) Moles of CuSO4(aq) = 0.2 x $^{25}/_{1000}$ = 0.005

b) i) $\Delta H = 25gx4.2Jg^{-1}K^{-1}$ x5.5K (ORΔ T)

c) i) Powdered metals have increased surface are many metal particles with come in contact with HCL acid and react
ii) Grey// metallic grey

d) - Metal A dissolves in CuSO4(aq) solution and a green/ pale green solution is formed
- The blue colour of copper (II) sulphate solution fades/ disappears. Brown solid deposited
- Metal A displaces copper; from its solution implying that A(q) is more reactive than $Cu_{(s)}$

e) i) $\Delta H = 25gx4.2Jg^{-1}K^{-1}$ xΔ T (22.5) K = 2362JJ

If 0.5g _____ 2362.5J
∴65g _____ $\frac{(65x2362.5)}{0.5}$ J = 307125J mol = 307.125KJmol

ii) B, A
_____ Decreasing reactivity

B gave higher Δ T// more heat energy was released when B reacted with CuSO4(aq)

Procedure;

Table of results

EXPERIMENT	*I*	*II*	*III*
Final Vol. of solution C (cm3)			
Initial Vol.of solution C (cm3)			
Vol.of solution C used (cm3)			

1. a) Volume of pipette = 25cm3

b) Average volume of C = $\frac{38.5 + 38.5 + 38.5}{3} = \frac{115}{3}$ = 38.5

c) Moles of solution C = 0.1 x $^{38.5}/_{1000}$ = 0.00385

d) i) $HCL_{(aq)} + MOH_{(aq)}$ _____ $MCL_{(aq)} + H_2O_{(L)}$

Penalize ½ for wrong or missing s

ii) $H^+_{(aq)} + OH^-_{(aq)}$ _____ $H_2O_{(L)}$

iii) $HCL_{(aq)}$: $MOH_{(aq)}$

1 : 1
0.00385 : 0.00385

e) i) $\frac{M_AV_A}{M_BV_B} = \frac{1(MR)}{1}$ where A = $HCL_{(aq)}$ B= $MOH_{(aq)}$

Therefore $M_B = \frac{0.1x38.5x1}{25x1} = 1.54$

ii) R.M.M = $\frac{\text{mass per litre}}{\text{molarity}} = \frac{6.16}{0.154} = 40$

iii) MOH = 40
M+ 17 = 40
M= 40-17= 23

Observation	*Inference*
a) White fine crystal solid	*Absence of coloured salts e.g. Cu^{2+}, Fe^{2+} or Fe^{3+} absent*
b) E dissolved to form a colourless solution	*E is a soluble salt*
i) No observable change No ppt	*Absence of insoluble hydroxides*
ii) No observable change No ppt	*Absence of ions that form isol. Ppt with $NH_{3(aq)}$*
iii) White ppt. insoluble in acid	*$SO4^{2-}$ ions present So_3^{2-} ions absent*
iv) White ppt. insoluble in acid	*Confirms the presence of SO_4^{2-} ions*
v) Nichrome wire burns with a yellow flame	*Confirms the presence of Na^+ ions*

BUTERE DISTRICT

TABLE 1

1. *Complete table*
   Penalties
   - *Unrealistic burette reading.*
   - *Arithmetic error*
   - *Inverted table.*

   N/B Penalize ½ mk each to a max. of ½ mk

2. *Use of decimal.*
   - Consistent 1 d.pt. or 2 d.pt. –
   - If 2 d.pt. the last digit must be zero or five.
   - Otherwise award 0
   - Accept the consistency of zero.

3. *Accuracy*
   - Tied to the school value.
   - Check any of the titre readings.
   (i) If any of them is within $\pm$ 0.1 from S.V. award
   (ii)If within $\pm$ 0.2 unit award – (½ mk).
   (iii) If outside $\pm$ 0.2 unit award zero.

4. *Principle of Averaging.*
   (i) 3 consistent values average –
   (ii) 2 consistent values averaged – (½ mk)
   (iii) Otherwise award 0.

Penalties

(i) Answer should be at least 2 d.p. unless divided exactly.

b) No. of moles M_2 = $\frac{\text{ans(a) x 1}}{1000}$ ✓1

Correct ans. ✓1

c) $2H^+(aq) + CO_3^{2-}(aq) \longrightarrow H_2O(l) + CO_2(g)$

(i) Balancing = ½ mk

(ii) States (correct) = ½ mk

d) Moles of base = ½ x ans. (b) ✓1 mk

= correct answer ✓1 mk

e) Concentration = answer in (d) x $\frac{1000}{25}$ ✓1 mk

= Correct answer ✓1 mk

f) Mass of Na_2CO_3 = 106 x ans. (e) ✓1 mk

= Correct answer ✓1 mk

g) Mass of NaCl = 95 – ans. (f) (½)

% of NaCl = $\frac{\text{95 – ans. (f)}}{95}$ x 100

= Correct answer ✓½

2. a) TABLE 2

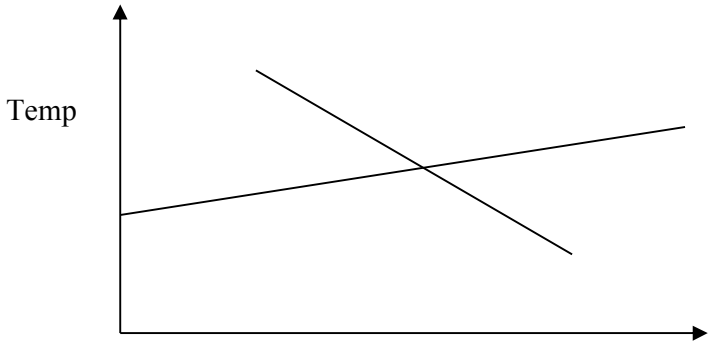
(i) Complete table 1 mk

(ii) Accuracy to S.V. 1 mk

(iii) Decimal 1 mk

(iv) Trend. 1 mk

b) Graph



Labeling – 1 mk
Plotting – 1 mk
Scale – 1 mk
Shape – 1 mk

c) (i) - Shown in graph (½ mk)

- Correct reading (½ mk)

(ii) ΔT shown in graph - (½ mk)

Correct answer from graph - (½ mk)

d) ΔH = MCΔT = (23 + c(i) x 4.2 x c (ii) ✓1 mk
Correct answer

e) Moles = $\frac{1 \times 23}{1000}$ ✓½ = 0.023 moles ✓ ½

f) Molar heat = $\frac{1 \times \text{ans. (d)}}{\text{ans. (e)}}$ ✓1
= Correct answer. ✓1

	Observation	Inferences
a)	Colourless solution forms ✓1	Soluble salt/ Absence of coloured ions /Fe^{2+}, Fe^{3+}, Cu^{2+} absent ✓1
b)	White ppt ✓1 soluble ✓1 in excess	Ba^{2+}, Pb^{2+}, Zn^{2+}, or Al^{3+} present. ✓1
c)	White ppt. insoluble in excess. ✓1	Ba^{2+}, Pb^{2+}, or Al^{3} present. ✓1
d)	No white ppt. // no ppt. ✓1	SO_4^{2-} absent. ✓1

CALCULATIONS

b. (i) Moles of soltn P = $\frac{\text{average titre} \times 0.2}{1000}$ ½ mk
= correct Ans. ½mk

b. (ii) $NaOH_{(aq)} + HCL_{(aq)} \longrightarrow Nacl_{(aq)} + H2O_{(l)}$
Mole ratio= NaOH: HCl is 1:1
∴Moles of NaOH soln S = $\frac{1}{1}$ x Ans. b(i) ½mk
= corr. Ans.

b. (iii) 25cm³ soltn. S = Moles in Ans. b(ii)
100cm³ soltn. S = ?
= $\frac{100}{25}$ x Ans. b(ii) ½mk
=Correct Ans. ½mk

(c) 100cm³ ⟶ soltn S Moles in Ans. b(iii)
200cm³ Soltn S ⟶ $\frac{200}{100}$ x moles in Ans. b(iii) ½mk
∴moles in 25cm³ NaOH = $\frac{200}{100}$ x moles in Ans. b.(iii) ½mk
= 2 x moles n Ans. b(iii)
= Correct Ans. ½mk

(f) Moles of R in 25cm³ = Ans. (e)
Moles of R in 1000 = ?
= $\frac{1000}{25}$ x Ans (e) ½mk
= corr. Ans. ½mk

(g) (i) Molar mass of H_2SO_4 = $\frac{49 \times 1}{\text{Moles in (f)}}$

= Corr. Ans.

(g) (ii) Let R.A.M of A be equal to a

∴ 2 + a = Ans. g(i)

a = Ans. g(i) – 2

= Corr. Ans.

2. (a) Table III..... .

- Distributed as follows:-

Complete table .....

- All columns filled 1mk

- Any 4 correctly filled ½mk

- Otherwise penalize fully

Accuracy.....

Compare candidate's initial temperature with S.V; if with ± 0.2 units award 1mk, otherwise penalize fully.

Trend.....1mk

Award 1mk for, increase then constant

(b) Award 4mks distributed as follows

Correct labelling.....1mk

Correct plotting.....1mk

Curve/line.....1mk

Appropriate scale.....1mk

. 4mks

(c) (i) Award 1mk for correct reading

(ii) Highest temperature-initial temp = corr.ans.

(d) Heat change = MCΔT ✓ (½mk)

= corr Ans (½mk)

(e) No. Vol. from highest temp change

(f) Moles used = vol. in (e) x 10 / 1000

= Corr. Ans.

∴ Moles in (f) produce ⟶ heat change (d)✓

I mole = ?

= 1 x Heat change in (d) / Moles in (f)

= Correct answer (½mk)

3. (a) Observations Inferences

- Dissolves ½mk to form a colourless Solution ½mk ✓

- Absence of coloured ions e.g. Cu^{2+}, Fe^{2+}, Fe^{3+}

i) To the first portion, add Nitric acid followed by Barium nitrate solution.

Observations	*Inferences*
½ ✓½ White ppt, insoluble in nitric acid	SO^{2-} ions present ✓ 4

ii) To the second portion, add Nitric acid, followed by lead(ii) Nitrate solution

Observations	*Inferences*
✓	SO^{2-} confirmed

White ppt, ½mk insoluble in nitric acid ✓
½ mk ✓

iii) To the third portion, add a few drops until in excess

Observations	***Inferences***
White ppt, ½mk soluble in excess ½ mk	Al^{3+} , Pb^{2+} or Zn^{2+} present

N/B - All three mentioned - 1mk
Any two mentioned - ½mk
Only 1 mentioned - 0mk

iv) To the fourth portion, add a few drops until in excess

Observations	***Inferences***
White ppt, ½mk soluble in excess ½mk	Zn^{2+} confirmed

TRANSNZOIA WEST DISTRICT

Q1. i) Complete table with 3 titrations done – 1 mark
ii) Incomplete table with 2 titrations done – ½ mark
iii) Incomplete table with 1 titration done – 0 marks

Penalties
i) Wrong arithmetic
ii) Inverted table
iii) Unrealistic values

Penalize ½ mark for each to maximum of ½ mark

Decimals (1 mark)
Conditions
i) Accept either 1 or 2 decimal point constitently.
ii) If 2 decimal point used the 2nd decimal point can only be 0 or 5

Accuracy 1 mark
Compare any litre values in the 3rd row with the school value (sv)

Conditions
i) If within I 0.1cm3 of S.V 1 mark
ii) If within I 0.2 of S.V ½ mark
iii) Beyond I 0.2 of SV 0 mark

N.B If there is wrong arithmetic in the table compare the SV with the correct value and credit accordingly

d) Principle of averaging 1 mark
Values averaged must be shown and must be within I 0.2cm3 of each other

Conditions
i) 3 values averaged and consistent - 1 mark

ii) 3 values done and only 2 possible averaged ***1 mark***
iii) 2 titrations done and averaged ***1 mark***
iv) 2 titrations done inconsistent ***½ mark***
v) 3 titrations done and possible but only two averaged ***0 mark***

e) Final answer ***1mark***
NB Compare the SV
i) If within I0.1 of SV ***1 mark***
ii) If within I 0.2 of SV ***½ mark***
If beyond I 0.2 of SV ***0 mark***
If the candidate has averaged wrong values, pick the correct value if any, average and credit accordingly

B. $HB_{(aq)} + NaOH_{(aq)} \_\_\_\_\_ NaB_{(aq)} + H_2O_{(L)}$ ***1 mark***

C. ***i)*** $\frac{0.2075 \times Volume}{1000} = Moles$ ***1 mark***

ii) Reacting ratio 1: 1
∴ Moles of T = answer in C (i) above

iii) Answer in b(ii) above $\times \frac{1000}{25}$

d) ***i) 1.62425g _____ 250cm3***
6.497g/l _____ 1000cm3
$M = \frac{g/l}{Mm}$

∴ mm = 6.497
Answer in b(ii) above

ii) HB = answer in d(ii) - 1
B =

Question 2.
1. ***120cm^3 of solution R***
2. ***80cm^3 of solutions***
3. ***250cm^3 of tap water***
4. ***25 or 50ml measuring cylinder***
5. ***100cm^3 glass beaker***
6. ***5 x5cm piece of white paper***
7. ***Stop watch or clock***

Q2. ***Table II***

Experiment	***1***	***2***	***3***	***4***	***5***
Time for ribbon to disappear (sec)	***12***	***18***	***22***	***32***	***96***
$^i/_t$	***0.083***	***0.0560***	***0.045***	***0.03125***	***0.0104***

a) Table
Marking areas
i) Complete table

Penalties

- ***Penalize ½ mark for each space not filled***
- ***Reject fractions for $^{i}/_{t}$ and award a max of 1 ½ for table***
- ***If fractions appear followed by an extra column of decimals, ignore the fractions and award accordingly***
- ***Penalize ½ mark each for wrong arithmetic in the value of $^{i}/_{t}$ not within an error of +-2 units in the 3rd decimal place unless it divides exactly***
- ***Accept reciprocals given to at least 3 decimal places otherwise penalize ½ mark each for rounding off to the 2nd decimal place to a max of 1 mark unless it divides exactly***
- ***Penalize ½ mark for every reading < 5 and > 120 seconds in the time row***
- ***Penalize ½ mark for each entry not in seconds***

ii) Use of decimals

(Tied to the 4th row only)

- Accept a whole numbers or decimals up to the 2nd decimal place only used consistently, otherwise penalize fully

iii) Accuracy

(Tied up to the 4th row only)

- Compare the candidates 1st reading to the S.V and if within +- 2 sec, award 1 mark, otherwise penalize fully

iv) Trend

(Tied to the 4th row only)

- ***Award 1 mark if time is continuously increasing otherwise penalize fully***

b) Graph

i) Labeling of both axes

Condition

- ***Penalize ½ mark for wrong units used in any of the axis***
- ***Penalize ½ mark for inverted axes***
- ***Accept if units are not shown. Otherwise if shown they MUST be correct***
- ***Both axes MUST be labeled***

ii) Scale

- ***Area covered by the actual plots including the origin should be 2/3 more of the squares provided in both axes***
- ***The scale interval should be consistent***

iii) Plotting

- ***Award 1 mark if 4 or 6 plots are correctly plotted***
- ***Award ½ mark if 2 or 3 plots are correctly plotted***
- ***Accept plots even if the axes are inverted***
- ***Accept rounding off the values of i/t to the 3rd decimal point when plotting***

iv) Line

- Accept a straight line passing through at least 2 points correctly plotted and through the origin (0,0) for 1 mark or if extrapolated can pass through the origin

c) – Showing $^{i}/_{t}$ on the graph

- Stating the correct reading of $^{i}/_{t}$ at 36cm^3

- Applying the expression that time = $^{i}/_{t}$ correct reading - Correct answer

d) Rate decrease with decrease in concentration of hydrochloric acid or vice versa

OR

Rate and concentration are directly proportional

Condition

- ***Tied to the correct graph or trend in the table***
- ***If volume is used in place of conc. Award ½ mark***

3. a)

Observations	*Inferences*
a) White solid sublimes	*Chloride of AL^{3+} or NH_{+4}*
b) White solid dissolves to form a colourless solution that turns blue litmus red	*AL^{3+} ions*
i) No white ppt formed	*SO_4^{-2} or SO_2^{-3}*
ii) A white ppt is formed which is insoluble in excess but dissolves on warming	*CL present*
iii) A colourless gas with a pungent smell and which turns moist red litmus blue is given off. A white ppt is formed which is soluble in excess NaOH	*NH4+ present* *AL3+ present*
A white ppt is formed which is insoluble in excess aqueous ammonia	*AL3+ confirmed*

b)

Observations	*Inferences*
i) Brown colour of bromine water is decolourized *- Accept bromine water become colourless*	
Effervescence/ bubbles/ fizzing sound	*H^+ present* *- COOH present*
Orange colour of potassium dichromate VI remain unchanged	*OH present*

iii) To the third portion add a few drops of acidified potassium dichromate (VI)

Q 1. Table 1 (5 mks)

a) Complete table (1 mk)

- Penalize ½ mk for arithmetic error or unrealistic value to a maximum of ½ marks

b) Use of decimal (1 mark)

- Candidates to use 1 d.p or 2 d.p throughout in 1st and 2nd rows

c) Accuracy (1 mark)

± 0.2 the S.V √½ NB Any one value from the table

± 0.1 the S.V √1

d) Principles of averaging (1 mark)

$$\frac{-I + II + III}{3} \quad \surd ½$$

- Correct answer √½

e) Final answer

Average of the candidate compared with school value (S.V)

± 0.2 √½

± 01 √1

ii) Moles of N = $\frac{25 \times 0.1}{1000}$ √½

= 0.0025 √½

iii) $HCL_{(aq)} + NaOH_{(aq)} \longrightarrow NaCL_{(aq)} + H_2O_{(L)}$

Balanced √½

State symbols √½

iv) HCL: NaOH √1

1 : 1

Moles of M = $\frac{1x0.0025}{1}$ √½

= 0.0025 √½

v) Average titre ⟶ 0.0025

$1000\ cm^3 \longrightarrow$?

$= \frac{1000x0.0025}{\text{Average titre}}$ √½

= Correct answer √½

vi) $\frac{\text{Answer (V) x 36.5}}{1}$ √½

= Correct answer √½

Table II

a) As in table I

b) $\frac{\text{Answer in (v) x Titre}}{1000}$ √½

= Correct answer √½

c) $2HCL_{(aq)} + Na_2CO_{3\ (aq)} \longrightarrow 2NaCL_{(aq)} + H_2O_{(l)} + CO_{2\ (g)}$

Balanced √½

State symbol √½

d) $HCL: Na_2CO_3$

2 : 1√1

$\frac{\text{1x Answer in (b)}}{2}$ √½

= Correct answer √½

e) $\frac{\text{1000 x Answer in (d)}}{25}$ √½

= Correct answer √ ½

f) 14.3g/litre √1

g) $R + M = \frac{\text{Mass in g/h}}{\text{Molarity}}$

$= \frac{14.3}{\text{Answer in (e)}}$ √½

= Correct answer √½

h) Answer in (g) = 106 + 18x √½

18x = Answer in (g) – 106

$x = \frac{\text{Answer in (g) – 106}}{18}$ √½

= Correct answer √1(should be a whole number)

Q 2. Table

Each entry ½ mark

- Penalize ½ mark to a maximum of 1 mark for unrealistic values
- Penalize ½ mark mixing decimal numbers and whole numbers

a) i) Labeling (½ mark)

ii) Scale (½ mark)

iii) Plotting (2 marks)

iv) Line/ curve (1 mark)

b) i) $\frac{1.}{1000} \times 5$ √½

= 0.005 √½

c) Pb^{2+} : I^-

0.0025: 0.005 √1

1 : 2 √1

d) $Pb(NO_3)_{2(aq)} + 2KI_{(aq)} \longrightarrow PbI_{(s)} + 2KNO_{3(aq)}$

Balanced √1

States symbol √1

e) $Pb^{2+}_{(aq)} + 2I^-(aq) \longrightarrow PbI_{2(s)}$

Balance √½

States √½

f) To make the setting of precipitate faster √1