NAME: **MARKING SCHEME** .... ADM NO: ....

SCHOOL: .... STREAM: ....

INDEX NO: .... SIGNATURE: ....

233/1
CHEMISTRY
PAPER 1
JULY 2024
2 HOURS

MUSLIM SCHOOLS JOINT EXAMINATIONS TEST (MUSJET)
Kenya Certificate of Secondary Education
CHEMISTRY – FORM 4

INSTRUCTIONS TO CANDIDATES

1. Write your name, school and index number in the spaces provided.
2. Answer **ALL** questions in the spaces provided.

FOR EXAMINERS' USE ONLY

| QUESTION	MAXIMUM SCORE	CANDIDATE'S SCORE
1 - 28	80	

MARKING SCHEME

1. Describe an experimental procedure that can be used to extract oil from nut seeds. (2mks) ½
- Crush the seeds in a mortar using a pestle ½
- Add a suitable solvent (propanone/ Acetone) ½
- Decant ½
- Evaporate the filtrate to obtain the oil ½

2. A luminous flame produces more light than a non-luminous flame. Explain. (1mk)
Presence of unburnt carbon which glows ✓1

3. Ethanol and dimethyl ether have both molecular formulae C_2H_6O. Explain why ethanol boils at 78.2°C and dimethyl ethen has a boiling point of -24°C ✓2 (2mks)
Ethanol contains hydrogen bonds which are stronger bonds than Van der waals forces in dimethyl ether

4. In an experiment, ammonium chloride was heated in a boiling tube with a moist red and blue litmus paper at the mouth of tube. State and explain the observation made. (3mks)
- Moist red litmus paper changed to blue and no effect on blue. Later they both changed to red.
- Ammonium chloride decomposes into NH_3 and HCl.
- NH_3 is less dense and diffuses faster changing red litmus to blue. HCl is denser, diffuses slower changing the litmus back to red.

5. The set up below was used to investigate the products of burning biogas (methane). Study it and answer the questions that follow:
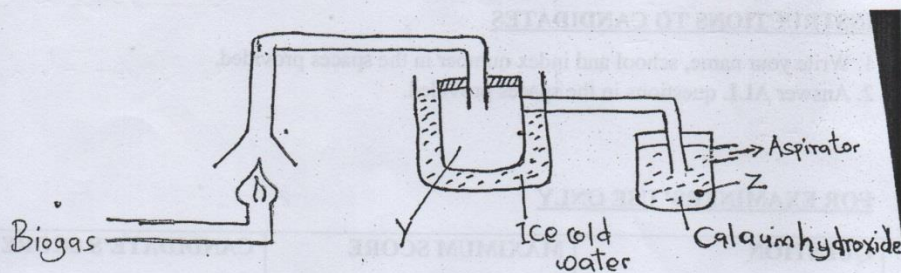
a) State one chemical test for the product formed in tube Y. (1mk)
Changes white anhydrous $CuSO_4$ to blue // any one
// Blue " $CoCl_2$ to pink

b) State and explain the observation which would be made in Z. (2mks)
White precipitate. insoluble $CaCO_3$ was formed //
white ppt. $CO_2 + Ca(OH)_2 \longrightarrow CaCO_3 + H_2O$ //
(g) (aq) (s) (l)

6. The plots below were obtained when the atomic radii of some elements in group I and II were plotted against atomic number.

Atomic radii (cm) — vertical axis

Points plotted: K, Na, Li, Ca, Mg, Be

Atomic number — horizontal axis
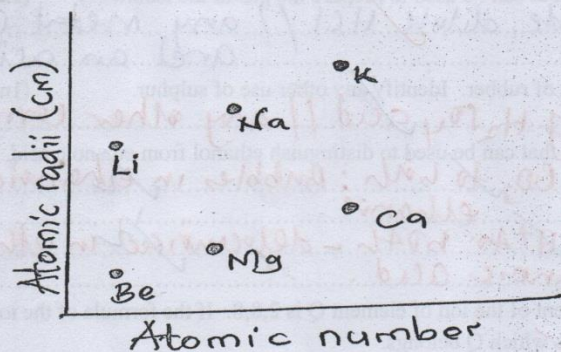
a) Explain the trends shown by Li, Na and K. (1mk)

Atomic radii increase with increase in atomic number due to increase in energy levels.

b) Explain why the atomic radius of elements Be, Mg and Ca are lower than those of Li, Na and K.(2mks)

Group (II) elements have more protons than group I elements hence this increases the nuclear attraction for the outer electrons

7. (a) Ammonium ion has the following structure

$$\left[\begin{array}{c} H \\ | \\ H - N - H \\ | \\ H \end{array}\right]^{+}$$

Dative bond
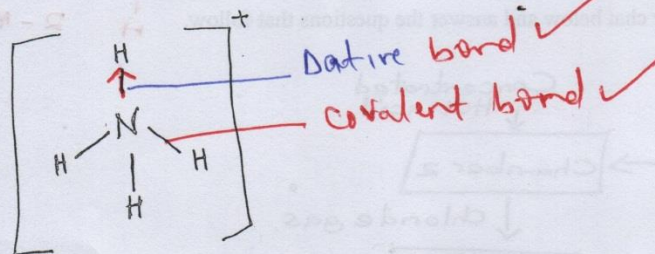
Covalent bond

Label on the structure:
(i) Covalent bond (1mk)
....

(ii) Dative bond (1mk)
....

(b) Why does an ammonia molecule form an ammonium ion with a proton? (1mk)

Ammonia molecule has lone pair of electrons

8. Hydrogen sulphide is highly toxic and flammable gas and is usually prepared in the flame chamber.

(a) Name any two reagents that can be used to prepare the gas in the laboratory. (1mk)

Iron(II) sulphide, dilute HCl // any metal sulphide and an acid

(b) Other than vulcanization of rubber. Identify any other use of sulphur. (1mk)

manufacture of H_2SO_4 acid // any other correct use

9. Describe two chemical tests that can be used to distinguish ethanol from ethanoic acid. (3mks)

Add $Mg/MgCO_3$ to both: Bubbles in ethanoic acid but not in ethanol.

Add $KMnO_4$(H+) to both – decolourised in ethanol but not in ethanoic acid.

o Add $K_2Cr_2O_7$ and warm!
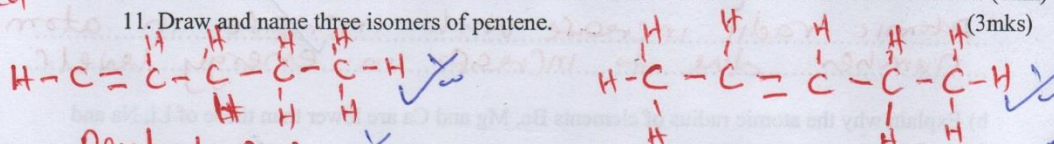*• turns from orange to green in ethanol but not in ethanoic acid*

10. (a) The electronic arrangement of the ion of element Q is 2,8,8. If the formula of the ion is Q^{3-}. State the group and period to which Q belongs.

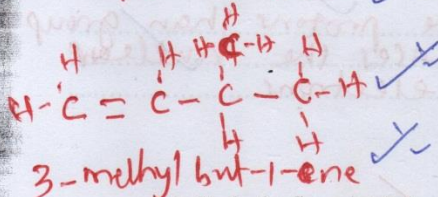Group .... V .... (1mk)

Period .... 3 .... (1mk)

11. Draw and name three isomers of pentene. (3mks)

H–C≡C–C–C–C–H ✓
Pent-1-ene ½

H–C=C–C–C–H
3-methyl but-1-ene ½

H–C–C=C–C–C–H ½
Pent-2-ene ½

H–C–C=C–C–H
H–C–H
2-methyl but-2-ene ½

Any 3
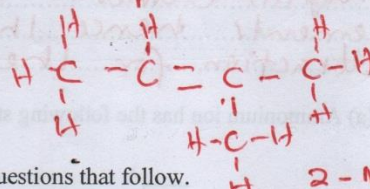
12. Study the flow chat below and answer the questions that follow.

Concentrated HCl acid
↓

Solid B ⟶ Chamber 2

↓ chloride gas

Chamber 1 ⟵ Aqueous Sodium hydroxide
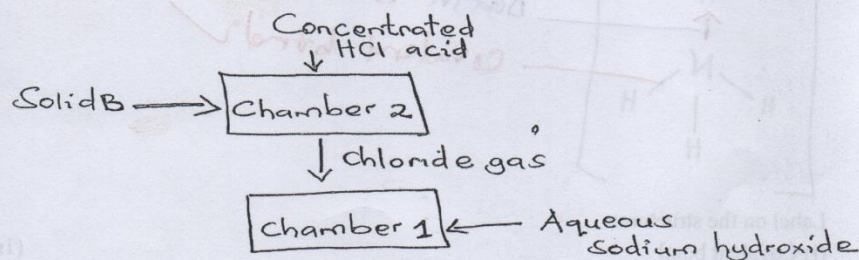
(a) Identify solid B. (1mk)

Potassium manganate (VII) // manganese (IV) oxide // lead (IV) oxide
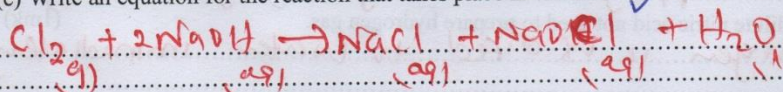
(b) Name the type of reaction that takes place in chamber 2.   (1mk)

Oxidation // Redox ✓

(c) Write an equation for the reaction that takes place in chamber 1.   (1mk)

$Cl_{2(g)} + 2NaOH_{(aq)} \rightarrow NaCl_{(aq)} + NaOCl_{(aq)} + H_2O_{(l)}$ ✓
- Correct chemical formula
- Balanced
- Correct physical states

13. The molar enthalpy of solution for potassium hydroxide is – 42kJ/mole.
    a) On the axes provided, draw a labelled energy level diagram for the dissolution process of potassium hydroxide.   (2mks)

$KOH_{(s)} + H_2O_{(l)}$
$KOH_{(s)} + H_2O$
$\Delta H = -42kJ/mol$
$K^+_{(aq)} + OH^-_{(aq)}$
Energy KJ
Reaction progress
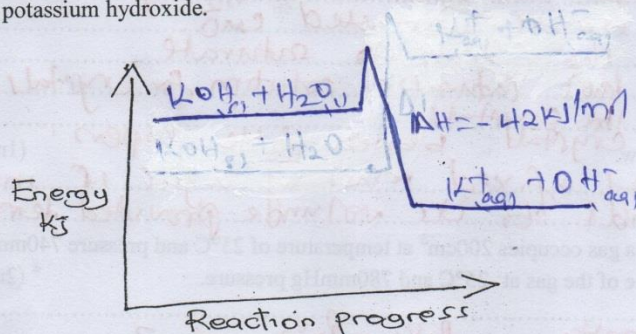
    b) Calculate the enthalpy change when 5.6g of potassium hydroxide is completely dissolved in water (K=39, O=16, H=1)   (2mks)
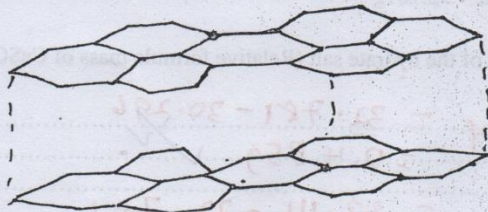
No of moles = $\frac{5.6}{56}$ ✓
= 0.1 moles
$\Delta H = 0.1 \times 42$ ✓
= – 4.2 KJ ✓

14. a) What is meant by allotropy.   (1mk)

Existence of an element in more than one form in the same physical state

    b) The diagram below shows the structure of one of the allotropes of carbon.

    (i) Identify the allotrope.   (1mk)

Graphite ✓

(ii) State two properties of the above allotrope and explain how it is related to its structure.(2mks)

- Conduct electricity due to delocalised electrons
- Soft and slippery – has hexagonal layers held by weak van der waals forces.

15. Why is dilute nitric acid not used to prepare hydrogen gas. (1mk)

Hydrogen is oxidised to water immediately

16. Starting with copper (II) oxide, describe how you can prepare copper (II) sulphate crystals.(3mks)

- React excess CuO with dilute H_2SO_4 ½ each procedure
- Filter to remove unreacted CuO
- Evaporate the filtrate to saturate
- cool the hot saturated solution for crystals to form
- Filter out the crystals
- Dry the crystals between filter papers

17. (a) State Boyles' Law. (1mk)

Pressure of a fixed mass of a gas is inversely proportional to its volume provided temperature is kept constant

(b) A fixed mass of a gas occupies 200cm³ at temperature of 23°C and pressure 740mmHg. Calculate the volume of the gas at -25°C and 780mmHg pressure. (2mks)

$$P_1 = 740mmHg \qquad \frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2} \qquad V_2 = ?$$

$$V_1 = 200cm^3$$

$$T_1 = 273 + 23K \qquad \frac{740 \times 200 \times 248}{296 \times 780}$$

$$P_2 = 780mmHg$$

$$T_2 = -25 + 273 \qquad = 158.78 cm^3$$

18. When a hydrated sample of calcium sulphate $CaSO_4 . nH_2O$ was heated until all the water was lost, the following data was recorded.

Mass of crucible = 30.296g
Mass of crucible + hydrated salt = 33.111g
Mass of crucible + unhydrous salt = 32.781g

Determine the empirical formula of the hydrate salt (Relative formula mass of $CaSO_4$ =136, H_2O=18) (3mks)

mass of $CaSO_4$ = 32.781 - 30.296
= 2.485g

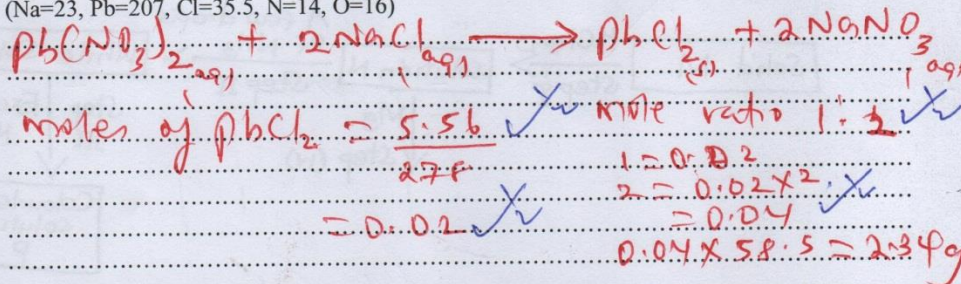mass of H_2O = 33.111 - 32.781
= 0.33g

| Compound	$CaSO_4$	H_2O		
mass	2.485	0.33	$\frac{0.0183}{0.0183}$	$\frac{0.0183}{0.0183}$
RFM	136	18		
moles	$\frac{2.485}{136}$	$\frac{0.33}{18}$	1	1
	0.0183	0.0183		$CuSO_4 . H_2O$

19. When excess lead (II) nitrate solution was added to a solution of sodium chloride, the precipitate was found to weigh 5.56g, determine the amount of sodium chloride in the solution. (3mks)
(Na=23, Pb=207, Cl=35.5, N=14, O=16)

$$Pb(NO_3)_{2(aq)} + 2NaCl_{(aq)} \longrightarrow PbCl_{2(s)} + 2NaNO_{3(aq)}$$

$$\text{moles of } PbCl_2 = \frac{5.56}{278} \quad \text{mole ratio } 1:2$$

$$= 0.02 \qquad 1 = 0.02$$
$$2 = 0.02 \times 2$$
$$= 0.04$$
$$0.04 \times 58.5 = 2.34g$$

20. The diagram below shows how sulphur is extracted from sulphur deposits.
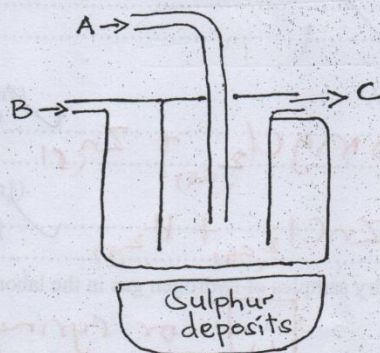
(a) Name the process represented above. (1mk)

Frasch process

(b) Identify A. (1mk)

Hot compressed air

(c) State one physical property of sulphur that makes it possible to be extracted by this method. (1mk)
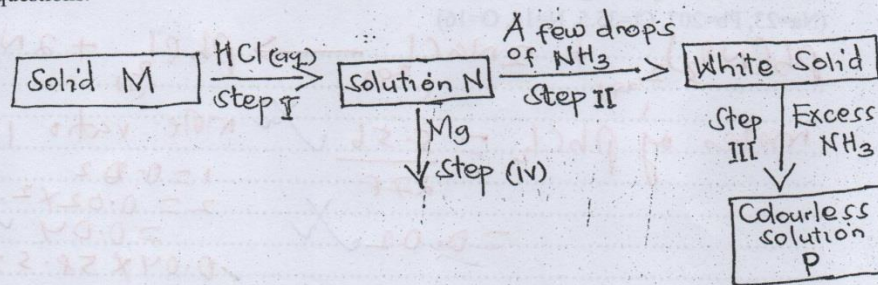
To melt sulphur// maintain sulphur in molten form

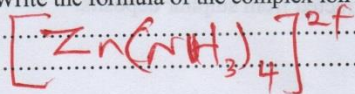d). State one physical property of sulphur that makes it possible to be extracted by this method (1mk)

• Melting point of sulphur is lower than 170°c//
sulphur is insoluble in water

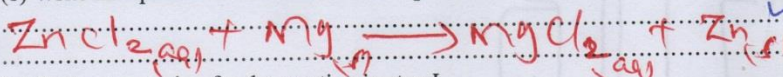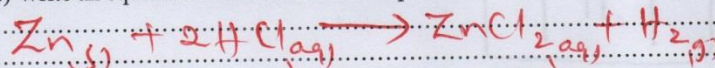21. The scheme below shows some reaction sequence starting with solid M. Study it and answer the
questions.

Solid M $\xrightarrow[\text{step I}]{\text{HCl}(aq)}$ Solution N $\xrightarrow[\text{Step II}]{\text{A few drops of } NH_3}$ White Solid $\xrightarrow[\text{III}]{\text{Step}}$ Excess NH_3 → Colourless solution P

Mg ↓ Step (IV)

(a) Write the formula of the complex ion in solution P. (1mk)

$[Zn(NH_3)_4]^{2+}$ ✓

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

$ZnCl_{2(aq)} + Mg \longrightarrow MgCl_{2(aq)} + Zn_{(s)}$ ✓

(c) Write an equation for the reaction in step I. (1mk)

$Zn_{(s)} + 2HCl_{(aq)} \longrightarrow ZnCl_{2(aq)} + H_{2(g)}$ ✓

22. Draw a well labelled diagram used to prepare dry samples of hydrogen gas in the laboratory.
(3mks)

Dilute HCl   or syringe

✓ Drying agent
✓ method of gas collection
✓ Workability

Zn granules   conc H_2SO_4
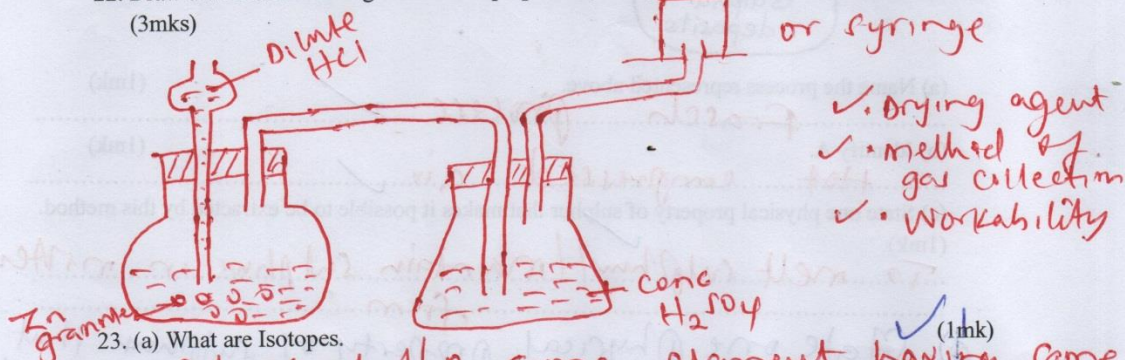
23. (a) What are Isotopes. (1mk)

Atoms of the same element having same atomic number but different mass number.

(b) Element Q (not the actual symbol of the element) has two isotopes with mass numbers
8 and 9. If the relative atomic mass of Q is 8.94, determine the percentage abundance of each
isotopes. (3mks)

$$8.94 = \frac{8x + 9(100 - x)}{100}$$ ✓

$x = 6\%$
$100 - 6 = 94\%$ ✓

$8.94 = 8x + 900 - 9x$

$-6 = -x$ ✓
$x = x$

24. Aluminium is extracted from aluminium oxide by electrolysis.

(a) Other than the cost of electricity, give another reason why this method is expensive. (1mk)

Graphite anode has to be replaced periodically since it is oxidised by air to carbon(IV) oxide

(b) Calculate the mass of aluminium obtained when a current of 20A is used for 5 hours (1 farudary=96500C, Al=27) (3mks)

$Al^{3+} + 3e^- \rightarrow Al$

$Q = It$

$= 20 \times 5 \times 60 \times 60$

$= 360,000 C$

$\dfrac{360,000}{3 \times 96500} = 1.244$

$1.244 \times 27 = 33.588 g$

25. (a) Name two ores of iron. (2mk)

Haematite, Siderite } any 2.
Magnetite

(b) Give the name of the suitable method used in extracting iron from the ore. (1mk)

Reduction

(c) Name one impurity present in pig iron and state one effect of the impurity in the physical property of iron. (2mks)

Carbon // Silicon   Makes iron brittle

26. The consentration of a solution of aluminium sulphate is 0.02M. How many sulphate ions are contained in 150cm^3 of the solution. (3mks)
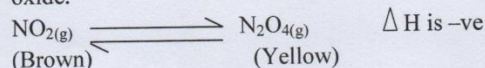
(Avogadros constant 6.0 x 10^{23})

Moles of $Al_2(SO_4)_3 = \dfrac{150 \times 0.02}{1000}$

$= 0.003$ moles

moles of $SO_4^{2-} = 0.003 \times 2$

$= 0.006$ moles

No of SO_4^{2-} ions $= 0.006 \times 6.0 \times 10^{23} = 5.4 \times 10^{21}$ ions

27. At room temperature, nitrogen (iv) oxide exists as an equilibrium mixture with dinitrogen tetra oxide.

$NO_{2(g)} \rightleftharpoons N_2O_{4(g)}$ ΔH is –ve

(Brown)   (Yellow)

State the observation made when the mixture is heated. Give a reason. (2mks)

Brown colour intensifies // Yellow colour fades Equilibrium shifts to the left, more NO$_2$ is formed

28. Define solubility. (1mk)

....

....

THE END