Name _____ Index No. _____

Candidate's Signature _____

Date _____

233/1
CHEMISTRY
PAPER 1
THEORY
AUGUST 2021
2 HOURS

GOLDEN ELITE EXAMINATION

CYCLE 1

Kenya Certificate of Secondary Education
CHEMISTRY
PAPER 1
2 HOURS

INSTRUCTIONS TO CANDIDATES

1. Write your name and index number in the spaces provided above.
2. Sign and write the date of examination in the spaces provided above.
3. Answer all the questions in the spaces provided.
4. Mathematical tables and silent electronic calculators many be used.
5. All working must be clearly shown where necessary.

FOR EXAMINER'SUSE ONLY

QUESTION	MAXIMUM SCORE	CANDIDATE'S SCORE
1 – 28	80	

This paper consists of 12 printed pages

1. Two elements R and Q have their ionic configuration 2.8 and 2.8.8. They are found in group six and group 1 respectively in the periodic table. Write down the electronic configuration of their neutral atoms.

(i) Q _____ (½ marks)

R _____ (½ mark)

(ii) Give the formula of the compound formed when R and Q combine. (1 mark)

_____

_____

_____

(iii) The compound in (ii) above was dissolved in water. What would be the effect on a blue litmus paper dipped into resulting solution? Explain. (1 mark)

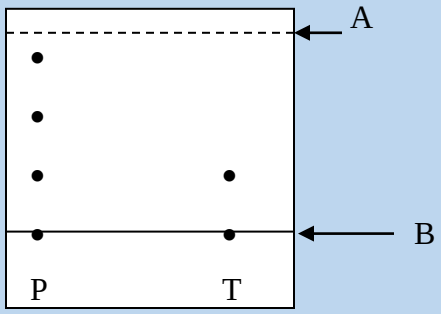
_____

_____

_____

_____

2. The following is a chromatogram showing the results obtained after separating two substances P and T.



(a) Name lines :

A _____ (½ mark)

B _____ (½ mark)

(b) Name a possible solvent which can be used in the above process. (1 mark)

_____

_____

_____

(c) Which of the two substances is pure? (1 mark)

_____

_____

_____

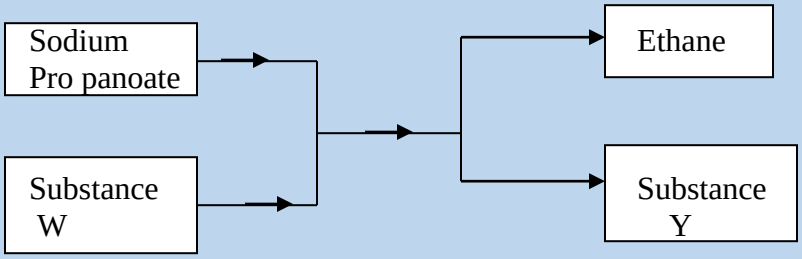
3. An oxide of metal M contains 59% of metal M and 41% oxygen. Given that the relative formula mass of the oxide is 78, determine its relative molecular formula. (3 marks)

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

Isotope	Relative atomic mass	% abundance
L_1	62.93	69.09
L_2	64.93	30.91

Calculate the R.A.M of element L. (2 marks)

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

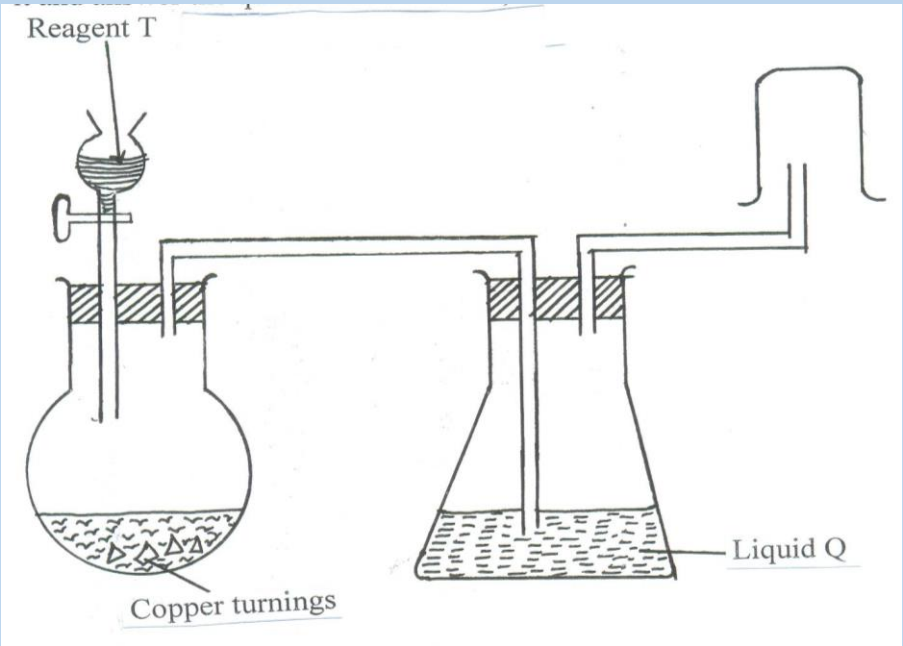


Name substances:

(i) W _____ (1 mark)

(ii) Y _____ (1 mark)

6. The set up below was used by a student to prepare sulphur (IV) oxide gas in the laboratory. Study it and answer the questions that follow;



(a) Name: (i) Reagent T _____ (1 mark)

(ii) Liquid Q _____ (1 mark)

(b) State one mistake in the set-up. (1 mark)

_____

_____

_____

_____

(c) What observation is made when sulphur (IV) oxide is passed through potassium chromate solution? (1 mark)

_____

_____

_____

_____

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

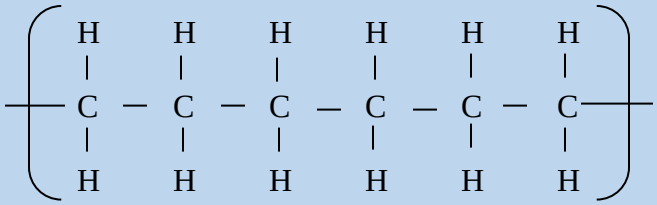
_____

_____

_____

_____

8. A student in form 4 was provided with the following polymer.



(a) Name the polymer _____ (1 mark)

(b) Draw the structure of the monomer. (1 mark)

(c) Name the type of reaction that take place during the formation of the polymer. (1 mark)

_____

_____

_____

9. Describe an experimental procedure that can be used to extract oil from nut seeds. (2 marks)

_____

_____

_____

_____

_____

10. Write equations to show the effect of heat on each of the following.

(a) Sodium hydrogen carbonate. (1 mark)

_____

_____

_____

(b) Silver nitrate (1 mark)

_____

_____

_____

(c) Anhydrous iron (II) sulphate (1 mark)

_____

_____

_____

11. (a) A student electroplated a spoon with copper metal write an equation for the process that took place at the cathode. (1 mark)

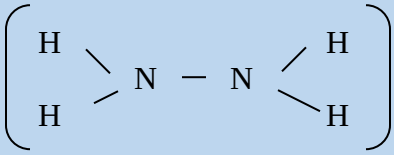
_____

_____

_____

_____

(b) Calculate the time in minutes required to deposit 1.184g of copper if a current of 2 amperes was used (1 Faraday = 96500 coulombs, Cu = 63.5) (2 marks)

12. Hydrazine gas, 

Burn in oxygen to form nitrogen gas and steam.

(a) Write an equation for the reaction. (1 mark)

_____

_____

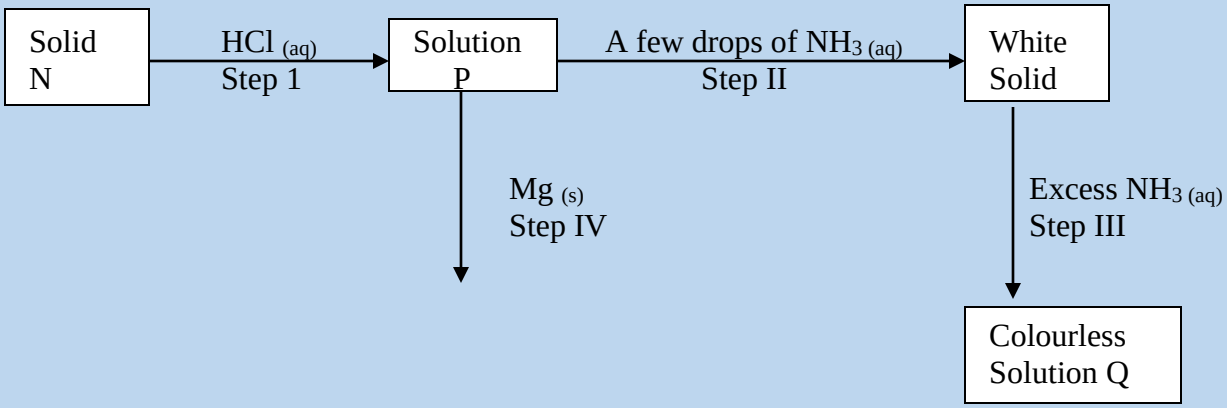
_____

_____

(b) Using the bond energies given below, calculate the enthalpy change for the reaction in (a) above. (2 marks)

Bond	Bond energy (Kj per mole)
N ≡ N	944
N – N	163
N – H	388
O = O	496
H - O	463

13. The scheme below shows some reaction sequence starting with solid N. Study it and answer the questions that follow.



(a) Write the formula of the complex ion in solution Q. (1 mark)

_____

_____

_____

(b) Write an equation for the reaction in step (IV). (1 mark)

_____

_____

_____

14. (a) State the Charles' law. (1 mark)

_____

_____

_____

_____

(b) A certain mass of gas occupies 146dm^3 at 291K and 98.31kPa. What will be its temperature if its volume is reduced to 133dm^3 at 101.325 kPa? (2 marks)

15. Draw a labeled diagram to illustrate how alpha, beta and gamma radiations can be distinguished from each other. (3 marks)

16. When fuels burn in the internal combustion engine at high temperature, one of the products formed is nitrogen (II) oxide.

(a) Write the equation for the formation of nitrogen (II) oxide. (1 mark)

_____

_____

_____

_____

(b) Give a reason why nitrogen (II) oxide is not formed at room temperature. (1 mark)

_____

_____

_____

_____

(c) Describe how formation of nitrogen (II) oxide in the internal combustion engine leads to gaseous pollution? (1 mark)

_____

_____

_____

_____

_____

17. (a) Name two ores from which copper is extracted. (1 mark)

_____

_____

_____

_____

(b) During extraction of copper metal, the ore is subjected to froth flotation.
Give a process why this process is necessary. (1 mark)

_____

_____

_____

_____

(c) Name one alloy of copper and state its use. (1 mark)

Alloy _____

Use _____

_____

18. (a) Name the four classes of oxides. (2 marks)

_____

_____

_____

_____

_____

(b) State one industrial application of amphoteric character of aluminium oxide. (1 mark)

_____

_____

_____

19. By using aqueous sodium chloride, describe how a student can distinguish calcium ions from lead ions. (2 marks)

_____

_____

_____

_____

_____

20. Using ammonia solution only. Describe how a solution containing Fe^{2+} can be differenciated from a solution containing Fe^{3+}. (2 marks)

_____

_____

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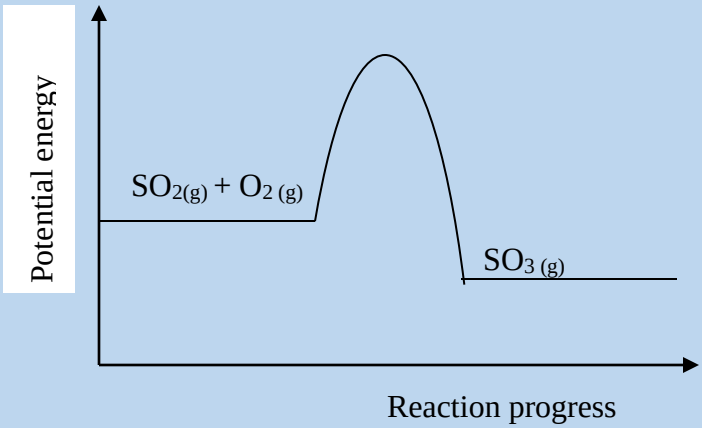
21. The diagram below represents energy charges in the reaction between sulphur (IV) oxide and oxygen gas without a catalyst.



Indicate on the same diagram the reaction path when a catalyst is used. (1 mark)

22. (a) State Le Chateliers Principle. (1 mark)

_____

_____

_____

_____

(b) Ammonia can be formed by the reaction shown below.

$$N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}; \qquad \Delta H = -92\ kJmol^{-1}$$

State and explain what happens if;

(i) The pressure of system is increased. (2 marks)

_____

_____

_____

_____

(ii)Cold water is poured over the system. (2 marks)

_____

_____

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_____

23. The table below shows the relative molecular masses and boiling points of propan-i-ol and ethanoic acid.

	Relative molecular mass	Boiling point ^0C
Propan-1-ol	60	36
Ethanoic acid	60	118

Explain why the boiling point of ethanoic acid is higher than that of propa-i-ol and yet they have the same molecular mass. (2 marks)

_____

_____

_____

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_____

24. The table below shows the pH values of some solutions.

Solution	A	B	C	D	E
pH	6	13	2	10	7

(a) Which solution is likely to be

(i) Strong base _____ (1 mark)

(ii) Weak base _____ (1 mark)

(b) Compare the electrical conductivity of solution A and C. (2 marks)

_____

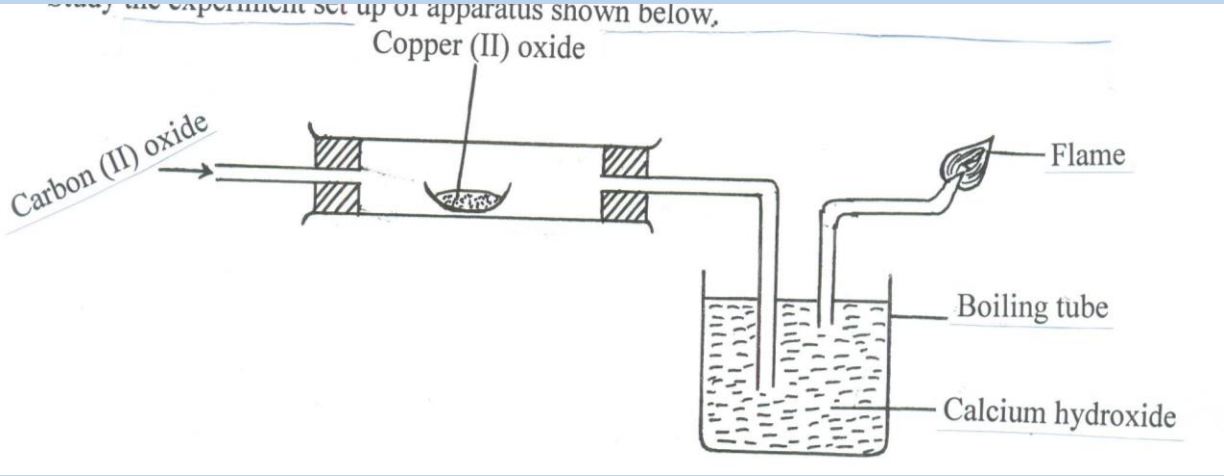
_____

_____

_____

25. Study the experiment set up of apparatus shown below.

26.



State the two observations made in the set up as the experiment progresses. (2 marks)

_____

_____

_____

_____

26. You are provided with
(i) Potassium carbonate solid
(ii) Zinc hydroxide
(iii) Nitric (V) acid

State briefly how you would prepare solid zinc carbonate using the reagent given. (3 marks)

_____

_____

_____

_____

_____

27. (a) Using the information given below, draw a well laballed diagram of electrochemical cell that can be constructed to measure the electrochemotive force between G and J. (3 marks)

$G^{2+}_{(aq)} + 2e^- \longrightarrow G_{(s)}$, $E^\theta = 0.74v$

$J^{2+}_{(aq)} + 2e^- \longrightarrow J_{(s)}$; $E^\theta = -0.14v$

(b) Determine the E^θ value for the cell constructed in 27 (a) above. (2 marks)

(c) Using the reduction potentials given below to explain why a solution containing copper (II) ions should be stored in a container made of zinc. (3 marks)

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

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

_____

_____

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_____

28. What is an isotope? (1 mark)

_____

_____

_____

_____

Name _____ Index No. _____

Candidate's Signature _____

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233/2
CHEMISTRY
PAPER 2
THEORY
AUGUST 2021
2 HOURS

GOLDEN ELITE EXAMINATION

CYCLE 1

Kenya Certificate of Secondary Education
CHEMISTRY
PAPER 2
2 HOURS

INSTRUCTIONS TO CANDIDATES

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FOR EXAMINER'S USE ONLY

QUESTION	MAXIMUM SCORE	CANDIDATE'S SCORE
1	12	
2	12	
3	10	
4	11	
5	11	
6	12	
7	12	
TOTAL SCOTE	**80**	

This paper consists of 13 printed pages

Turn Over

1. (a) The grid below represents part of the periodic table. Study it and answer the questions that follow. The letters do not represent the actual symbols of elements.

E			H				J	
	N							
F	G					L		K
							M	

(i) Identify the element which gains electrons most readily. (1 mark)

_____

_____

_____

(ii) Which of the metals is the most reactive? Explain. (2 marks)

_____

_____

_____

_____

(iii) What name is given to the family to which elements E and F belong? (1 mark)

_____

_____

_____

(iv) Explain why the ionic radius of F is smaller than that of L. (2 marks)

_____

_____

_____

_____

(v) Explain why element F forms ions more readily than E. (2 marks)

_____

_____

_____

_____

(vi) Write down the equation of the reaction between G and J. (1 mark)

_____

_____

_____

_____

(b) Study the table below and use it to answer the questions that follow.

Substance	X	Y	W	U	S	T
Melting point (^{0}C)	801	113 119	-39	-5	-10	1356
Boiling point (^{0}C)	1410	444	457	54	-36	2860
Electrical conductivity of solid	Poor	Poor	Good	Poor	Poor	Poor
Electrical conductivity of molten	Good	Poor	Good	Poor	Poor	Poor

(i) Name the type of bond that exist in:

W _____ (½ mark)

X _____ (½ mark)

(ii) Which substance has a molecular structure and exists in gaseous state at room temperature? (1 mark)

_____

_____

_____

(iii) Both X and W conduct electricity in liquid state. Explain the difference in conductivity. (1 mark)

_____

_____

_____

_____

2. (a) Name one natural fibre. (1 mark)

_____

_____

_____

_____

(b) State two advantages of synthetic fibre over natural fibre. (2 marks)

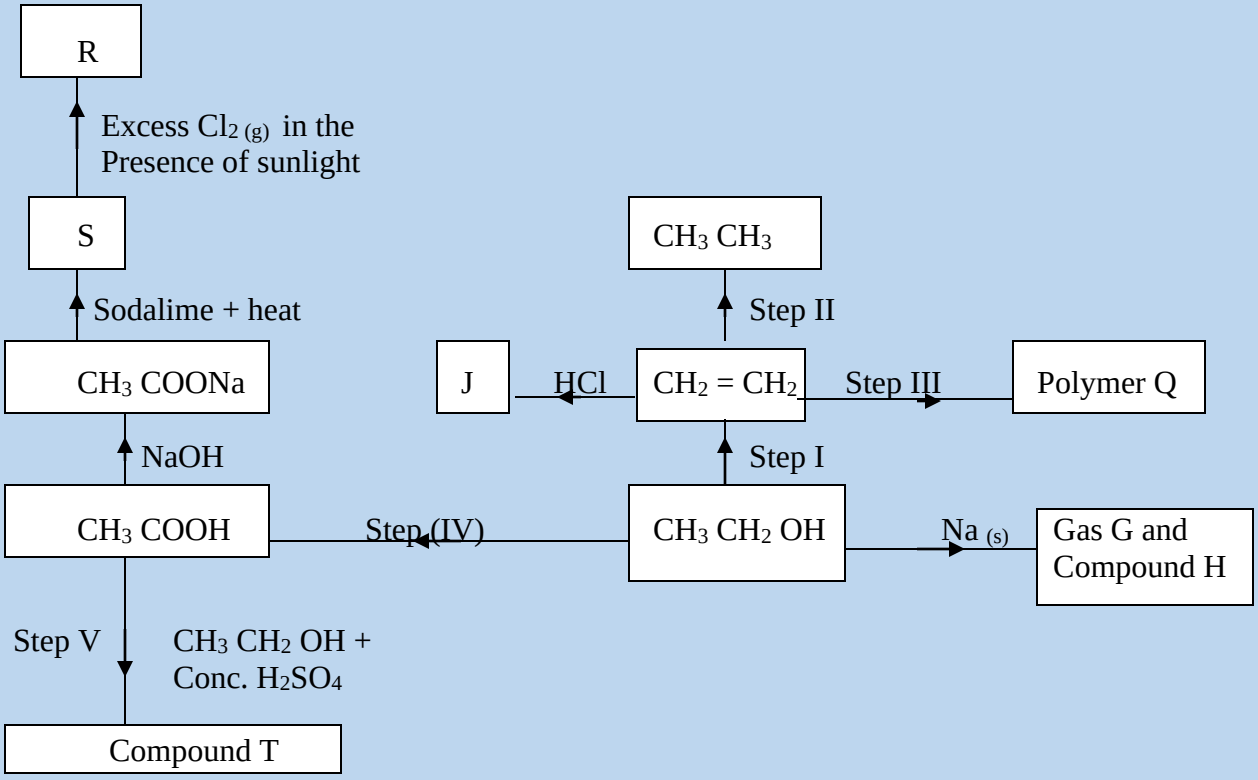
_____

_____

_____

_____

(c) The scheme below shows reactions starting with ethanol. Study it and answer the questions that follow.



(i) Name gas G _____ (1 mark)

(ii) Write the structural formulae and names of

T Formula _____ (1 mark)

Name _____ (1 mark)

S Formula _____ (1 mark)

Name _____ (1 mark)

(iii) Name the homologous series to which T belongs. (1 mark)

_____

_____

_____

(iv) Write down the structural formula of compound R and give its name. (2 marks)

_____

_____

_____

_____

(v) Name polymer Q _____ (1 mark)

3. (a) Give the sources of carbon (IV) oxide and ammonia used in the solvay process. (1 mark)

Carbon (IV) oxide _____

Ammonia _____

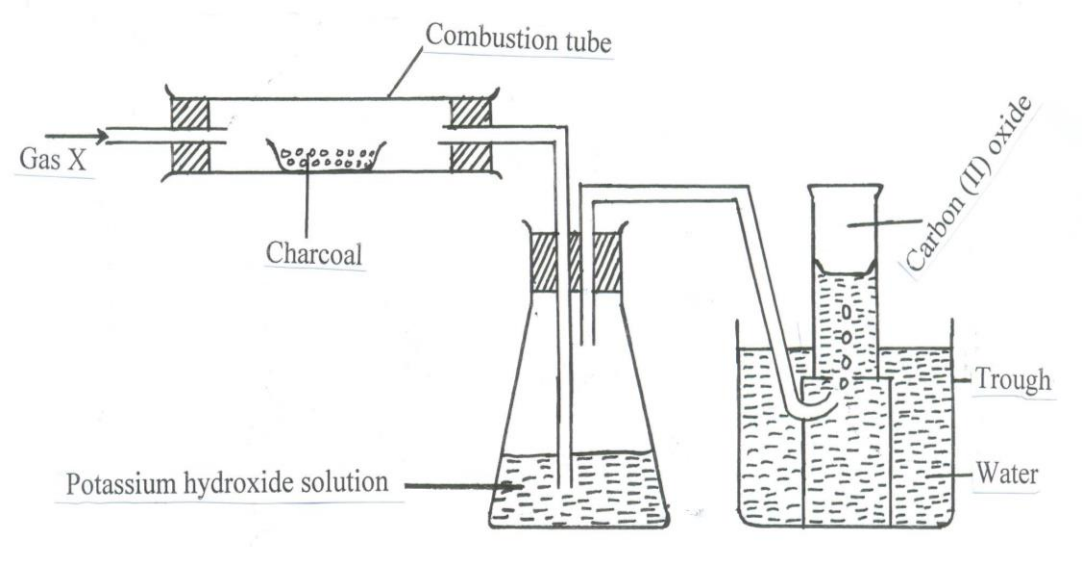
(b) State one use of sodium carbonate. (1 mark)

_____

_____

_____

(c) The diagram below is an experimental set up for the preparation of carbon (II) oxide. Study it and answer the questions that follow.



(i) Identify gas X _____ (1 mark)

(ii) State one condition that is missing in the set up but must be present for the experiment to proceed. (1 mark)

_____

_____

_____

(iii) What is the role of potassium hydroxide? (1 mark)

_____

_____

_____

_____

(iv) Why is the gas collected using the method shown? (1 mark)

_____

_____

_____

_____

(v) Name another substance that can be used instead of potassium hydroxide. (1 mark)

_____

_____

_____

(vi) Describe a simple test that ca n be used to distinguish between carbon (II) oxide and carbon (IV) oxide. (2 marks)

_____

_____

_____

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_____

_____

(vii) Why is it necessary to carry out the experiment in a fume cupboard? (1 mark)

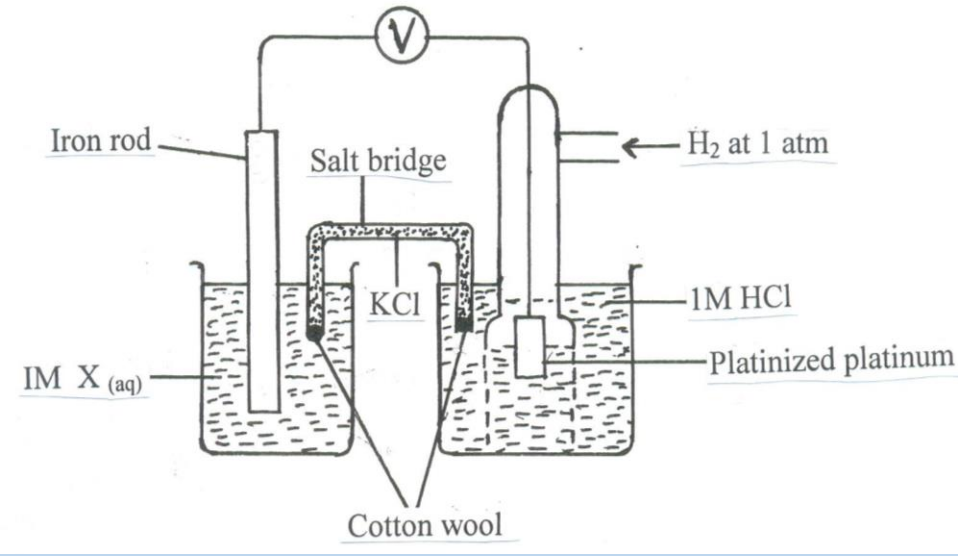
_____

_____

_____

_____

4. (a) The diagram below illustrates an iron-hydrogen electrochemical cell. Study it and answer the questions that follow.



Given that the E^{θ} value for $Fe^{2+}_{(aq)} / Fe$ (s) is -0.44V and that of $2H^{+}_{(aq)} / H_{2(g)}$ is 0.00V:

(i) On which electrode does reduction occur? (1 mark)

_____

_____

_____

(ii) Give the overall redox reaction that takes place in the two half cells. (1 mark)

_____

_____

_____

_____

(iii) Suggest suitable identity of solution X. (1 mark)

_____

_____

_____

(iv) Give two functions of the salt bridge. (2 marks)

_____

_____

_____

_____

(v) What happens to the iron electrode as reaction progresses? (1 mark)

_____

_____

_____

_____

(b) Electrolysis of aqueous solution of a salt of metal M resulted in the deposition of 1.07g of the metal upon passage of a current of 1.32 amperes for 75 minutes.
(Relative atomic mass of M = 52, 1 Faraday = 96500 coulombs).
(i) Calculate the quantity of electricity that passed through the cell. (2 marks)

(ii) Calculate the quantity of electricity required to deposit 1 mole of the metal. (2 marks)

(iii) Determine the charge on the metal ion. (1 mark)

(iv) Give the ionic half equation for the reaction that results in the formation of the metal deposit. (1 mark)

5. (a) From an experiment, 25.0cm^3 of hydrochloric acid required 20.0cm^3 of 0.02M sodium carbonate for a complete reaction. Calculate:

(i) The number of moles of sodium carbonate used. (1 mark)

(ii) The number of moles of hydrochloric acid used . (1 mark)

(iii) The molarity of the acid. (1 mark)

(b) A solution of sodium hydroxide was found to contain 12.4g/dm^3 of sodium hydroxide. 25cm^3 of this solution reacted with 15cm^3 of a solution of sulphuric (VI) acid.
(i) Find the molarity of the sodium hydroxide solution. (1 mark)

(ii) Calculate the number of moles of sodium hydroxide solution used. (1 mark)

(iii) Calculate the number of moles of the acid used. (2 marks)

(iv) Determine the concentration of the sulphuric (VI) acid solution in g/dm^3. (3 marks)
(Na = 23, O = 16, H = 1, S = 32)

6. (a) At 25^0C, 50g of potassium nitrate were added to 100g of water to make a saturated solution. What is meant by a saturated solution? (1 mark)

_____

_____

_____

_____

(b) The table below gives the solubilities of potassium nitrate at different temperatures.

Temperature ^{0}C	12	20	28	36	44	52
Solubility g/100g of water	22	31	42	55	70	90

(i) Plot a graph of the solubility of potassium nitrate against temperature. (3 marks)

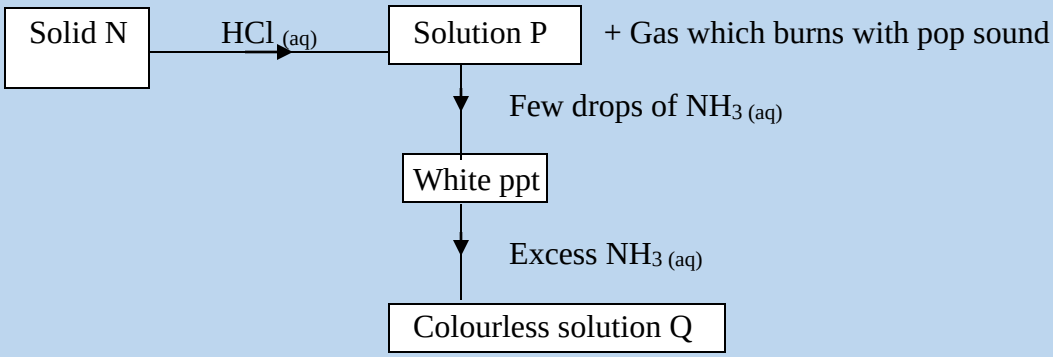
(ii) Using the graph, determine:

I) The solubility of potassium nitrate at 15^0C. (1 mark)

II) The mass of potassium nitrate that remained undissolved given that 80g of potassium nitrate were added to $100cm^3$ of water and warmed to 40^0C. (2 marks)

(c) Determine the molar concentration of potassium nitrate at 15^0C. (3 marks)
(Assume there is no change in density of water at this temperature. K = 39, N = 14, O = 16)

(d) The scheme below shows some reactions sequence starting with solid N.



(i) Identify solid N _____ (1 mark)

(ii) Write the formula of the complex ion present in solution Q. (1 mark)

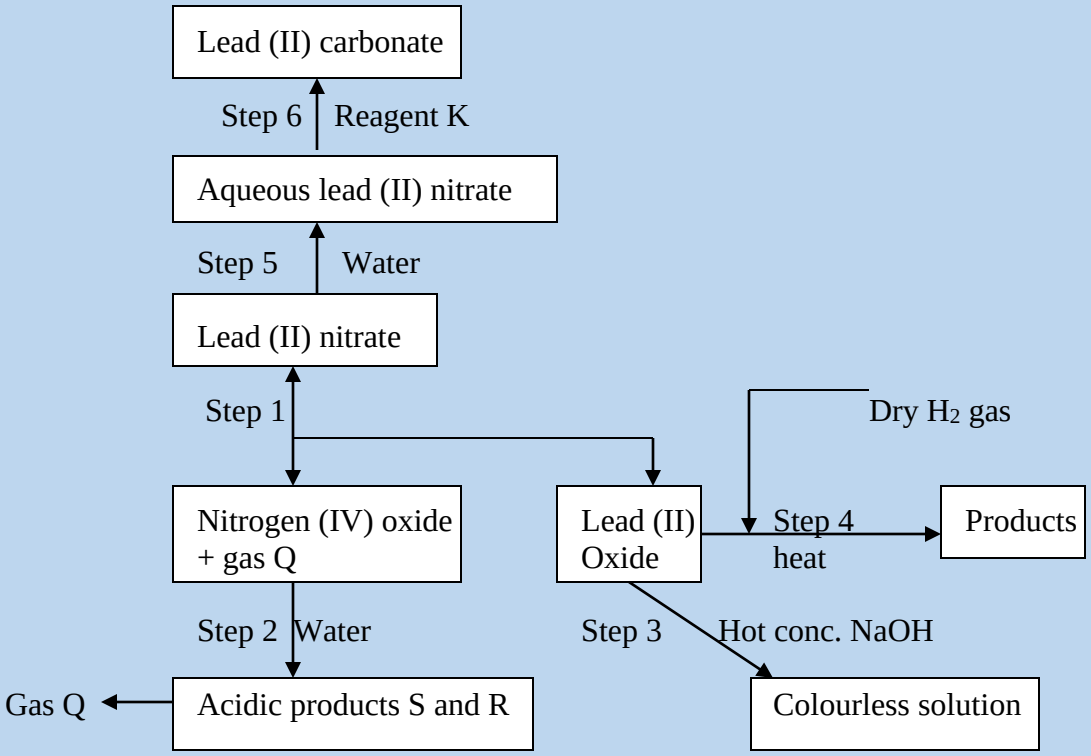
_____

_____

_____

_____

7. The flow chart below shows some reactions starting with lead (II) nitrate. Study it and answer the questions that follow.



(i) State the condition necessary in step 1. (1 mark)

_____

_____

_____

_____

(ii) Identify: I) Reagent K _____ (1 mark)

II) Gas Q _____ (1 mark)

III) Acidic products S and R (1 mark)

S _____

R _____

(iii) Write

I) The formula of the complex ion formed in step 3. (1 mark)

_____

_____

_____

_____

II) The equation of the reaction in step 4. (1 mark)

_____

_____

_____

_____

(b) The use of materials made of lead in roofing and in water pipes is being discouraged,. State

(i) Two reasons why these materials have been used in the past. (2 marks)

_____

_____

_____

_____

(ii) One reason why their use is being discouraged. (1 mark)

_____

_____

_____

_____

(c) (i) The reaction between lead (II) nitrate and conc. Sulphuric (VI) acid starts but stops immediately. Explain. (2 marks)

_____

_____

_____

_____

_____

_____

(ii) Name one suitable reagent that can be reacted with conc. Sulphuric (VI) acid to produce nitric (V) acid. (1 mark)

_____

_____

_____

Name _____ Index No. _____

Candidate's Signature _____

Date _____

233/3
CHEMISTRY
PAPER 3
PRACTICAL
AUGUST 2021
2 ¼ HOURS

GOLDEN ELITE EXAMINATION

CYCLE 1

Kenya Certificate of Secondary Education
CHEMISTRY
PAPER 3
2 ¼ HOURS

INSTRUCTIONS TO CANDIDATES

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(c) Mathematical tables and silent electronic calculators many be used.

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FOR EXAMINER'SUSE ONLY

QUESTION	MAXIMUM SCORE	CANDIDATE'S SCORE
1	15	
2	12	
3	13	
TOTAL SCORE	**40**	

This paper consists of 8 printed pages

1. You are provided with"

- Solution C_1 which is a solution of a dibasic acid, $H_2C_2O_4.XH_2O$ containing 5.04g in $500cm^3$ of solution.
- Solution C_2 which is a 0.2M solution of sodium hydroxide.

You are required to:-

- Determine the value of X in the formula $H_2C_2O_4.XH_2O$ (H =1, C = 12, O = 16)

Procedure

Fill the burette with solution C_1. Pipette $25cm^3$ of solution C_2 into a clean dry conical flask. Add 2 drops of phenolphthalein indicator and titrate against C_1 until the indicator just turns colourless.
Repeat the procedure two more times and complete the table below.

(4 marks)

Titration	I	II	III
Final burette reading (cm^3)			
Initial burette reading (cm^3)			
Volume of solution C_1 used (cm^3)			

(a) Calculate the average volume of C_1 used. (1 mark)

(b) Calculate the moles of the acid, C_1 reacting. (3 marks)

(c) Calculate the concentration of the acid, C_1 in moles / litre. (2 marks)

(d) Calculate the relative formula mass of the acid. (3 marks)

(e) Hence determine the value of X in $H_2C_2O_4.XH_2O$. (2 marks)

2. You are provided with:
- 5g of solid K
- Distilled water

You are required to determine solubility of solid K at different temperatures.

Procedure

Transfer solid K into a boiling tube. Using a 10ml measuring cylinder, measure $10cm^3$ of water into the boiling tube. Heat the mixture while stirring with the thermometer to about 90^0C. When all the solid has dissolved, allow the solution to cool while stirring with the thermometer. (Cooling of the solution can be speeded up by dipping the boiling tube in cold water in a glass beaker for a few seconds.)
Record the temperature at which the crystals of solid K first appear. In the table below.
Retain the boiling tube and its contents for further experiments.
Measure $5cm^3$ of distilled water and add to the mixture in the boiling tube. Heat until the crystals dissolve, then cool while stirring with a thermometer.
Record the temperature at which the crystals again start to reappear.
Repeat this procedure, each time adding more $5cm^3$ of distilled water, heating, cooling and recording the crystallization temperature until the table is completely filled.

Total volume of water added to 5g of solid K (cm^3)	10	15	20	25	30	35
Temperature at which crystals appear (^0C)						
Solubility of K in g/100g of water						

(a) Complete the table and calculate the solubility of solid K in g/100g of water at different temperatures. (6 marks)

(b) On the grid provided, plot a graph of solubility of solid K against temperature. (3 marks)

(c) From the graph determine:-

(i) The solubility of K at 25^0C. (1 mark)

(ii) The temperature when the solution will contain 22g of K. (1 mark)

(d) From your results calculate the mass of K that will crystallize out when a hot solution at 52^0C is cooled to 37^0C. (1 mark)

3. You are provided with solid F and P. Carry out the tests below. Write your observations and inferences in the spaces provided.

(a) Using a clean spatula heat the solid F in a Bunsen burner flame.

Observations	Inferences
(½ mark)	(½ mark)

(b) Place the remaining portion of the solid F in a boiling tube. Add about $10cm^3$ of distilled water. Stir and filter. Keep the residue for further tests. Divide the filtrate into four portions.

(i) To the first portion, add sodium hydroxide solution till in excess.

Observations	Inferences
(1mark)	(1 mark)

(ii) To the second portion, add ammonium hydroxide solution till in excess.

Observations	Inferences
(1 mark)	(½ mark)

(iii) To the third portion, add lead (II) nitrate solution then warm.

Observations	Inferences
(1 mark)	(½ mark)

(iv) To the fourth portion, add barium chloride solution followed by hydrochloric acid.

Observations	Inferences
(½ mark)	(½ mark)

(c) Dissolve the residue into about $5cm^3$ of 2M hydrochloric acid and record your observation and make inferences.

Observations	Inferences
(½ mark)	(½ mark)

(d) Carry out the following tests on P.

(i) Using a clean metallic spatula heat solid P in a Bunsen burner flame.

Observations	Inferences
(½ mark)	(½ mark)

(ii) Put two spatulafuls of P in a boiling tube. Add $10cm^3$ of distilled water. Warm the mixture to dissolve and divide the solution into three portions.

I) To the first portion, add sodium hydrogen carbonate.

Observations	Inferences
(½ mark)	(½ mark)

II) To the second portion add 3 drops of conc. H_2SO_4. Shake well and add $1cm^3$ of ethanol and warm the mixture.

Observations	Inferences
(½ mark)	(½ mark)

III) To the third portion, add 1-2 drops of acidified potassium manganate (VII) solution.

Observations	Inferences
(1 mark)	(1 mark)