



NAME.....INDEX NO:....ADM NO.....

SCHOOL..... DATE.....

233/1

CHEMISTRY

TERM 1

MARCH 2024

2 HOURS

FORM 4

Kenya Certificate of Secondary Education (K.C.S.E)

MARKING SCHEME

For Examiner's Use Only

Question	Maximum score	Candidates score
1-27	80	

1. The electronic configurations for elements represented by letters **A**, **B**, **C** and **D** are

A 2.8.6 **B**. 2.8.2. **C**.2.8.1. **D**.2.8.8

(a) Select the element which forms:

i) A double charged cation (1 mark)

B

ii) A soluble carbonate (1 mark)

C

(b) Which elements has the largest atomic radius (1 mark)

C

2. An element **R** has atomic number 3, relative atomic mass 6.94 and consist of two isotopes of mass numbers 6 and 7.

(i) What is the mass number of the more abundant isotope of **R**? Give a reason for your answer. (2 marks)

7- the relative atomic mass is closer to 7

(ii) Complete the following table. (1 mark)

Element	Number of neutrons	Number of electrons
R	4	3

3. $\text{R COO}^- \text{Na}^+$ and $\text{RC}_6\text{H}_5 \text{OSO}_3^- \text{Na}^+$ represent two cleaning agents where **R** is a long hydrocarbon chain.

(a) Which of the cleansing agents is suitable for use with hard water? (1 mark)

$\text{RC}_6\text{H}_5 \text{OSO}_3^- \text{Na}^+$

(b) Write the formula of an ion than causes:

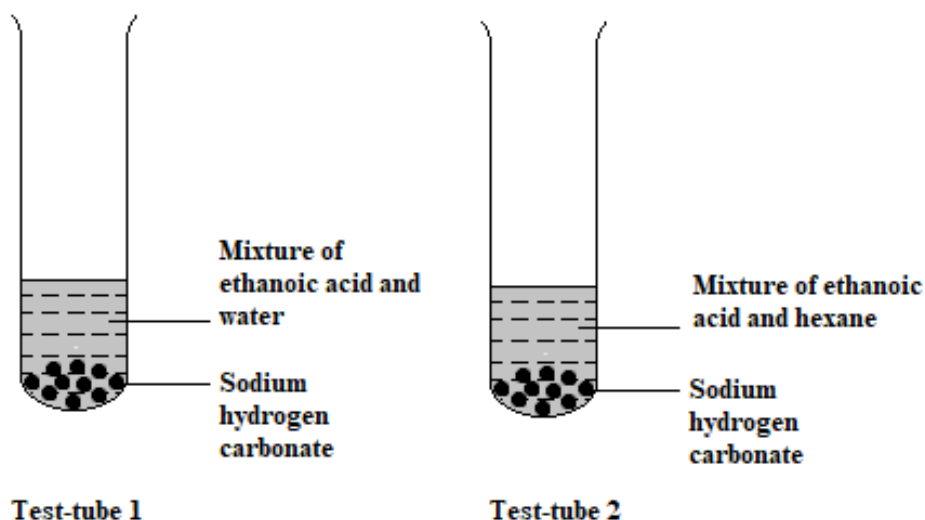
(i) Water hardness (1 mark)

Mg^{2+} or Ca^{2+}

(ii) Permanent water hardness (1 mark)

SO_4^{2-}

4. In an experiment, a student put equal volumes of mixtures of ethanoic acid in water and ethanoic acid in hexane in two test-tubes as shown below. In each test tube, equal amounts of solid sodium hydrogen carbonate were added.



- a) State the observation which was made in each test-tube (1 mark)

Test tube 1

Effervescence ($\frac{1}{2}$) / bubbles

Test tube 2

No effervescence ($\frac{1}{2}$)

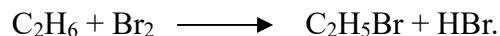
- b) Explain the observations in (a) above (2 marks)

Ethanoic acid ionizes in water (1)

H^+ reacts with CO_3^{2-} to form CO_2

In hexane ethanoic acid exists in form of molecules. No reaction with carbonate or acid does not ionize. (1)

5. Bromine reacts with ethane as shown below



- (a) What condition is necessary for this reaction to occur? (1 mark)

Presence of U.V light

- (b) Identify the bonds which are broken and those that are formed. (2 marks)

Bonds broken are Br – Br ($\frac{1}{2}$) and C – H ($\frac{1}{2}$)

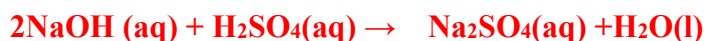
Bonds formed are C – Br ($\frac{1}{2}$) and H – Br ($\frac{1}{2}$)

6. Draw a well labelled diagram of the non-luminous flame (3 marks)



7. In an experiment 20cm³ of 0.1 M sulphuric (VI) acid were reacted with 20cm³ of 0.1 M sodium hydroxide.

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



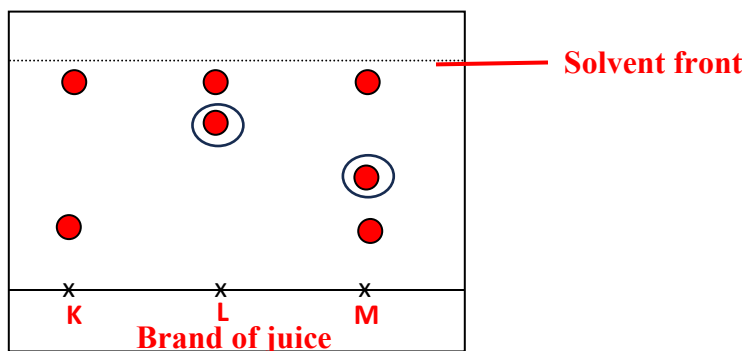
(b) State the observations that were made when both red and blue litmus papers were dropped into the mixture. (1 mark)

Blue litmus paper turns red while the red litmus paper remains red.

(c) Give a reason for your answer in (a) above (1 mark)

The acid was in excess

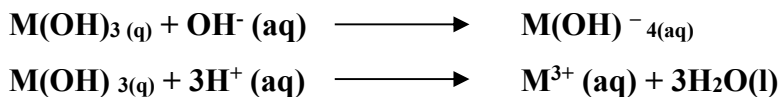
8. The diagram below represents a paper chromatogram for three brands of juices suspected to contain banned food colourings.



The results showed the presence of banned food colourings in **L** and **M** only. On the same diagram:

- Circle the spots which show the banned food colourings (2 marks)
- Show solvent front. (1 mark)

9. A Compound whose general formula is $M(OH)_3$ reacts as shown by the equation.



(a) What name is given to compounds which behave like $M(OH)_3$ in the two reactions.

Amphoteric (1 mark)

(b) Name **two** elements whose hydroxides behave like that of M. (2 marks)

Zinc
Aluminium
Lead

10. A compound contains 82.75% carbon and the rest is Hydrogen.

(a) **Determine** its empirical formula. (2 marks)

Element	Carbon	Hydrogen
Percentage	82.75%	17.25%
Atomic masses	82.75/12	17.25/1
mole	6.89	17.25
Mole ratio	6.895/6.895	17.25/6.895
	1 1x2	2.5 2.5x2

= C₂H₅

(b) **Determine** the molecular formula if its molecular mass is 58. (1 mark)

Efm = 29
Mfm = 58
58/29 = 2
C₄H₁₀

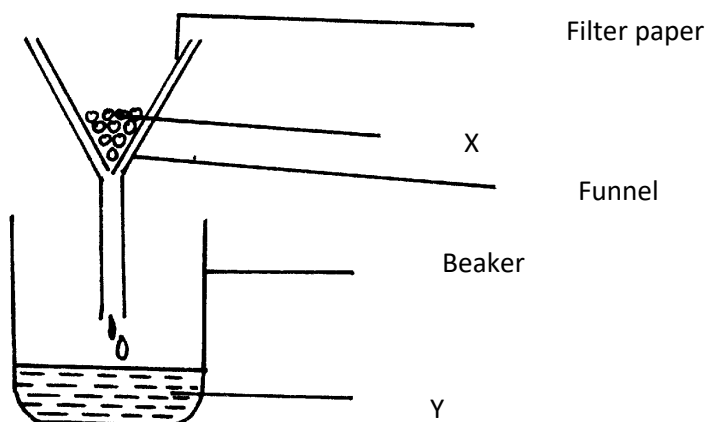
11. A form four student wanted to determine the solubility of potassium nitrate. He obtained the following results.

Mass of evaporating dish = 15.13g
Mass of evaporating dish and solution = 36.51g
Mass of evaporating dish and salt = 19.41g

Use the information above to calculate the solubility of potassium nitrate. (3 marks)

Mass of solution 36.51 - 15.13 = 21.38
Mass of salt 19.4 - 15.13 = 4.28g
Mass of water 21.38 - 4.28 = 17.1g
17.1g of water dissolved 4.28g of salt
100g of water will dissolve = $\frac{100 \times 4.28}{17.1}$
= 25.0292g/100g H₂O

12. Filtration is carried out in the apparatus shown below.



a) Name X and Y (2 marks)

X – residue✓1

Y – filtrate✓1

b) State one application of filtration. (1 mark)

- **Purification of domestic water**

- **Large scale purification of water**

13. a) State Boyle's law (1 mark)

The volume of a fixed mass of gas is inversely proportional to its pressure at constant temperature.✓1

b) A gas occupies a volume of 80dm³ at s.t.p. At what pressure will its volume be doubled if the temperature rises by 105°C? (At s.t.p temperature = 0°C, pressure = 760mmHg) (2 marks)

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

$$P_1 = 760 \quad V_1 = 80$$

$$T_1 = 273$$

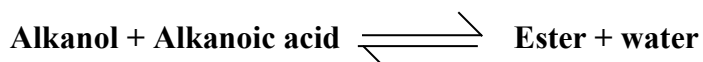
$$P_2 = ? \quad V_2 = 160$$

$$T_2 = 273 + 105 = 378$$

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

$$= \frac{760 \times 80 \times 378}{273 \times 160} = 526.15$$

14. Consider the reaction below.



- a) Give the name of the process represented by the above reaction. (1 mark)

Esterification ✓1

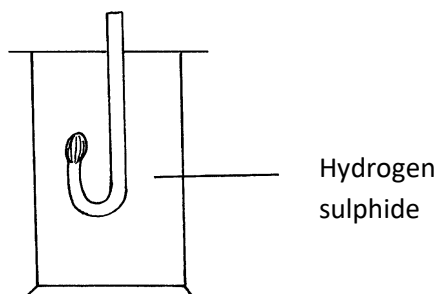
- b) Name the catalyst which is usually used in the above reaction. (1 mark)

Concentrated sulphuric acid ✓1 Reject formula

- c) State the observation made during the reaction of alkanols and alkanoic acids.

Pleasant smell/ fruity smell/ good smell / reject sweet smell

15. Hydrogen sulphide gas was lighted in a gas jar of air using the arrangement below.



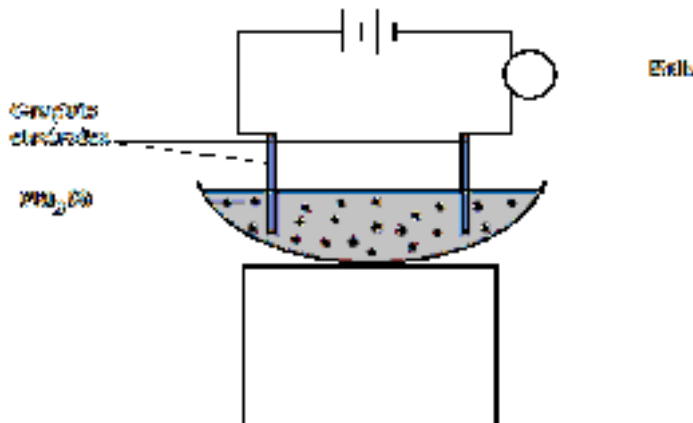
- a) Write an equation for combustion of hydrogen sulphide gas. (1 mark)



- b) State what is observed if the product is passed through acidified potassium dichromate (VI) solution. (1 mark)

Potassium dichromate (VI) changes from orange to green ✓1

16. A set-up to investigate electrical conductivity of substances was assembled as shown below.



The bulb did not light.

- (a) What was missing in the set-up? (1 mark)

Heat ✓1

- (b) The bulb lit when the omission was corrected. Explain. (1 mark)

PbI_{2(s)} melted ✓ ½ when heated. Ions became free and mobile ✓ ½ thus conducting electricity

- (c) State one application of electrolysis. (1 mark)

Extraction of some metals

Purification of metals

Manufacture of chlorine/hydrogen/sodium hydroxide

Electroplating of metals such as iron to improve their appearance and prevent corrosion.

17. Steam is passed over heated iron filings in a combustion tube.

- (a) Name the two products of this reaction. (2 mark)

Tri-iron tetra oxide ✓1

Hydrogen

- (b) Why is it not advisable to react sodium metal with steam? (1 mark)

Sodium reacts with steam explosively

18. Diamond and graphite are allotropes of carbon.

- (a) What are allotropes? (1 mark)

Different forms of the same element existing in the same physical state.

- (b) In terms of structure and bonding explain why diamond is used in drilling through hard rocks while graphite is a lubricant. (2 marks)

In diamond each C-atom is bonded to 4 others through strong covalent bonds $\sqrt{\frac{1}{2}}$ leading to a giant atomic structure $\sqrt{\frac{1}{2}}$ in which covalent bonds permeate the whole lattice, hence very hard.

In graphite each C-atom is bonded to 3 other C-atom through covalent bonds $\sqrt{\frac{1}{2}}$ forming hexagonal layers $\sqrt{\frac{1}{2}}$. The layers are joined by weak Van der Waals forces hence they slide over each other graphite is soft and slippery

19. Give the systematic name of each of the compounds represented by the formulae below.

(3 marks)

- (a) $\text{CH}_3\text{C}\equiv\text{CCH}_3$

But-2-yne

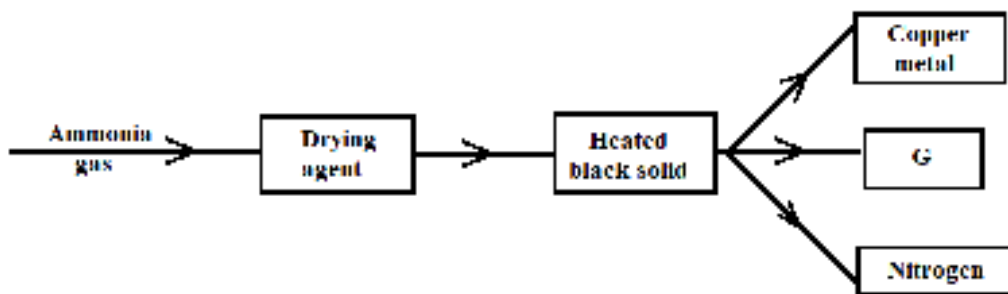
- (b) $\text{CH}_3\text{CH}=\text{CHCH}_2\text{CH}_3$

Pent-2-ene

- (c) $\text{CH}_3\text{CH}_2\text{COONa}$

Sodium propanoate

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



(a) Name a suitable drying agent for ammonia. (1 mark)

Calcium oxide / quicklime

(b) Describe one chemical test for ammonia. (1 mark)

**Expose NH_3 to HCl(g) , dense white fumes form (or use equation)
 Or dump red litmus paper turn blue when exposed to ammonia
 Or use of indicators
 Or pass the gas in Ca^{2+} ions a pale blue ppt which dissolves to give a deep blue solution is seen.
 NB; Don't split the (1 mark) one must be complete**

(c) Name G. (1 mark)

Steam//water vapour //water

21. Describe how dry chlorine and hydrogen chloride gases in gas jars can be distinguished using dry blue litmus papers, distilled water and a fume chamber. (3 marks)

**MOISTEN the blue litmus papers with distilled water ✓1 and place them in the gas jars containing the gases inside a FUME CHAMBER. ✓½
 The blue litmus paper in chlorine turns RED AND THEN WHITE in the gas jar containing chlorine gas ✓1
 In hydrogen chloride the blue litmus paper RED only. ✓½**

22. (a) State two factors that accelerate rusting. (2 marks)

Acids

Salts

(b) Iron sheets are dipped in molten zinc to prevent rusting. Name this process. (1 mark)

Galvanization

23. Given the following substances: wood ash, lemon juice and sodium chloride.

(a) Name one commercial indicator that can be used to show whether rain water wood ash, lemon juice and sodium chloride are acidic, basic or neutral. (1 mark)

Universal indicator

- (b) Classify the substances in 15(a) above as acids, bases or neutral. (2 marks)

Acidic	Basic	Neutral
Rain water Lemon juice	Wood ash	Sodium chloride

24. Emission of carbon (IV) oxide into the atmosphere has become one of the world's major concerns.

- (a) State one disadvantage of releasing carbon (IV) oxide into the atmosphere. (1 mark)

Global warming

- (b) What causes the level of carbon (IV) oxide in the atmosphere to increase? (1 mark)

Burning of fossil fuels/natural gas/wood/charcoal

- (c) How can the amount of carbon (IV) oxide in the atmosphere be reduced other than avoiding the causes in (b) above? (1 mark)

Planting of more trees

25. When Xcm³ of 0.5M zinc nitrate solution were reacted with excess ammonium carbonate solution, the mass of zinc carbonate formed was 12.5g.

- (a) Write the ionic equation for the reaction that took place. (1 mark)



- (b) Calculate the value of X. (C = 12.0, Zn = 65.0, O = 16.0) (2 marks)

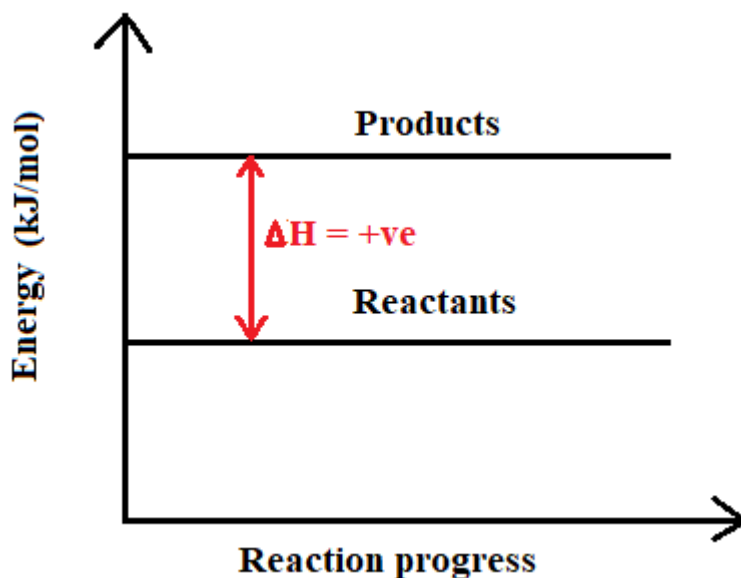
$$\begin{aligned} \text{Moles of ZnCO}_3 &= \frac{12.5}{125} \\ &= 0.1 \text{ moles} \quad \checkmark^{1/2} \end{aligned}$$

$$\begin{aligned} \text{Mole ratio Zn}^{2+} : \text{ZnCO}_3 &= 1 : 1 \\ \therefore \text{Moles of Zn}^{2+} &= 0.1 \quad \checkmark^{1/2} \\ 0.5\text{M Zn}^{2+} &\longrightarrow 1000\text{cm}^3 \\ 0.1\text{M} &\longrightarrow ? \end{aligned}$$

$$= \frac{0.1 \times 1000}{0.5} \quad \checkmark^{1/2}$$

$$= 200\text{cm}^3 \quad \checkmark^{1/2}$$

26. Below is a sketch of an energy level diagram.



a) On the diagram show the heat of reaction ΔH . (1 mark)

b) State and explain the type of reaction represented by the above energy level diagram. (2marks)

**Endothermic reaction. The products have higher energy than the reactants//
 $\Delta H = +ve$.**

27. Starting with copper metal describe how a sample of crystals of copper (II) chloride may be prepared in the laboratory (3 marks)

Heat copper metal to obtain copper (II) oxide. ✓½

React excess copper (II) oxide with hydrochloric acid. ✓½

Filter. ✓½

Heat ✓½ to saturate ✓½ the filtrate and cool ✓½ to obtain copper (II) chloride crystals.