8.0 CHEMISTRY (233)

In the year 2006, Chemistry was tested using three papers. Unlike in the previous years, ***paper one (233/1)*** was marked out of 80 marks and tested the entire syllabus. It was also taken in two hours unlike in the previous years when it was taken in one and a half hours. ***Paper two (233/2)***, also a theory paper did not under go any changes in the format. ***Paper three (233/3)*** is a Practical paper taken in two and a quarter hours and marked out of 40 marks. Use of pipette fillers has been introduced as a precaution against poisoning during titration. The current syllabus also allows the use of volumetric flasks in the making of molar solutions.

8.1 GENERAL CANDIDATES' PERFORMANCE

The table below shows the performance in Chemistry during the year 2006 KCSE Chemistry examination.

Table 11: Candidates' Overall Performance in Chemistry in the Year 2006 KCSE Examination

Year	Paper	Candidature	Maximum Mark	Mean Score	Standard Deviation
2006	1		80	20.79	14.95
	2		80	17.56	13.82
	3		40	11.48	5.10
	Overall	**236,831**	**200**	**49.82**	**32.00**

Questions in which candidates performed poorly are discussed below.

8.2 PAPER 1 (233/1)

Question 6

In an experiment to study the properties of concentrated sulphuric acid, a mixture of the acid And wood charcoal was heated in a boiling tube.

(a) Write the equation of the reaction that took place in the boiling tube.

(b) Using oxidation numbers, show that reduction and oxidation reactions took place in the Boiling tube.

Candidates were required to recall the oxidation properties of concentrated sulphuric acid in a reaction with heated charcoal. They were also expected to write a balanced chemical reaction for a redox reaction between concentrated sulphuric acid and charcoal and use the equation to show that a redox reaction had occurred.

Weaknesses

Most candidates managed to write the correct equation for the reaction between heated carbon and concentrated sulphuric acid. However, some candidates did not know the products of the reaction. The candidates who seemed to know the products wrote the correct formulae of the reactants and products and hence had difficulties in balancing the equation. These weaknesses occurred because candidates were not exposed to experimental work. Students understand concepts in chemistry better when they are involved in carrying out experiments. Results of experiments should be discussed thoroughly between candidates and the teacher. Poor learners should be given remedial coaching in order to raise their level of understanding of the subject. It has been stressed before and will be repeated here that for equations to be acceptable, the formulae and symbols of the reactants and products must be correct and equations must be balanced and have the correct state symbols.

Concentrated sulphuric acid is a strong oxidizing agent. During reactions, it usually reduces to Sulphur dioxide and water is formed. Since generally oxidation - reduction processes take place simultaneously carbon would be oxidized to carbon dioxide. Therefore, it is possible to predict the products of the reaction even if they were not known. This calls for constant practice and thorough exposure to redox reactions.

Expected Responses

(a) $C_{(s)} + 2H_2SO_{4\,(l)} \_ CO_{2\,(g)} + 2H_2O_{(l)}$

(b) During the reaction, carbon changes from an oxidation of zero (0) to +4. Therefore, an increase in the oxidation state implies oxidation has occurred. Sulphur in sulphuric acid has an oxidation state of +6 but in the product ($S0_2$), it is at +4.

Question 16

When hydrogen sulphide gas was bubbled into an aqueous solution of iron (III) chloride, a yellow precipitate was deposited.

(a) State another observation that was made
(b) Write an equation for the reaction that took place.
(c) What type of reaction was undergone by hydrogen sulphide in this reaction?

Candidates were required to state the observations which would be made when hydrogen sulphide gas which is a reducing agent is bubbled into an aqueous solution of iron (III) chloride. They were also required to write an equation for the reaction between iron (III) chloride (aqueous) with hydrogen sulphide gas hence deduce whether an oxidation or reduction process had occurred.

Weaknesses

Candidates failed to state the correct observations that had been made. Others could not write equations hence were not able to deduce whether oxidation or reduction had occurred. The candidates' responses show that preparation of H_2S was not done and thus the properties of the gas were not properly learnt. Some wrong responses given by candidates included ***"A pale green precipitate was formed", "Hydrochloric acid was formed", "Colourless gas was evolved"*** and ***"White fumes were formed"***. Others did not attempt the question.

Though hydrogen sulphide is poisonous, it does not mean its properties cannot be studied. This can be done in a fume cupboard inside the laboratory with all windows open or the experiment can be conducted in the open. Most teachers are afraid of preparing such gases and this is quite unfair to the students as the practical aspect cannot therefore be tested. The syllabus says only theoretical treatment is allowed. The gas can however, be prepared in micro scale for its properties to be demonstrated. Innovation in sciences is very important.

Candidates should also think about the responses they write. Some of the candidates' responses were ***"Hydrochloric acid was formed"***. Even if it was formed, there was no way one would tell that it was HCL. The only observation would be a clear pale green solution formed. Once more, it is emphasised that equations should always be balanced.

Expected Responses

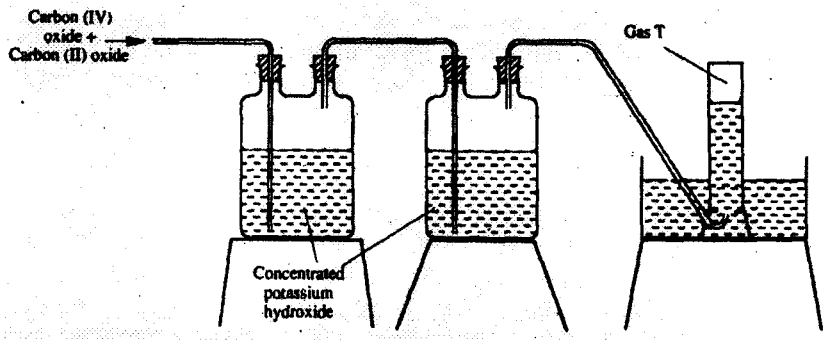
(a) Pale green solution was formed.

(b) 2Fe CL + H S

(c) Oxidation.

Question 22

The diagram below represents part of a set-up used to prepare and collect gas T.



(a) *Name **two** reagents that are reacted to produce both carbon (IV) oxide and carbon (II) oxide.*

(b) *Write the equation for the reaction which takes place in the wash bottles.*

(c) *Give a reason why carbon (II) oxide is not easily detected.*

In this question, candidates were expected to state two reagents which when reacted would give both Carbon (IV) oxide and Carbon (II) oxide. They were also expected to know the reactions which occur when acidic Carbon (IV) oxide is passed through basic Potassium Hydroxide and also the properties of Carbon (II) oxide.

Weaknesses

Majority of the candidates did not know that Carbon (IV) oxide is $C0_2$ and Carbon (II) oxide is CO hence they could not give the two reagents which when reacted produced both. Equations were poorly written and properties of carbon (II) oxide were not well understood.

The gas T being collected is Carbon (II) oxide. Like the case with H_2S, CO is poisonous. It can be prepared in the fume cupboard in small scale to demonstrate its properties. Teachers should change their methods of teaching from theoretical to experimental approach otherwise results in Chemistry will remain poor.

Expected Responses

(a) Oxalic acid and concentrated H_2SO4

(b) $2KOH_{(aq)} + CO_{2\,(g)} \rightarrow K_2CO_{3\,(aq)} + H_2O_{(1)}$

(c) CO is colourless, CO has no smell.

Question 23

Explain why the boiling point of ethanol is higher than that of hexane.
(Relative molecular mass of ethanol is 46 while that of hexane is 86).

In this question, candidates were expected to explain why the boiling point of ethanol whose relative molecular mass is 46 is higher than that of hexane whose relative molecular mass is 86.

Weaknesses

Candidates were not able to give a precise explanation as to why the boiling point of ethanol is

lower than that of hexane. Some irrelevant responses which were given by candidates included ***"Ethanol is a liquid in room temperature while hexane is a gas", "Ethanol is a giant structure while hexane is a simple molecular", "Ethanol has hydroxide bond while hexane has carbon bonds", "Because the boiling point of alkanols decreases down the group while that of alkanes increases"*** and ***"Covalent bonds in ethanol are stronger than those in hexane".*** Such responses show that the topic on hydrogen bonding had not been taught or had been taught poorly. The topic was tested for the first time in the year 2006 and it is possible that candidates were not expecting a question from this topic.

Generally melting and boiling of substances increases with increase in molecular mass. This is not the case. The difference is caused by the existence of hydrogen bonds in ethanol. These bonds do not exist in hexane. Hydrogen bonds are quite strong hence the boiling point of ethanol is higher than that of hexane. Candidates need to be thoroughly prepared in all topics. Test items can be picked from any section of the syllabus hence thorough preparation in all areas is necessary.

Expected Responses

In addition to Van der Waals forces of attraction, strong hydrogen bonds exist in ethanol. These bonds require more energy to break.

8.3 PAPER 2 (233/2)

Question 1

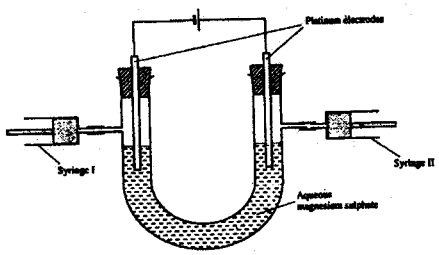
(a) What is an electrolyte?

(b) State how the following substances conduct electricity:

(i) molten calcium chloride

(ii) graphite

(c) The diagram below shows a set up that was used to electrolyse aqueous magnesium sulphate.



(i) On the diagram above, using an arrow, show the direction of flow of electrons.

(ii) Identify the syringe in which hydrogen gas would be collected. Explain.

(d) Explain why the concentration of magnesium sulphate was found to have increased at the end of the experiment

(e) During the electrolysis, a current of O.72A was passed through the electrolyte for 15 minutes. Calculate the volume of gas produced at the anode. (1 Faraday = 96 500 coulombs; molar gas volume is 24000 cm^3 at room temperature).

In this question, candidates were required to define an electrolyte, demonstrate an understanding on how metals and graphite conduct electric currents and name the products at the anode and cathode when $MgSO_{4(aq)}$ is fully electrolysed. The candidates were also required to state how the

concentration of aqueous Magnesium sulphate changes during electrolysis and calculate the volume of the gaseous product formed at the anode.

Weaknesses

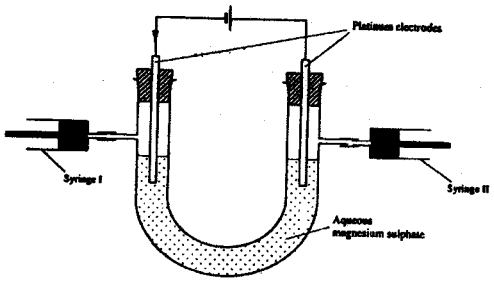
- Candidates failed to give the precise definition of an electrolyte. Some wrong responses given by candidates were ***"It is a substance that conducts an electric current', "It is a compound which conducts an electric current when in solution", "It is a solution containing ions"*** and ***"It is a substance which allows an electric current to pass"***
- Candidates were not able to state how molten Calcium Chloride conducts an electric current. Some wrong responses presented by candidates were ***"through electrolysis", "ions carry the current with it", "it is a good conductor of electricity"*** and ***"by using charged ions".*** From the responses given, it is clear that candidates had an idea about how Calcium Chloride (molten) conducts an electric current but were not able to communicate this in writing. In the case of $CaCl_2$, candidates were supposed to realize that it is an ionic substance. Ionic substances have mobile ions when in molten form and it is these mobile ions which conduct an electric current.
- Candidates were not able to give a reason for their choice of the syringe where hydrogen gas was collected. Perhaps this was through guessing, which should be avoided.
- Candidates were not able to explain why the concentration of Mg SO_4 increases during electrolysis. Indeed, many candidates were not able to score a mark. Some wrong responses given by candidates were ***"Mg So_4 was reduced to solid", "H+ ions which are acidic are introduced into solution"*** and ***"Mg^{2+} and SO_2^{2-} ions are being returned into solution".*** Others left the question unanswered. This kind of responses given by candidates show total lack of knowledge on the process of electrolysis of Mg $SO_{4(aq)}$. This could have been caused by poor tuition methods. Students should be allowed to carry out practicals in all topics. Clear observations should be recorded and these should be discussed thoroughly if performance in Chemistry is to be improved. Theoretical teaching in sciences should be avoided as much as possible.

Expected Responses

(a) A substance that allows the passage of an electric current and is decomposed by it.

(b) (i) $CaCl_2$ (molten) conducts an electric current because it has mobile ions.
(ii) Graphite conducts by movement of the delocalized electrons. (Notice electrons exist in substances but not all substances have delocalized electrons. This difference must be brought out clearly).

(c) (i)



(ii) The H+ ions migrate to the negatively charged electrode where they get discharged to form hydrogen gas.

(d) $4\ OH^-_{(aq)} \longrightarrow 2H_2\ 0(l) + O_{2\,(g)} + 4e$

$4H_2O_{(l)} \rightleftharpoons 4H^+_{(aq)} + 4OH^-_{(aq)}$

From the two equations, it is clear that 4 moles of water will be required to form 4 OH^- (first equation) hence the amount of water used to produce 4 OH^- ions is more than the 2 moles formed at the anode. Removal of water molecules makes the electrolyte more concentrated.

(e) Quantity of electricity 15 x 0.72 x 60 = 648 C

$4OH^- \longrightarrow 2H_2O + O_2 + 4e$

Faradays of electricity $\frac{648}{96500}$

$= 0.006715F$

Moles of Oxygen $\frac{0.006715}{4}$

$= 0.0016750$

Volume of Oxygen 0.001675 x 24000 = 40.29 cm^3

Question 2

(a) In an experiment to determine the molar heat of reaction when magnesium displaces Copper, 0.15g of magnesium powder were added to 25.0cm^3 of 2.0M copper (II) chloride solution. The temperature of copper (II) chloride solution was 25°C. while that of the mixture was 43°C.

(i) Other than increase in temperature, state and explain the observations which were made during the reaction

(ii) Calculate the heat change during the reaction (Specific heat capacity of the solution = 4.2$jg^{-1}K^{-1}$ and the density of the solution = Ig/cm^3).

(iii) Determine the molar heat of displacement of copper by magnesium. (Mg =24.0)

(iv) Write the ionic equation for the reaction.

(v) Sketch an energy level diagram for the reaction.

(b) Use the reduction potentials given below to explain why a solution containing copper ions should not be stored in a container made of zinc.

$Zn^{2+}_{(aq)} + 2e \rightarrow Zn_{(s)}$; $E^\theta = -0.76V$

$Cu^{2+}_{(aq)} + 2e \rightarrow Cu_{(s)}$; $E^\theta = +0.34V$

The question required the candidates to:

- State the observations made when solid magnesium is put into a solution containing CU^{2+} ions.
- Calculate the heat involved when some magnesium powder reacts with aqueous copper sulphate hence determine the molar heat of displacement of copper ions by Magnesium
- Write an ionic equation for the displacement reaction and draw an energy level diagram.
- State reasons why aqueous copper sulphate cannot be stored in a container made of zinc.

Weaknesses

- The average and below average candidates were not able to compute the molar heat of displacement.
- Some candidates could not write the ionic equation for the displacement reaction hence

they could not draw the energy level diagram. The weaknesses stated show that the topic was either not covered or was poorly covered using the lecture method. Head teachers are urged to allocate sufficient funds for purchase of equipment and chemicals for use during teaching and examinations. Theory papers will test everything from purely theoretical aspects to purely practical aspects of chemistry. Students should be adequately equipped in all aspects.

- Candidates were also not able to explain precisely why a solution containing copper ions should not be stored in container made of zinc. Some irrelevant responses presented by candidates were ***"Copper being a strong oxidizing agent will react with zinc'***, ***"Copper ions would be attracted by the negative zinc ions leading to formation of precipitate"*** and ***"Zinc can reduce copper solution to copper metal".***

The meanings of the sign and magnitude of the standard reduction potentials appear not to be well understood. The topic is rather abstract but if it is methodically approached using simple experiments, and examples the concept can be easily internalized. Zinc and copper are the substances used in batteries. When such batteries have been in use for sometime, they become soft. Students must have noticed this. This observation should have assisted candidates in answering the question. Concepts learnt must be linked to real life situations. This would make meaningful comparisons and arouse interest in the subject. In our case, Zinc has a negative potential, therefore, it must be more reactive than copper which has a positive reduction potential. If a solution containing CU^{2+} ions is put in a container made of Zinc, the Zinc would dissolve and disappear.

Expected Responses

(a) (i) The blue colour of the solution fades. (The colour is due to presents of CU^{2+} ions in solution. When these are removed by displacement, colour fades) Brown solid deposited (copper).

(ii) Heat change 25 x 4.2 x 18 = 1890 joules.

(iii)Mg Moles of Mg = $\frac{0.152}{24}$

$= 0.00625$

$0.00625M = 1890Joules$

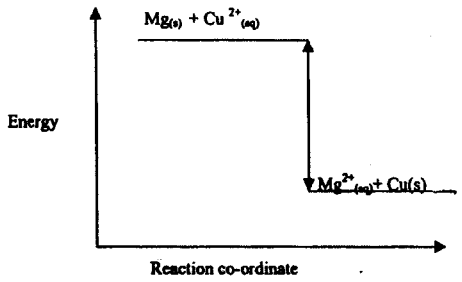
$1\ Mole = 1890/0.00625$

$= -303.4\ KJ\ mol^{-1}$

It should be noted that since the temperature of the reaction mixture went up, heat must have been released therefore the sign of the molar heat of displacement is negative.

(iv) $Mg_{(s)} + Cu^{2+}{}_{(aq)} \quad Mg^{2+}{}_{(aq)} + Cu_{(s)}$

(v)



(b) Zinc is higher than copper in the reactivity series or zinc is more reactive than copper. Zinc will thus dissolve in solution leading to weakening of the container.

8.4 PAPER 3 (233/3)

Question 2

*You are provided with solid **E**. Carry out the tests below. Write your observations and inferences in the spaces provided.*
*(a) Place about one third of solid **E** in a clean dry test-tube and heat it strongly.*
*(b) Place the remaining solid **E** in a boiling tube. Add about 10 cm^3 of distilled water. Shake the mixture thoroughly for about one minute. Filter and divide the filtrate into four portions.*
(i) To the first portion, add 2 drops of phenolpthalein indicator.
(ii) To the second portion, add 2 cm^3 of dilute hydrochloric acid.
(iii) To the third portion, add 5 cm' of aqueous sodium sulphate.

This question was on qualitative analysis where an unknown substance is given to candidates and they are expected to carry out experiments to find out its composition or functional groups present in it. The question tested on candidates' ability to select suitable apparatus for various tests, heat substances in test-tubes, make accurate observations and record them using acceptable scientific language and make accurate inferences based on the observations and report these using scientific language.

Weaknesses

Candidates did not take precautions when carrying out experiments hence the observations made were inaccurate. They were unable to make accurate inferences and communicate them using acceptable scientific language. Candidates are reminded that when carrying out experiments, suitable apparatus must be chosen.

Apparatus must be cleaned to avoid contamination and must be assembled correctly if accurate results are to be obtained. Accidents must be avoided as much as possible. Observations should be recorded as soon as they are made in order to avoid confusion later. Candidates are also informed that planning is very crucial before carrying out any experiment. Depending on the reagent being used, one can predict the results, for example: if aqueous sodium hydroxide is added to a colourless solution, one should expect either ***"A white precipitate"*** or ***"No White precipitate"***. On reporting, candidates should therefore write: "***White precipitate formed"*** or ***"No white precipitate"***. Candidates should avoid the use of phrases such as ***"No observation change"*** when they mean a precipitate was not formed. Also to be avoided are the use of terms such as ***"greenish", "yellowish"*** or "***brownish"*** when describing colour changes. Candidates should instead use terms such as "***pale-green", "light yellow"*** etc.

Inferences must also be written correctly. Formulae of ions, molecules, symbols or elements must be correct otherwise no mark will be given for wrong symbols or formulae, for example: ***"pb"*** instead of ***"Pb"***. Candidates must thus plan, carry out experiments cautiously, record observations correctly and then write inferences thoughtfully.

8.5 CONCLUSION

One of the demands in the 21st Century is the acquisition of scientific skills. Kenya cannot afford to be left behind. Teaching of Sciences, Chemistry included should therefore be enhanced in most schools. Laboratories must be constructed and properly equipped for teaching and examinations. The scientific approach is the method recommended worldwide for the teaching / learning of sciences. This not only provides the students with the necessary skills but makes the subject very interesting.

23.6 CHEMISTRY (233)

23.6.1 Chemistry Paper 1 (233/1)

Name ..... **Index No:** ...../.....

233/1
CHEMISTRY
Paper 1
THEORY
Oct. /Nov. 2006
2 hours

THE KENYA NATIONAL EXAMINATIONS COUNCIL
Kenya Certificate of Secondary Education
CHEMISTRY
Paper 1
THEORY
2 hours

Write your name and index number in the spaces provided above.
*Answer **all** the questions in the spaces provided.*
Mathematical tables and electronic calculators may be used.
*All working **must** be clearly shown where necessary.*

For Examiner's Use Only

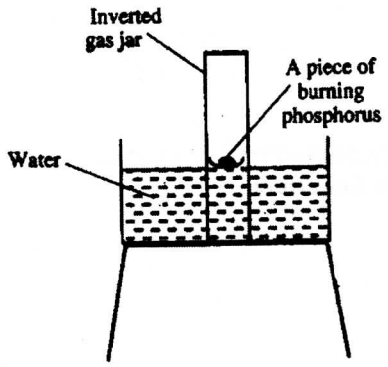
Questions	Maximum Score	Candidate's Score
1 – 28	80	

Candidates should check the question paper to ensure that all the pages are printed as indicated and no questions are missing.

1 (a) What is meant by isomerism? (1 mark)

(b) Draw and name two isomers of butene. (2 marks)

2 The diagram below represents a set-up that was used to show that part of air is used during burning.



(a) Given that the phosphorus used was in excess, draw a diagram of the set-up at the end of the experiment (When there was no further observable change). (1 mark)

(b) Suggest one modification that should be made on the apparatus if the percentage of the air used is to be determined. (1 mark)

3 60 cm^3 of oxygen gas diffused through a porous partition in 50 seconds. How long would it take 60 cm^3 of sulphur (IV) oxide gas to diffuse through the same partition under the same conditions? (S = 32.0, 0 = 16.0). (3 marks)

4 (a) Complete the nuclear equation below. (1 mark)

$$^{37}_{18}A + \cdots\cdots \longrightarrow {}^{37}_{17}B$$

(b) State one:

(i) use of radioisotopes in agriculture (1 mark)

(ii) danger associated with exposure of human beings to radioisotopes. (1 mark)

5 The atomic numbers of elements C and D are 19 and 9 respectively. State and explain the electrical conductivity of the compound CD in:

(a) solid state (1 ½ marks)

(b) aqueous state. (1 ½ marks)

6 In an experiment to study the properties of concentrated sulphuric acid, a mixture of the acid and wood charcoal was heated in a boiling tube.

(a) Write the equation of the reaction that took place in the boiling tube. (1 mark)

(b) Using oxidation numbers, show that reduction and oxidation reactions took place in the boiling tube. (2 marks)

7 A group of compounds called chlorofluorocarbons have a wide range of uses but they also have harmful effects on the environment.
State one:

(a) use of chlorofluorocarbons (1 mark)

(b) harmful effect of chlorofluorocarbons on the environment. (1 mark)

8 When 94.5g of hydrated barium hydroxide, $Ba(OH)_2 . nH_2O$ were heated to constant mass, 51.3 g of anhydrous barium hydroxide were obtained. Determine the empirical formula of the hydrated barium hydroxide.
(Ba = 137.0; 0 = 16.0, H = 1.0). (3 marks)

9 At 20°C, NO_2 and N_2O_4 gases exist in equilibrium as shown in the equation below

$$2NO_{2(g)} \rightleftharpoons N_2O_{4(g)}; \quad \Delta H = -ve$$

Brown Pale yellow

State and explain the observation that would be made when:

(a) a syringe containing the mixture at 20°C is immersed in ice-cold water (1 ½ marks)

(b) the volume of the gaseous **mixture** in a syringe is reduced. (1 ½ marks)

10 Name the process which takes place when:

(a) solid carbon (IV) oxide (dry ice) changes directly into gas (1 mark)

(b) a red litmus paper turns white when dropped into chlorine water (1 mark)

(c) propene gas molecules are converted into a giant molecule. (1 mark)

11 (a) Water from a town in Kenya is suspected to contain chloride ions but not sulphate ions. Describe how the presence of the chloride ions in the water can be shown. (2 marks)

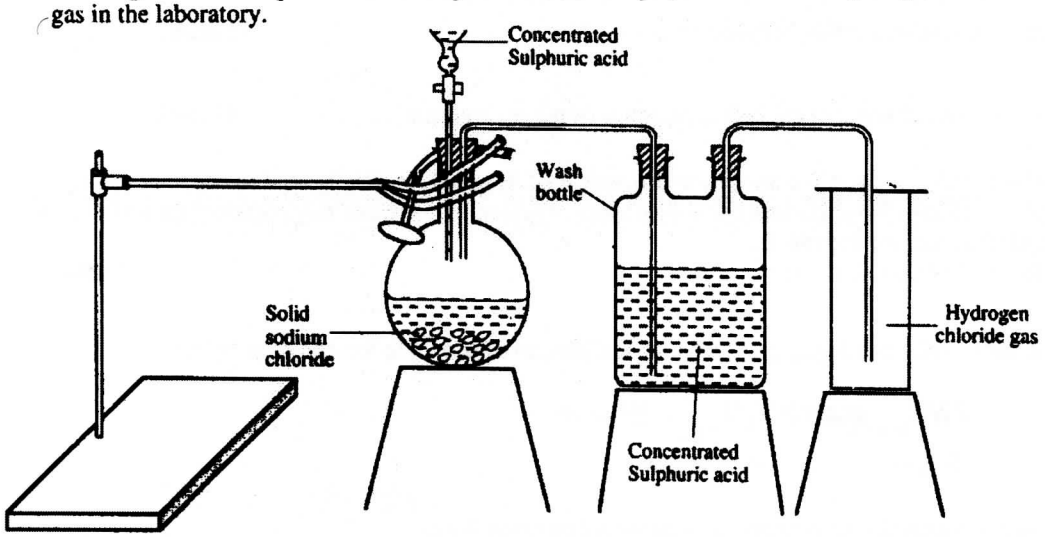
(b) State one advantage of drinking hard water rather than soft water. (1 mark)

12 The table below shows the relative atomic masses and the percentage abundance of the isotopes L_1 and L_2 of element L.

	Relative atomic mass	% abundance
L_1	62.93	69.09
L_2	64.93	30.91

Calculate the relative atomic mass of element L. **(3 marks)**

13 The diagram below represents the set-up that was used to prepare and collect hydrogen chloride gas in the laboratory.



(a) State the purpose of concentrated sulphuric acid in the wash bottle. (1 mark)

(b) Write an equation for the reaction between dry hydrogen chloride gas and heated iron (1 mark)

(c) Hydrogen chloride gas is dissolved in water to make hydrochloric acid.
State one use of hydrochloric acid. (1 mark)

14 Below is a list of oxides.
MgO, N_2O, K_2O, CaO, and Al_2O_3.

Select:

(a) a neutral oxide (1 mark)

(b) a highly water soluble basic oxide (1 mark)

(c) an oxide which can react with both sodium hydroxide solution and dilute hydrochloric acid. (1 mark)

15 Study the standard reduction potentials given below and answer the questions that follow. (The letters are not the actual symbols of the elements).

	E^{θ} (Volts)
$M^{2+}_{(aq)} + 2e \longrightarrow M_{(s)}$	-0.76
$N^{2+}_{(aq)} + 2e \longrightarrow N_{(s)}$	-2.37
$P^{+}_{(aq)} + e \longrightarrow P_{(s)}$	+0.80
$Q^{2+}_{(aq)} + 2e \longrightarrow Q_{(s)}$	-0.14

(a) The standard reduction potential for $Fe^{2+}_{(aq)}$ is -0.44 volts. Select the element which would best protect iron from rusting. (1 mark)

(b) Calculate the E^{θ} value for the cell represented as $M_{(s)}\left|M^{2+}_{(aq)}\right|\left|P^{+}_{(aq)}\right|P_{(s)}$. (2 marks)

16 When hydrogen sulphide gas was bubbled into an aqueous solution of iron (III) chloride, a yellow precipitate was deposited.

(a) State another observation that was made. (1 mark)

(b) Write an equation for the reaction that took place. (1 mark)

(c) What type of reaction was undergone by hydrogen sulphide in this reaction? (1 mark)

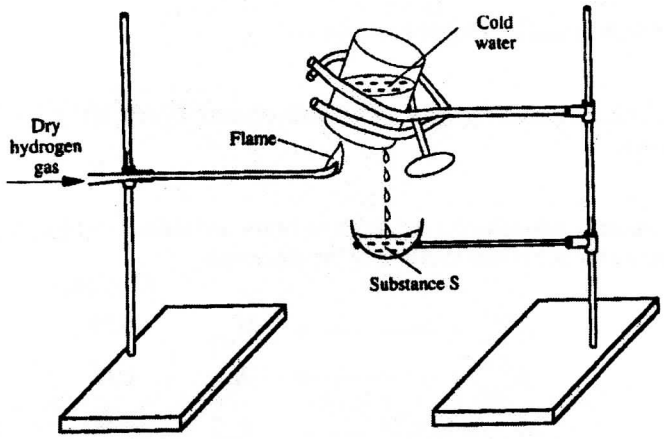
17 The first step in the industrial manufacture of nitric acid is the catalytic oxidation of ammonia gas.

(a) What is the name of the catalyst used? (1 mark)

(b) Write the equation for the catalytic oxidation of ammonia gas. (1 mark)

(c) Nitric acid is used to make ammonium nitrate. State two uses of ammonium nitrate. (1 mark)

18 Study the diagram below and answer the question that follows.



Describe **one** chemical test that can be carried out to identify substance S. (2 marks)

19 (a) Starting from solid magnesium oxide, describe how a solid sample of magnesium hydroxide can be prepared. (2 marks)

(b) Give **one** use of magnesium hydroxide. (1 mark)

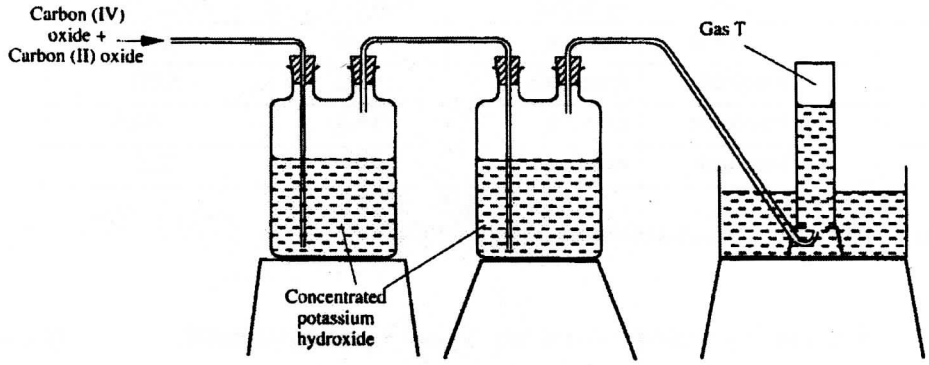
20 (a) Distinguish between a covalent bond and a co-ordinate bond. (2 marks)

(b) Draw a diagram to show bonding in an ammonium ion. (1 mark)
(N = 7, H = 1.)

21 (a) Explain why the metals magnesium and aluminium are good conductors of electricity. (1 mark)

(b) Other than cost, give **two** reasons why aluminium is used for making electric cables while magnesium is **not**. (2 marks)

22 The diagram below represents part of a set-up used to prepare and collect gas T.



(a) Name **two** reagents that are reacted to produce both carbon (IV) oxide and carbon (II) oxide. (1 mark)

(b) Write the equation for the reaction which takes place in the wash bottles. (1 mark)

(c) Give a reason why carbon (II) oxide is not easily detected. (1 mark)

23 Explain why the boiling point of ethanol is higher than that of hexane. (Relative molecular mass of ethanol is 46 while that of hexane is 86). (2 marks)

24 (a) Complete the table below to show the colour of the given indicator in acidic and basic solutions. (1 mark)

Indicator	Colour in	
	Acidic solution	Basic solution
Methyl orange	.....	Yellow
Phenolpthalein	Colourless	.....

(b) How does the p^H value of 0.1M potassium hydroxide solution compare with that of 0.1M aqueous ammonia? Explain. (2 marks)

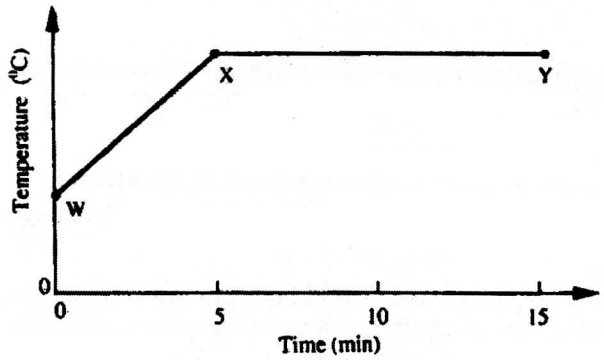
25 Study the properties of substances V_1 to V_4 in the table below and answer the questions that follow.

Substance	Solubility in water	Solubility in petrol	Melting Point (°C)	Boiling Point (°C)
V_1	Insoluble	Soluble	-30	250
V_2	Insoluble	Insoluble	1535	3000
V_3	Insoluble	Soluble	16.8	44.8
V_4	Insoluble	Soluble	75	320

(a) Which of the substances are liquids at 24°C? (1 mark)

(b) Describe how a mixture containing V_2 and V_4 can be separated. (2 marks)

26 The graph below shows a curve obtained when water at 20°C was heated for 15 minutes.

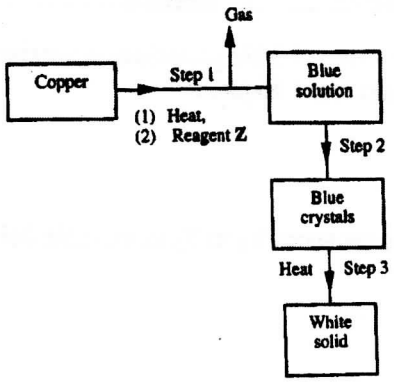


(a) What happens to the water molecules between points W and X? (1 mark)

(b) In which part of the curve does a change of state occur? (1 mark)

(c) Explain why the temperature does not rise between points X and Y. (1 mark)

27 Study the flow chart below and answer the questions that follow.

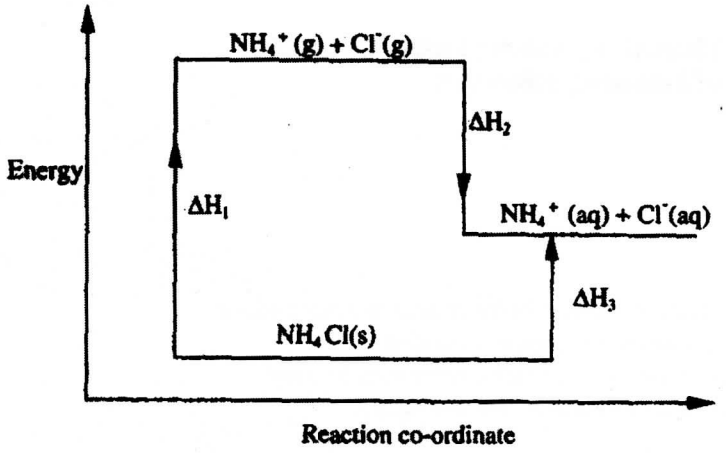


(a) Name reagent Z. (1 mark)

(b) Describe the process which takes place in step 2. (1 mark)

(c) Identify the white solid. (1 mark)

28 Study the diagram below and answer the questions that follow.



(a) What do ΔH_1 and ΔH_2 represent? (2 marks)

(b) Write an expression to show the relationship between ΔH_1, ΔH_2 and ΔH_3. (1 mark)

Name .....**Index number** ...../.....

233/2
CHEMISTRY
Paper 2
THEORY
Oct./Nov. 2006
2 hours

THE KENYA NATIONAL EXAMINATIONS COUNCIL
Kenya Certificate of Secondary Education
CHEMISTRY
Paper 2
THEORY
2 hours

Write your name and index number in the spaces provided above.
*Answer **ALL** the questions in the spaces provided.*
Mathematical tables and electronic calculators may be used.
*All working **must** be clearly shown where necessary.*

For Examiner's Use Only

Question	Maximum Score	Candidate's Score
1	11	
2	12	
3	10	
4	12	
5	11	
6	10	
7	14	
Total Score	**80**	

Candidates should check the question paper to ensure that all the pages are printed as indicated and no questions are missing.

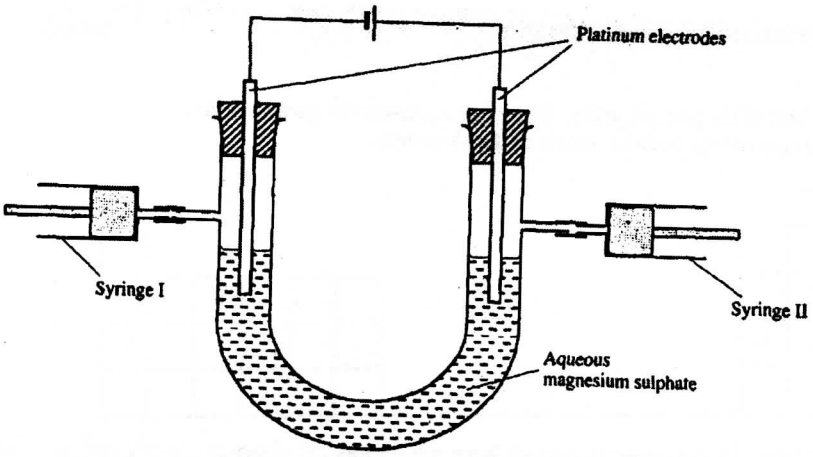
1. (a) What is an electrolyte? (1 mark)

(b) State how the following substances conduct electricity:

(i) molten calcium chloride (1 mark)

(ii) graphite. (1 mark)

(c) The diagram below shows a set up that was used to electrolyse aqueous magnesium sulphate.



(i) On the diagram above, using an arrow, show the direction of flow of electrons. (1 mark)

(ii) Identify the syringe in which hydrogen gas would be collected. Explain. (1 mark)

(d) Explain why the concentration of magnesium sulphate was found to have increased at the end of the experiment. (2 marks)

(e) During the electrolysis, a current of 0.72A was passed through the electrolyte for 15 minutes. Calculate the volume of gas produced at the anode. (1 Faraday = 96 500 coulombs; molar gas volume is 24000 cm^3 at room temperature). (4 marks)

2. (a) In an experiment to determine the molar heat of reaction when magnesium displaces copper, 0.15g of magnesium powder were added to 25.0cm^3 of 2.0M copper (II) chloride solution. The temperature of copper (II) chloride solution was 25°C. while that of the mixture was 43°C.

(i) Other than increase in temperature, state and explain the observations which were made during the reaction. (3 marks)

(ii) Calculate the heat change during the reaction (Specific heat capacity of the solution = 4.2$jg^{-1}K^{-1}$ and the density of the solution = 1g/cm^3). (2 marks)

(iii) Determine the molar heat of displacement of copper by magnesium. (Mg = 24.0). (2 marks)

(iv) Write the ionic equation for the reaction. (1 mark)

(v) Sketch an energy level diagram for the reaction. (2 marks)

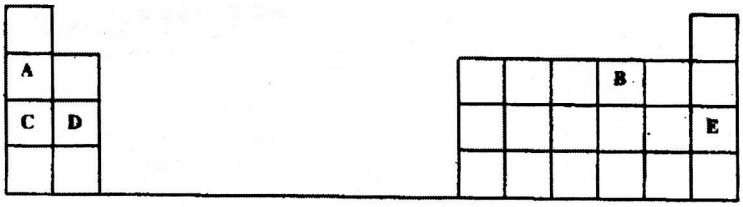
(b) Use the reduction potentials given below to explain why a solution containing copper ions should not be stored in a container made of zinc.

$$Zn^{2+}_{(aq)} + 2e \rightarrow Zn_{(s)}; \quad E^{\theta} = -0.76V$$

$$Cu^{2+}_{(aq)} + 2e \rightarrow Cu_{(s)}; \quad E^{\theta} = +0.34V$$ (2 marks)

3. (a) Distinguish between isotopes and allotropes. (2 marks)

(b) The chart below is part of the periodic table. Study it and answer the questions that follow. (The letters are not the actual symbols of the elements).



(i) Select the element in period three which has the shortest atomic radius. Give a reason for your answer. (2 marks)

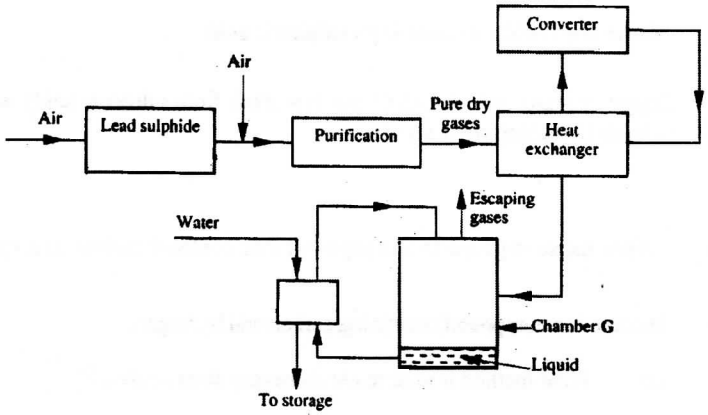
(ii) Element F has the electronic structure, 2.8.18.4. On the chart above, indicate the position of element F. (1 mark)

(iii) State one use of the elements of which E is a member. (1 mark)

(iv) Write an equation to show the action of heat on the nitrate of element C. (1 mark)

(c) When 3 litres of chlorine gas were completely reacted with element D, 11.875g of the product were formed. Determine the relative atomic mass of element D. (Atomic mass of chlorine = 35.5; molar gas volume = 24 litres). (3 marks)

4. (a) The diagram below shows some processes that take place during the industrial manufacture of sulphuric acid.



(i) Write the equation for the reaction in which sulphur dioxide gas is produced. (1 mark)

(ii) Why is it necessary to keep the gases pure and dry? (1 mark)

(iii) Describe the process that takes place in chamber G. (1 mark)

(iv) Name the gases that escape into the environment. (1 mark)

(v) State and explain the harmful effect on the environment of one of the gases named in (iv) above. (1 mark)

(vi) Give **one** reason why it is necessary to use a pressure of 2 -3 atmospheres and not more. (1 mark)

(b) (i) Complete the table below to show the observations made when concentrated sulphuric acid is added to the substances shown. (2 marks)

Substance	Observation
Iron filings	
Crystals of white sugar	

(ii) Give reasons for the observations made using:

I iron filings (1 mark)

II crystals of white sugar. (1 mark)

(c) Name one fertilizer made from sulphuric acid. (1 mark)

(d) Suggest a reason why $BaSO_4$ (A pigment made from sulphuric acid) would be suitable in making paint for cars. (1 mark)

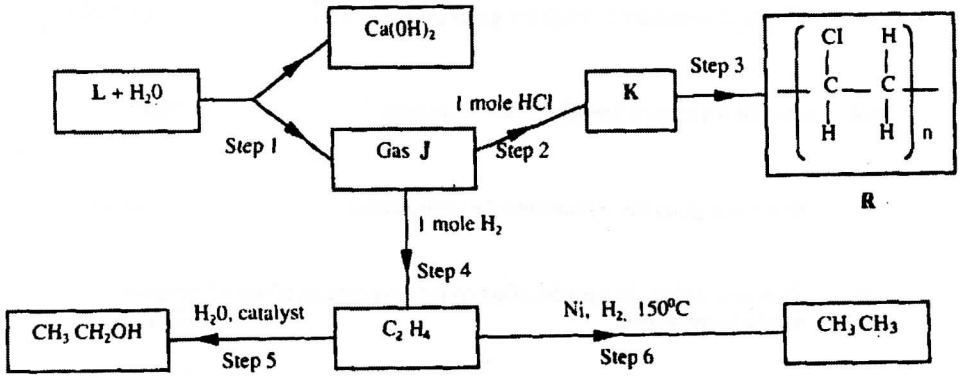
5. (a) What name is given to a compound that contains carbon and hydrogen only? ($^1/_2$ mark)

(b) Hexane is a compound containing carbon and hydrogen.

(i) What method is used to obtain hexane from crude oil? (1 mark)

(ii) State **one** use of hexane. (1 mark)

(c) Study the flow chart below and answer the questions that follow.



(i) Identify reagent **L**. (1 mark)

(ii) Name the catalyst used in Step 5. (1 mark)

(iii) Draw the structural formula of gas **J**. (1 mark)

(iv) What name is given to the process that takes place in step 5? ($^1/_2$ mark)

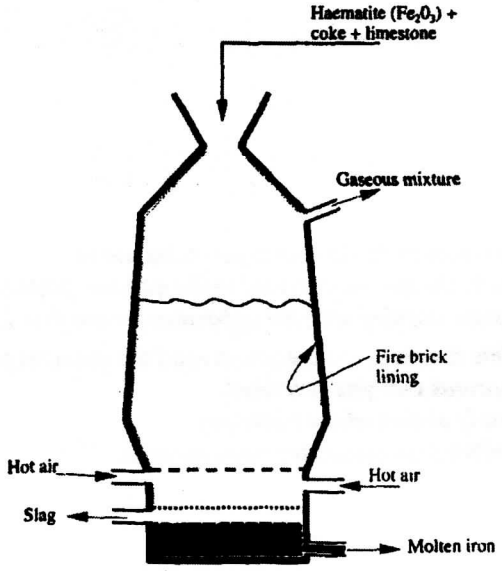
(v) State:
I **one** use of product **R** (1 mark)

II a commercial application of the process which takes place in step 6.
(1 mark)

(d) (i) Write the equation for the reaction between aqueous sodium hydroxide and aqueous ethanoic acid. (1 mark)

(ii) Explain why the reaction between 1g of sodium carbonate and 2M hydrochloric acid is faster than the reaction between 1g of sodium carbonate and 2M ethanoic acid. (2 marks)

6 The extraction of iron from its ores takes place in the blast furnace. Below is a simplified diagram of a blast furnace. Study it and answer the questions that follow.



23.6.3 Chemistry Paper 3 (233/3)

Name ..... **Index No.** ...../.....

233/3
CHEMISTRY
Paper 3
PRACTICAL
Oct./Nov. 2006
2 1/4 hours

THE KENYA NATIONAL EXAMINATIONS COUNCIL
Kenya Certificate of Secondary Education
CHEMISTRY
Paper 3
PRACTICAL
2 1/4 hours

Write your name and index number in the spaces provided above.
*Answer **ALL** the questions in the spaces provided in the question paper.*
*You are **NOT** allowed to start working with the apparatus for the first 15 minutes of the 2 1/4 hours allowed for this paper. This time is to enable you to read the question paper and make sure you have all the chemicals and apparatus that you may need.*
*All working **MUST** be clearly shown where necessary.*
Mathematical tables and electronic calculators may be used.

For Examiner's use only

Question	Max. Score	Score
1	21	
2	13	
3	06	
Total Score	40	

Candidates should check the question paper to ensure that all the pages are printed as indicated and no questions are missing.

6031 **Turn over**

1 You are provided with:

- 4.5 g of solid A in a boiling tube.
- Solution B, 0.06 M acidified Potassium manganate (VII)

You are required to determine:

(1) the solubility of solid A at different temperatures

(2) the number of moles of water of crystallisation in solid A.

Procedure

(a) Using a burette, add 4 cm^3 of distilled water to solid A in the boiling tube. Heat the mixture while stirring with the thermometer to about 70°C. When **all** the solid has dissolved, allow the solution to cool while stirring with the thermometer. Note the temperature at which crystals of solid A first appear. Record this temperature in table 1.

(b) Using the burette, add 2 cm^3 of distilled water to the contents of the boiling tube. Warm the mixture while stirring with the thermometer until **all** the solid dissolves. Allow the mixture to cool while stirring. Note and record the temperature at which crystals of solid A first appear.

(c) Repeat procedure (b) two more times and record the temperatures in table 1. **Retain the contents of the boiling tube** for use in procedure (e).

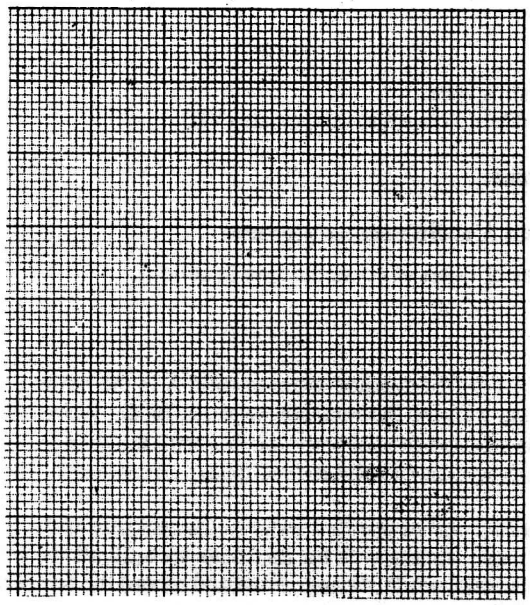
(d) (i) Complete table 1 by calculating the solubility of solid A at the different temperatures. The solubility of a substance is the mass of that substance that dissolves in 100 cm^3 (100 g) of water at a particular temperature.

Table 1

Volume of water in the boiling tube (cm^3)	Temperature at which crystals of solid A first appear (°C)	Solubility of solid A (g/100 g water)
4		
6		
8		
10		

(6 marks)

(ii) On the grid provided, plot a graph of the solubility of solid A (vertical axis) against temperature. (3 marks)



(iii) Using your graph, determine the temperature at which 100 g of solid **A** would dissolve in 100 cm^3 of water. (1 mark)

(e) (i) Transfer the contents of the boiling tube into a 250 ml volumetric flask. Rinse both the boiling tube and the thermometer with distilled water and add to the volumetric flask. Add more distilled water to make up to the mark. Label this solution **A**. Fill a burette with solution **B**. Using a pipette and a pipette filler, place 25.0 cm^3 of solution **A** into a conical flask. Warm the mixture to about 60°C. Titrate the hot solution **A** with solution **B** until a permanent pink colour persists. Record your readings in table 2. Repeat the titration two more times and complete table 2. **(Retain the remaining solution B for use in question 3 b(i)).**

Table 2

	I	II	III
Final burette reading			
Initial burette reading			
Volume of solution **B** used (cm^3)			

(3 marks)

(ii) Calculate the:

I average volume of solution **B** used (1 mark)

II number of moles of potassium manganate (VII) used (1 mark)

III number of moles of **A** in 25 cm^3 of solution **A** given that 2 moles of potassium manganate (VII) react completely with 5 moles of **A** (1 mark)

IV relative formula mass of **A**. (3 marks)

(iii) The formula of **A** has the form $D.xH_2O$. Determine the value of x in the formula given that the relative formula mass of **D** is 90.0 and atomic masses of oxygen and hydrogen are 16.0 and 1.0 respectively. (2 marks)

2 You are provided with solid **E**. Carry out the tests below. Write your observations and inferences in the spaces provided.

(a) Place about one third of solid **E** in a clean dry test-tube and heat it strongly.

Observations	Inferences
(1 mark)	(1 mark)

(b) Place the remaining solid **E** in a boiling tube. Add about 10 cm^3 of distilled water. Shake the mixture thoroughly for about one minute. Filter and divide the filtrate into four portions.

Observations	Inferences
(1 mark)	(1 mark)

(i) To the first portion, add 2 drops of phenolpthalein indicator.

Observations	Inferences
(1 mark)	(1 mark)

(ii) To the second portion, add 2 cm^3 of dilute hydrochloric acid.

Observations	Inferences
(1 mark)	(1 mark)

(iii) To the third portion, add 5 cm^3 of aqueous sodium sulphate.

Observations	Inferences
(1 mark)	(1 mark)

(iv) To the fourth portion, add dilute sodium hydroxide **dropwise** until in excess.

Observations	Inferences
(1 mark)	(1 mark)

3 You are provided with solid **F**.
Carry out the following tests and record your observations and inferences in the spaces provided.

(a) Using a **metallic** spatula, take one-third of solid **F** and ignite it using a Bunsen burner

Observations	Inferences
(1 mark)	(1 mark)

(b) Place the remaining solid **F** in a boiling tube. Add about 10 cm^3 of distilled water. Shake the mixture until all the solid dissolves.

(i) To about 4 cm^3 of the solution, add 2 to 3 drops of acidified potassium manganate (VII), solution **B**.

Observations	Inferences
(1 mark)	(1 mark)

(ii) To about 4 cm^3 of the solution, add 2 to 3 drops of bromine water. Warm the mixture.

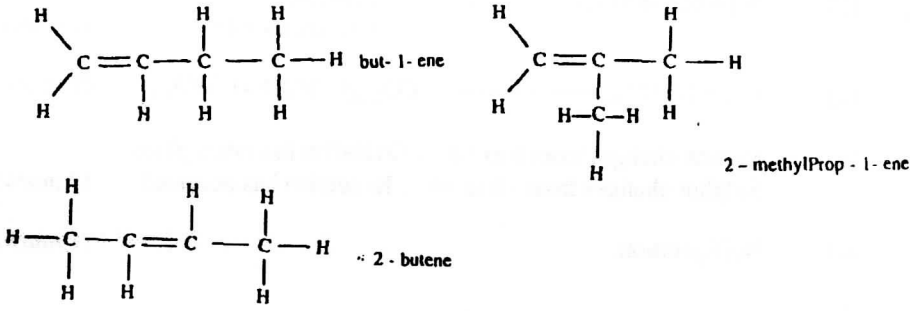
Observations	Inferences
(1 mark)	(1 mark)

24.6 CHEMISTRY (233)

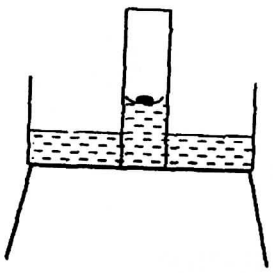
24.6.1 Chemistry Paper 1 (233/1)

1. (a) Compounds with the same molecular formula but different structural formulae. *(1 mark)*

(b)



2. (a) *(2 marks)*



(1 mark)

(b) Calibrate the gas jar before the start of experiment. *(1 mark)*

3. $\frac{\text{Time for } SO_2}{\text{Time for } O_2}$

$$= \sqrt{\frac{R.M.M.SO_2}{R.M.M.O_2}}$$

R.M.M. of SO_2 = 64
R.M.M of O_2 = 32

$$\frac{\text{Time for } SO_2}{50} = \sqrt{\frac{64}{32}}$$

Time for SO_2 = 70.7 seconds *(3 marks)*

4. (a) $37 + 0 \longrightarrow 37$
$18^{A} -1^{e} \quad 17^{B}$

(1 mark)

(b) (i) Studing rate of absorption of phosphorus from a fertilizer *(1 mark)*

(ii)
- May result to babies with deformities
- May cause cancer *(1 mark)*

5. (a) In solid state - Does not conduct
Ions are fixed *(1½ marks)*

(b) Aqueous solution - Conducts
Ions are mobile *(1½ marks)*

6. (a) $C_{(s)} + 2H_2SO_{4(l)} \longrightarrow CO_{2\,(g)} + 2H_2O_{(l)} + 2SO_{2(g)}$ *(1 mark)*

(b) Carbon changes from 0 to +4 ∴ Oxidation has taken place
Sulphur changes from +6 to +4 ∴ Reduction has occurred *(2 marks)*

7. (a) Refrigeration. *(1 mark)*

(b)
- They deplete the ozone layer.
- They cause green house effect. *(2 marks)*

8. Mass of water 94.5 – 51.3 = 43.2
R.M.M. of $Ba(OH)_2$ = 171
R.M.M. of H_2O = 18

$\frac{51.3}{171}$ $\frac{43.2}{18}$

$\frac{0.3}{0.3} = 1$ $\frac{2.4}{0.3} = 8$

E.F. = $Ba(OH)_2.8H_2O$ *(3 marks)*

9. (a)
- Pale yellow intensifies.
- Forward reaction is exothermic.
- Lowering temperature shifts the equilibrium to the right. *(1½ marks)*

(b)
- Pale yellow intensifies.
- Reducing the volume of syringe.
- Increases the pressure.
- The equilibrium shifts to the right. *(1½ marks)*

10. (a) Sublimation . *(1 mark)*
(b) Bleaching. *(1 mark)*
(c) Polymerisation. *(1 mark)*

11. (a)
- Acidify water with nitric acid.
- Add aqueous lead nitrate.
- Formation of white PPt shows presence of Cl^- *(2 marks)*

(b) Provides essential minerals e.g. Ca^{2+} *(1 mark)*

12. $\frac{62.93 \times 69.09 + 64.93 \times 30.91}{100}$

= 43.4783 + 20.0698

= 63.548 *(3 marks)*

13. (a) It is a drying agent. *(1 mark)*

(b) $Fe_{(S)} + 2HCl_{(g)} \longrightarrow FeCl_{2\,(s)} + H_{2(g)}$ *(1 mark)*

(c) Pickling of metals. *(1 mark)*

14. (a) N_2O *(1 mark)*

(b) K_2O *(1 mark)*

(c) Al_2O_3 *(1 mark)*

15. (a) N *(1 mark)*

(b) $E^{\varnothing}$ = 0.80 + 0.76

= 1.56 volts *(1 mark)*

16. (a) The solution changed from brown/yellow to light/pale green. *(1 mark)*

(b) $2\,FeCl_{3(aq)} + H_2S_{(g)} \longrightarrow 2\,FeCl_{2(aq)} + 2\,HCl_{(aq)} + S_{(s)}$ *(1 mark)*

(c) Oxidation. *(1 mark)*

17. (a) Platinum
Platinum – Rhodium *(1 mark)*

(b) $4\,NH_{3(g)} + 5O_2 \xrightarrow[(g)]{} 4\,NO_{(g)} + 6\,H_2O$ *(1 mark)*

(c)
- Fertilizers
- Explosives *(1 mark)*

18. Add anhydrous copper (11) Sulphate to substance S. It changes from white to blue.

OR

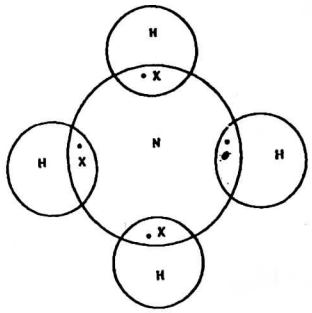
Dip cobalt chloride paper into Substance S. It changes from blue to pink.
(2 marks)

19. (a) To MgO add excess HNO_3 HCl or H_2SO_4. Add NaOH or KOH to the mixture. Filter and dry the residue. *(2 marks)*

(b) Anti-acid (Treatment of acid indigestion). *(1 mark)*

20. (a) Covalent bond is formed by equal contribution of the shared electrons by the atoms. Co-ordinate bond is where the shared electrons are contributed by one of the atoms. *(2 marks)*

(b)



(1 mark)

21. (a) They have delocalised valency electrons *(1 mark)*

(b) Aluminium has three delocalised electrons. *(2 marks)*
It is resistant to corrosion.

22. (a) Oxalic acid and Conc. H_2SO_4 *(1 mark)*

(b) $2\ KOH_{(aq)} + CO_{2(g)} \longrightarrow K_2CO_{3(aq)} + H_2O_{(l)}$ *(1 mark)*

(c)
- CO is odourless.
- CO is colourless. *(1 mark)*

23. In addition to van der waals forces, strong hydrogen bonds exist in ethanol.
These bonds require more energy to break. *(2 marks)*

24. (a)

Acidic	Basic
Orange	Pink

(1 mark)

(b) The P^H of 0.1M KOH is higher than that 0.1M aqueous ammonia.
KOH is strongly dissociated in solution. *(2 marks)*

25. (a) V_1 and V_3. *(1 mark)*

(b) Add petrol to the mixture. Filter. V_2 is the residue. Filtrate is V_4.
Distil the filtrate. *(2 marks)*

26. (a) They gain energy and move faster. The intermolecular distance increases. *(1 mark)*

(b) XY *(1 mark)*

(c) The energy supplied changes molecules of water from liquid to Gaseous state. *(1 mark)*

27. (a) Conc. H_2SO_4 *(1 mark)*

(b) Heat the solution to concentrate it. Allow for crystal to form. Filter. *(1 mark)*

(c) Anhydrous copper (11) Sulphate *(1 mark)*

28. (a) ΔH_1 = Lattice energy
ΔH_2 = Hydration energy *(2 marks)*

(b) $\Delta H_3 = \Delta H_1 + \Delta H_2$ *(1 mark)*

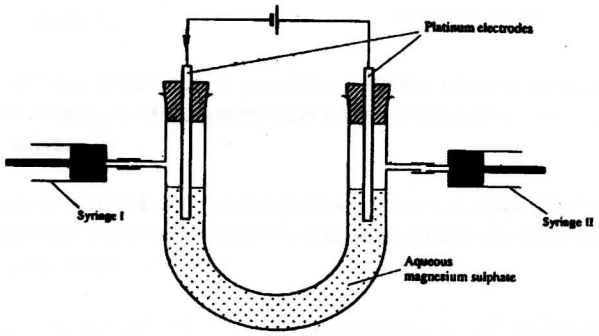
24.6.2 Chemistry Paper 2 (233/2)

1. (a) A substance that allows the passage of an electric current and is decomposed by it. *(1 mark)*

(b) (i) Molten calcium chloride: Conducts by movement of ions. *(1 mark)*

(ii) Graphite: Conducts by movement of delocalised electrons *(1 mark)*

(c) (i)



(1 mark)

(ii) Syringe I: The H^+ ions migrate to the negatively charged electrode (cathode) where they get discharged to form hydrogen gas. *(1 mark)*

(d) The amount of water used to produce O_2 and H_2 gases is **MORE** than that produced at the anode. *(2 marks)*

(e) Quantity of electricity 15 x 0.72 x 60
= 648 coulombs

$4\ OH^-_{(aq)} \longrightarrow 2\ H_2O_{(l)} + O_{2(g)} + 4\ e^-$

Faradays of electricity $\frac{648}{96500}$ = 0.006715 F

Moles of oxygen produced = 0.006715

$= \frac{0.006175}{4}$

Volume of oxygen =0.001675 x 24000

= 40.2888 cm^3

= 40.29 cm^3 *(4 marks)*

2. (a) (i) The blue colour of solution fades. Brown solid is deposited because the coloured copper ions are discharged to form copper. *(3 marks)*

(ii) Heat change
25 x 4.2 x 18(= 1890 Joules *(2 marks)*

(iii) Moles of M_g used = $\frac{0.15}{24}$ = 0.00625

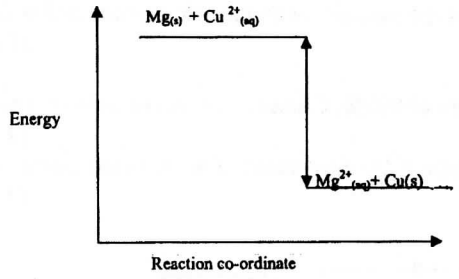
0.00625 = 1890 Joules

∴ 1 mole = $\frac{1890}{0.00625(}$

= -302.4 kJ mol^{-1} *(2 marks)*

(iv) $Mg_{(s)} + Cu^{2+}_{(aq)} \longrightarrow Mg^{2+}_{(aq)} + Cu_{(s)}$ (1) ***(1 mark)***

(v)



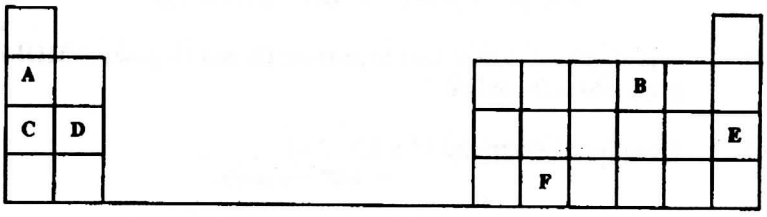
(2 marks)

(b) Zinc is higher than copper in the reactivity series or Zinc is more reactive than copper or Zinc will dissolve in the solution leading to weakening of the container or Redox reaction will take place. ***(2 marks)***

3. (a) Isotopes are atoms with same atomic number (protons) but different mass numbers while allotropes are different forms/structure of an element in the same physical state. ***(2 marks)***

(b) (i) E Atomic radius decreases across a period / E has the highest nuclear attraction / E has the highest no. of protons. ***(2 marks)***

(ii)



(1 mark)

(iii) Used in Advertising Sign Lamps / Light / fluorescent lamps
Weather / metrological /arch welding. ***(1 mark)***

(iv) $2CNO_{3\ (S)} \longrightarrow 2CNO_{2(S)} + O_{2(g)}$

$2NaNo_{3(s)}(s) \xrightarrow{Heat} 2NaNo_2(s) + O_2(g)$ ***(1 mark)***

(c) Moles of chlorine used $^3/_{24} = 0.125$

$\therefore$ Mass of Cl_2 in product formed $= 0.125 \times 71^{(1/2)} = 8.875$

Moles of D $= 0.125$

Mass of D $11.875 - 8.875 = 3g$

$= 3/0.125$

$\therefore$ R.A.M. of D $= 24$ ***(3 marks)***

4. (a) (i) $2\ PbS_{(s)} + 3O_{2(g)} \longrightarrow 2PbO_{(s)} + 2SO_{2(g)}$ ***(1 mark)***

(ii) To avoid poisoning of the catalyst. ***(1 mark)***

(iii) SO_3 is absorbed in 98% conc. Sulphuric acid to make Oleum
or $SO_2 + H_2SO_4 \longrightarrow H_2S_2O_{7\ (l)}$ ***(1 mark)***

(iv) $SO_{2(g)}$ (½) and $SO_{3(g)}$ (½) *(1 mark)*

(v) They form acid rain which corrodes buildings / toxic – kills/causes respiratory problems. *(1 mark)*

(vi) To minimize costs. *(1 mark)*

(b) (i)

Substance	Observations
Iron filings	- Effervescence starts and stops immediately. - Bubbles of a colourless gas with a pungent smell. - A brown solution is formed *(1 mark)*
Crystal of white sugar	- Black spongy solid *(1 mark)*

(ii) I Heating is required for conc. H_2SO4 to react.
Some SO_2 is formed / produced. *(1 mark)*
II Formation of Carbon by dehydration of sugar. *(1 mark)*

(c) $(NH_4)SO_4$ - Ammonium Sulphate.
$2\ CaSO_4 + Ca(H_2PO_4)_2$ Calcium Superphosphate. *(1 mark)*

(d) It is insoluble in water hence cannot be washed easily. *(1 mark)*

5. (a) Hydrocarbon. *(1 mark)*

(b) (i) Fractional distillation. *(1 mark)*
(ii) Fuel solvent/ source of H_2 gas. *(1 mark)*

(c) (i) L = Calcium cabide, CaC_2 *(1 mark)*
(ii) Phosphoric acid/Aluminium oxide / $H_2\ SO_4$ *(1 mark)*

(iii) $H - C \equiv C - H$ *(1 mark)*

(iv) Hydrolysis or hydration or Oxidation . *(1 mark)*

iv) I
- Making rain coats.
- Plastic water pipes.
- Electrical insulation.
- Floor tiles. *(1 mark)*

II Hardening of oils to form fats / margarine manufacture. *(1 mark)*

(d) (i) $CH_3COOH_{(aq)} + NaOH_{(aq)} \rightarrow CH_3CO - ONa_{(aq)} + H_2O_{(l)}$ *(1 mark)*

(ii) HCl is fully dissociated while ethanoic acid dissociates partially.
∴ Ethanoic acid is weak while HCl is strong *(2 marks)*

6. (a) (i) Calcium silicate / Calcium aluminate. *(1 mark)*

(ii) Magnetite, Fe_3O_4
Siderite, $Fe\ CO_3$ / Iron pyrites / iron lemonite
Accept both the name and or a correct formula *(1 mark)*

(iii) Carbon dioxide, CO_2 / Carbon (IV) Oxide *(1 mark)*

(b) Air reacts with carbon (coke) to form carbon dioxide (CO_2). Carbon dioxide reacts with coke to form carbon monoxide. The carbon monoxide reacts with Fe_2O_3 to form Iron. *(3 marks)*

(c) To produce calcium oxide which reacts with silica to form slag. *(1 mark)*

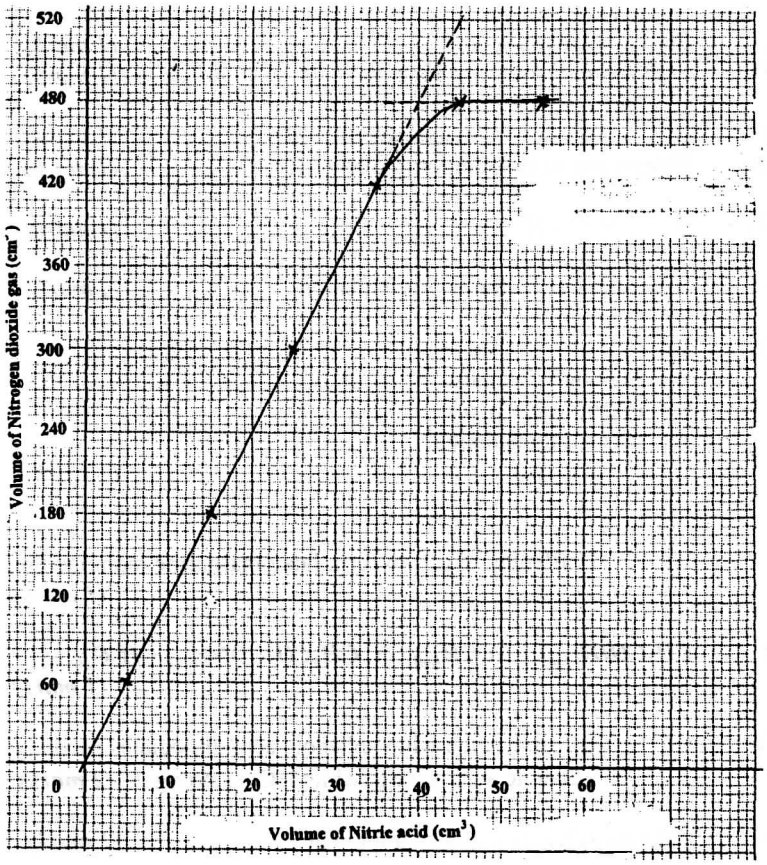
(d) Cast iron is impure. *(1 mark)*

(e) Manufacture of
- Rails.
- Drainage pipes.
- Engine blocks / utensils / nails / cutlery / surgical instruments / bridges / cars / iron sheets etc *(2 marks)*

7. (a) Nitric acid is a strong oxidising acid. It oxidises hydrogen gas to water. *(1 mark)*

(b) Increase Molecules acquire the necessary activation energy This increases the frequency of collisions hence the rate of reaction. *(2 marks)*

(c)



(d) (i) $360\ cm^3$ (Correct value read from graph) *(1 mark)*

(ii) $40\ cm^3$ (Correct value read from graph) *(1 mark)*

(e) (i) Moles of lead $= \frac{2.07}{2.07}$

$\therefore$ 1 Mole of lead $= \frac{40}{0.01}$

$= 4000$ cm *(2 marks)*

(ii) $\frac{480}{0.01} = 48000\ cm^3$ *(1 mark)*

(f) (i) Moles of nitric acid That react with 1 mole of lead $= \frac{4000}{1000}$

$= 4$ *(1 mark)*

(ii) Moles of nitrogen dioxide $= \frac{48000}{24000}$

$= 2$ *(1 mark)*

(g) $Pb_{(s)} + 4HNO_{3(aq)} \longrightarrow Pb(NO_3)_{2(aq)} + 2\,H_2O_{(l)} + 2NO_{2(g)}$ *(1 mark)*

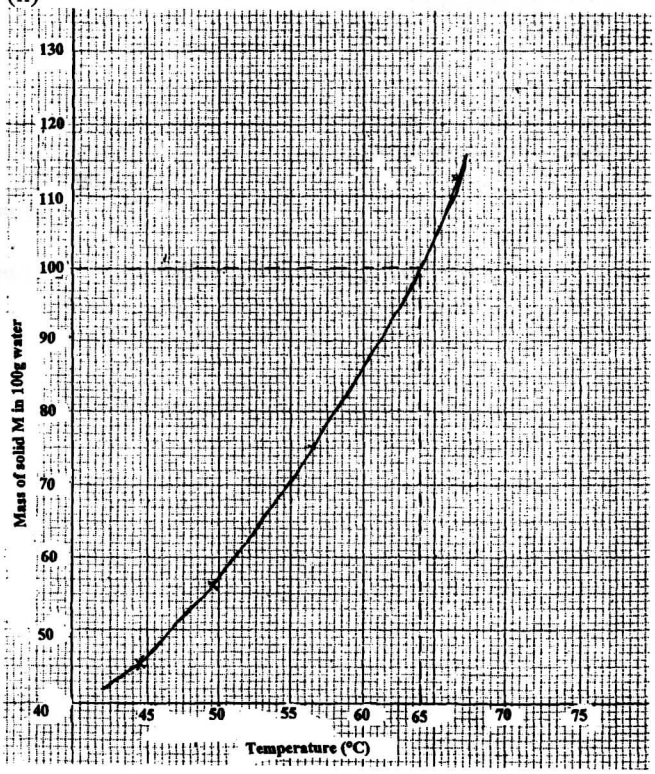
24.6.3 Chemistry Paper 3 (233/3)

1. (a), (b), (c) and (d) (i)

Volume of water in the boiling tube (cm^3)	Temperature at which crystals of solid A first appear (°C)	Solubility of solid A (g/100g water)
4	66 - 67	112.5
6	56 - 57	75
8	49 - 50	56
10	44 - 45	45

(6 marks)

(ii)



(3 marks)

(iii) 63 ± 0.5 °C ***(1 mark)***

(e) (i)

	I	II	III
Final burette reading	24.40	48.60	26.20
Initial burette reading	0.00	24.40	2.00
Volume of solution B used (cm^3)	24.40	24.20	24.20

(3 marks)

(ii)

I Average $\frac{24.20 + 24.20 + 23.4}{3}$

$= 24.20 cm^3$ ***(1 mark)***

II $\frac{0.06 x 24.20}{1000}$

$= 1.45 \times 10^{-3}$ moles ***(1 mark)***

III $\frac{1.45 \times 10^{-3} \times 5}{2}$

$=3.63 \times 10^{-3}$ moles *(1 mark)*

IV $3.63 \times 10^{-3} \times 10$

$=3.63 \times 10^{-2}$ moles

$\frac{4.5}{3.63x10^{-2}}$

$= 124$ *(3 marks)*

(iii) $Dx\ H_20$

$90 + 18x = 124$

$x = \frac{34}{18}$

$= 1.9$

≈ 2 *(2 marks)*

		Observations	Inferences	
2. (a)		Colourless liquid condenses on cool parts of test-tube White solid remains	Probably Hydrated Salt/compound present	*(2 marks)*
(b)		Colourless filtrate White residue	Compound sparingly soluble	*(2 marks)*
	(i)	Solution turns pink	Compound is basic: OH^-,HCO^-_3 or CO_3^{2-} present	*(2 marks)*
	(ii)	No effervescence	OH^-Present or HCO_3 or CO_3^{2-} Absent	*(2 marks)*
	(iii)	White PPt formed	$Ca^{2+}, Ba^{2+}, Pb^{2+}$ present	*(3 marks)*
	(iv)	No white PPt	Ba^{2+} Present or Ca^{2+} or pb^{2+} Absent.	*(2 marks)*
3 (a)		Burns with luminous (yellow, smoky) flame	Unsaturated compound OR long chain hydrocarbon	*(2 marks)*
(b)		Potassium manganate (VII) is decolourised (changes from purple to colourless)	Alkene or alcohol present	*(2 marks)*
(c)		Bromine water is decolourised (changes from red to colourless)	Alkene present	*(2 marks)*