

Name: **MARKING SCHEME.** Class: Adm.No.

CHEMISTRY

THEORY

Paper 1

March - April 2018

Time: 2 hours

POST EVALUATION EXAMINATION

MARCH - APRIL 2018

Kenya Certificate of Secondary Education

CHEMISTRY

PAPER 1

INSTRUCTIONS TO CANDIDATES

- Answer **ALL** the questions in the spaces provided.
- Electric calculators fx - 82 ms is allowed.
- All working must be clearly shown.

FOR EXAMINER USE ONLY

Question	Maximum score	Candidate's score
1 - 30	80	

1. A mixture contains zinc oxide, iron (III) chloride and potassium chloride. Describe how each of the substances can be obtained from the mixture. (3 marks)

- heat the mixture in a beaker covered with watch glass containing cold water. FeCl_3 will sublime & deposit below the surface.

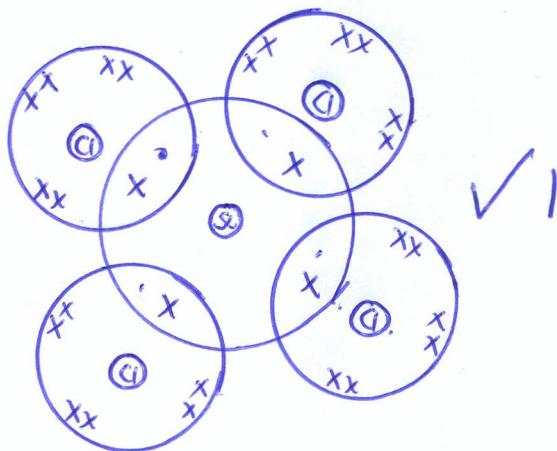
- add water to the remaining mixture for KCl to dissolve.

- filter the mixture to obtain Zinc Oxide as a residue.

- heat the filtrate to saturation for water to evaporate.

- allow it to cool to form potassium chloride crystals.

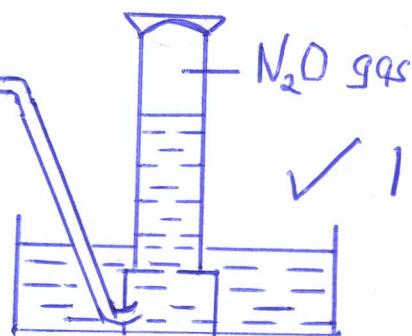
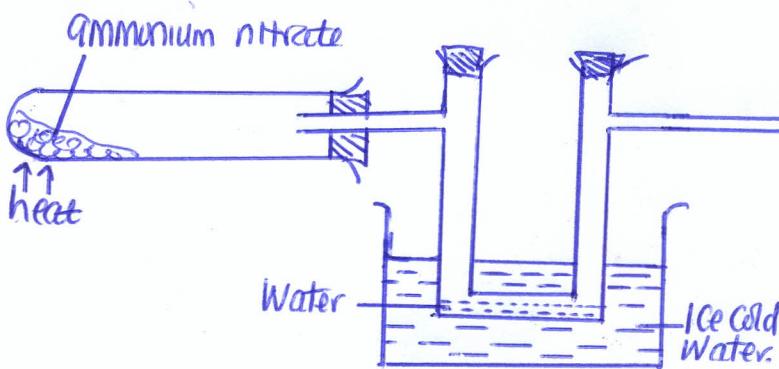
2. Using a dot (•) and cross (x) diagram, draw the structure for silicon (IV) chloride. (1 mark) (Atomic numbers Si = 14, Cl = 17)



C.A.O

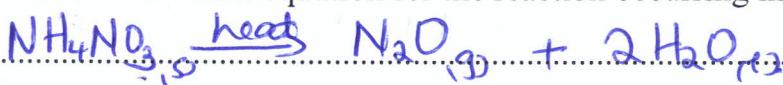
- Must show the nucleus
- must show electron distribution in the outermost energy level.

3. Ammonium nitrate was gently heated as shown below.



- Must label the gas
- Correct method of collection

- a) Complete the diagram to show how the gas is collected. (1 mark)
- b) Write the chemical equation for the reaction occurring in the boiling tube. (1 mark)



- c) State one chemical test that can be used to identify the gas collected in the above set up.
(1 mark)

It relights a glowing splint with a pleasant smell.

4. a) What is a saturated solution? (1 mark)

It is a solution that cannot dissolve any more solute at a particular temperature.

- b) 115g of a saturated solution at 65°C is found to contain 65g of potassium nitrate. Calculate the solubility of potassium nitrate at 65°C. (2 marks)

$$\text{Mass of solvent} = 115 - 65 = 50\text{g}$$

$$\therefore 65\text{g } \text{KNO}_3 \rightarrow 50\text{g water}$$

$$\therefore ? \leftarrow 100\text{g water}$$

$$\frac{65 \times 100}{50} \checkmark$$

$$= 130\text{g KNO}_3 \checkmark \text{ in 100g water}$$

5. What do you understand by the term prescription in relation to drugs? (1 mark)

It's a written instruction by a qualified physician/doctor on how a given dose of drug is to be administered.

Accept words to that effect.

6. Starting with sodium solid, describe how a sample of sodium hydrogen carbonate crystals may be prepared. (3 marks)

- drop ^{or add} a small sodium solid in a beaker containing water to form sodium hydroxide solution.
- bubble excess $\text{CO}_2(\text{g})$ through the solution to form sodium hydrogen carbonate.
- heat the solution to saturation || or leave in the open to crystallise slowly.
- allow it to cool to form crystals.

7. In the extraction of sulphur by the Frasch process, hot compressed air at 15 atmospheres is forced down the innermost pipe.

- a) What is the role of the hot compressed air? (1 mark)

- to produce a light froth consisting of molten Sulphur and Water.
- high pressure forces the mixture up the middle pipe.

- b) Which allotrope of sulphur;

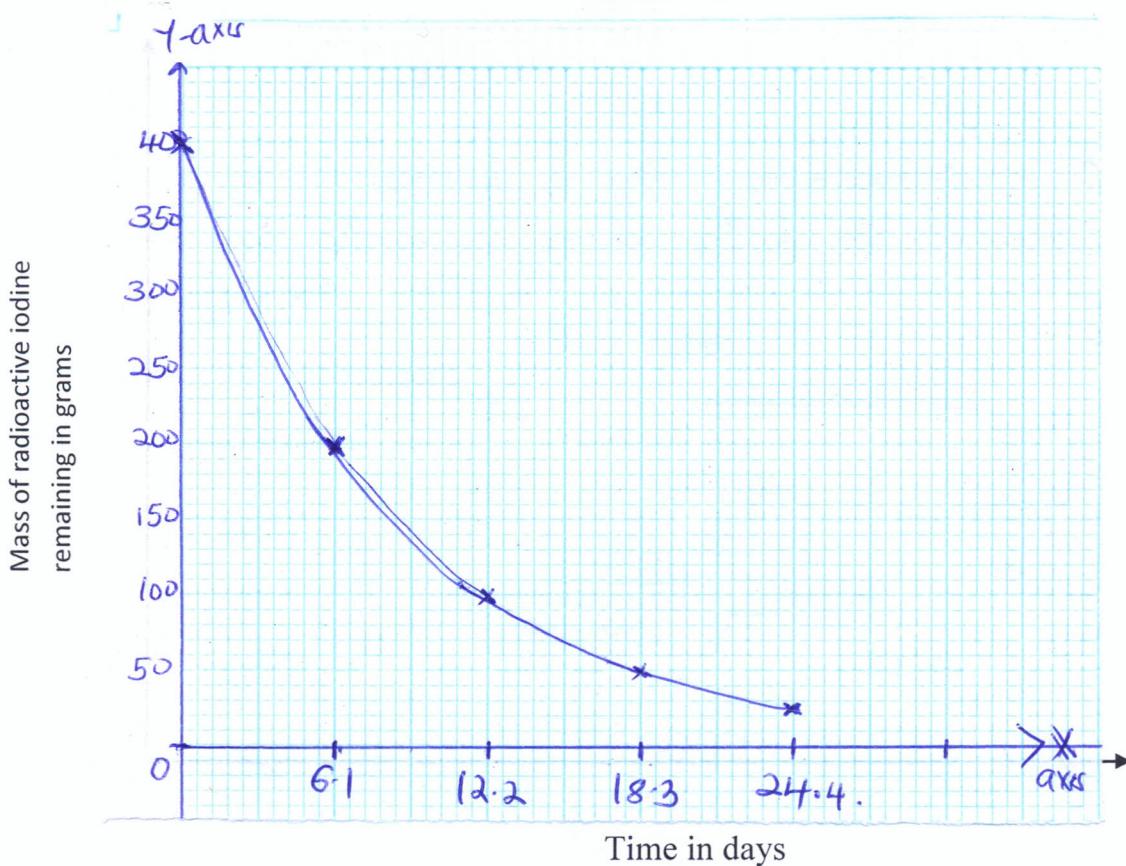
- (i) is stable below the transition temperature of 96°C ? (1 mark)

Rhombic. ✓

- (ii) has prismatic crystals? (1 mark)

Monoclinic. ✓

8. The graph below shows the radioactive decay for a sample 400g of iodine -131.



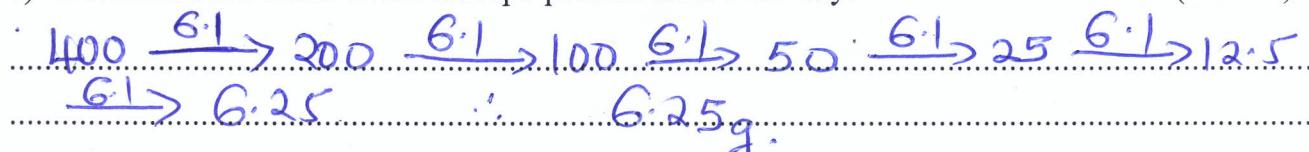
- a) Define half life. (1 mark)

Time taken for a given mass to decay to half its original mass. or W.b.t.e¹

- b) From the graph determine the half life of iodine-131 (1 mark)

6.1 days

- c) Determine the mass of the isotope present after 36.6 days (1 mark)



9. A certain salt was found to form a solution when exposed to air. Name the process undergone by the salt. (1 mark)

Deliquescence

Refract deliquescent

- Give one example of such a salt (1 mark)

NaOH, CaCl₂, FeCl₂, KOH, ZnCl₂, FeCl₃

10. State and explain two observations made when a spatulaful of sodium carbonate solid is added to aluminium chloride solution in a boiling tube. (3 marks)

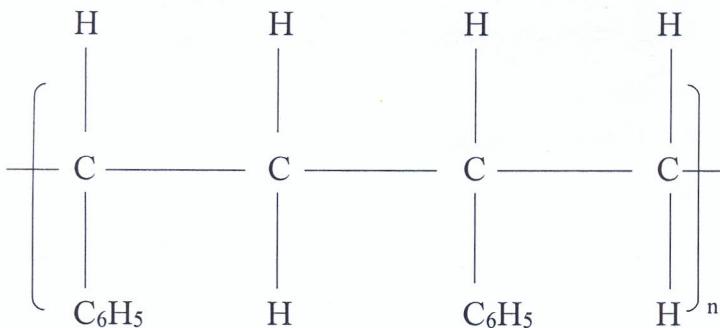
Observations

- Bubble effervescence & a colourless gas.
- The boiling tube becomes warm

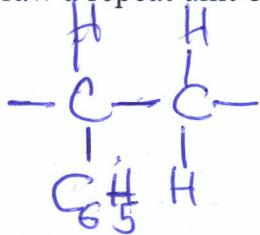
Explanations

- CO₂(g) is produced
- AlCl₃ hydrolyses in water forming acidic solution which reacts with sodium carbonate evolving carbon (IV) oxide gas.
- The reaction is exothermic

11. The structure below shows a portion of a polymer



- (i) Draw a repeat unit of the polymer (1 mark)



- (ii) Name the polymer (1 mark)

Polystyrene.

12. Give one use and difference between the apparatus below (2 marks)

	Use	Difference
	use for delivering liquid substances.	has no tap.
	Used to add Controlled amounts of liquids	has a tap.

13. Element R has two isotopes with mass numbers 29.46 and 31. If the relative atomic mass of element R is 30. Determine the percentage abundances of each isotope. (3 marks)

$$\left(\frac{x}{100} \times 29.46\right) + \left(\frac{100-x}{100} \times 31\right) = 30. \quad \checkmark 1$$

$$29.46x + 3100 - 31x = 3000 \quad \checkmark 1$$

$$-1.54x = -3000 - 3100$$

$$x = 64.9351\% \quad \text{and}$$

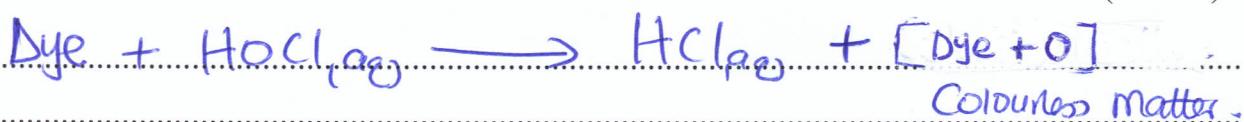
$$35.0649\%. \quad \checkmark 2$$

14. When chlorine is bubbled through water, the resulting solution acts as a bleaching agent.

- a) Write an equation for the reaction between chlorine gas and water. (1 mark)



- b) Using an equation, explain how the resulting solution acts as a bleaching agent. (1 mark)



- c) State and explain the observation made when chlorine gas is pumped into a gas jar containing moist hydrogen sulphide gas. (1 mark)

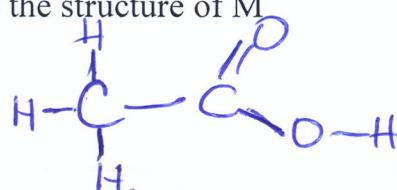
Yellow deposits of Sulphur. Chlorine oxidises Sulphide ions to yellow solid which is Sulphur

15. A compound M reacts with propanol to give another compound $\text{CH}_3\text{COOCH}_2\text{CH}_2\text{CH}_3$.

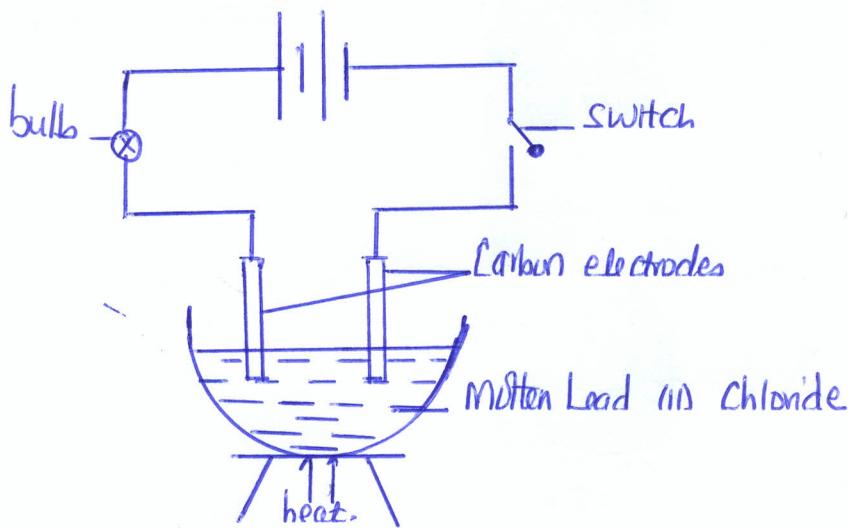
- a) Name compound M. (1 mark)

Ethanoic acid

- b) Draw the structure of M (1 mark)



16. Study the set up below and use it to answer the questions that follow.

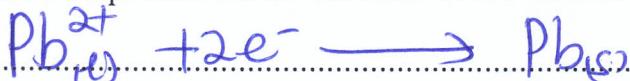


- a) State and explain an observation that would be made at the anode when the circuit is completed. (2 marks)

greenish yellow fumes/bubbles of chlorine gas.

Cl^- ions loses electron gets oxidised to form chlorine gas.

- b) Write an equation for the reaction at the cathode. (1 mark)

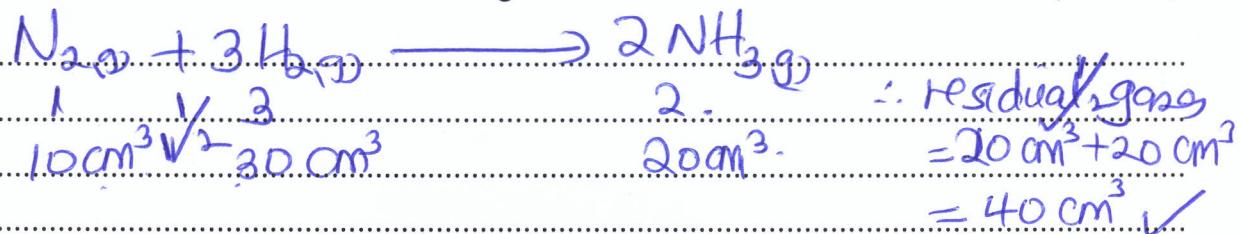


17. In preparation of ammonia gas 30cm^3 of nitrogen gas and 30cm^3 of hydrogen gas were exploded in a vacuum

- (i) Write an equation for this reaction (1 mark)



- (ii) Calculate the volume of the residual gases (2 marks)



18. Juice extracted from a nettle plant were added drop wise into a boiling tube containing 5cm^3 potassium hydrogen carbonate solution until there was no further change.

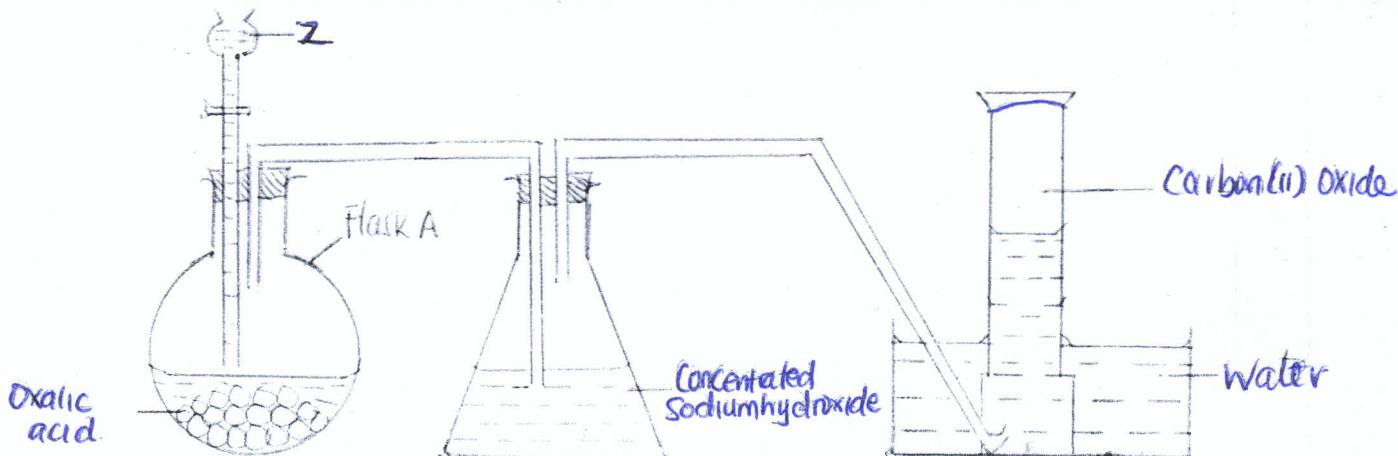
- a) Explain the observation made in the boiling tube when the reaction was going on. (2 marks)

~~Effervescence due to production of CO_2~~
Methanolic acid from the nettle plant reacts with $\text{KHCO}_3\text{(aq)}$ to produce CO_2

- b) What observation would have been made if the nettle juice were added to silver metal in a boiling tube? Explain (1 mark)

- No effervescence; Silver is below hydrogen in reactivity series.

19. The set up below was used to prepare and collect carbon (II) oxide in the laboratory.



- (i) Identify Z and give its role in the reaction (1 mark)

~~reject~~ ~~an.~~ • Concentrated Sulphuric (VI) acid. $\text{H}_2\text{SO}_4 \checkmark$
 • dehydration of oxalic acid. \checkmark

- (ii) Write an equation for the reaction in the flask A (1 mark)



- (iii) Give one use of carbon (II) oxide. (1 mark)

* • Reducing agent in extraction of metals. Any one.
 * • Source of fuel.

20. When 94.5g of hydrated barium hydroxide $\text{Ba}(\text{OH})_2 \cdot n\text{H}_2\text{O}$ was heated to a constant mass, 51.3g of anhydrous barium hydroxide was obtained. Determine the empirical formula of the hydrated barium hydroxide ($\text{Ba} = 137$, $\text{O} = 16$, $\text{H} = 1$) (3 marks)

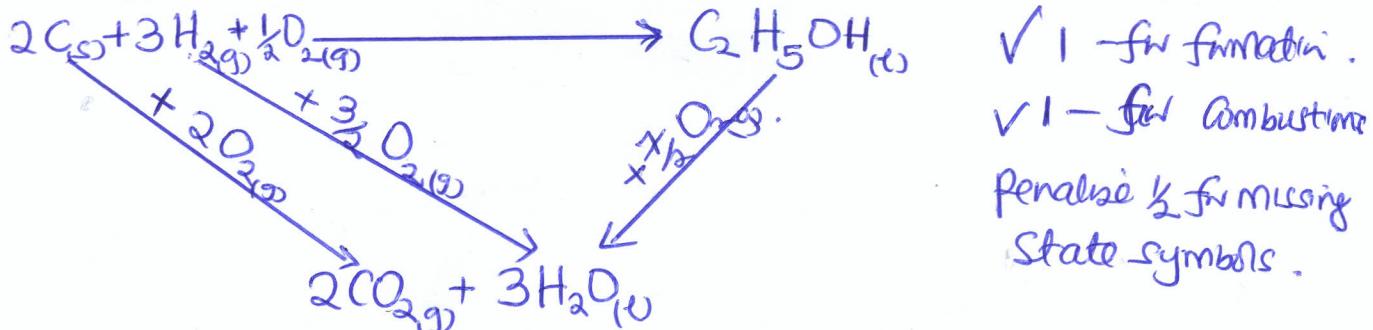
Compound	$\text{Ba}(\text{OH})_2$	H_2O
Mass	51.3	43.2
Moles	$\frac{51.3}{137} = 0.3$	$\frac{43.2}{18} = 2.4$
Mole ratio	$\frac{0.3}{0.3} = 1$	$\frac{2.4}{0.3} = 8 \checkmark$

\therefore EF is $\text{Ba}(\text{OH})_2 \cdot 8\text{H}_2\text{O}$. \checkmark

21. Given that the thermochemical equations for combustion of ethanol, hydrogen and graphite (carbon) are;



- a) Draw an energy cycle diagram linking the enthalpy of combustion of ethanol and the enthalpy of combustion of its constituent elements. (2 marks)



b) Calculate the enthalpy of formation of ethanol

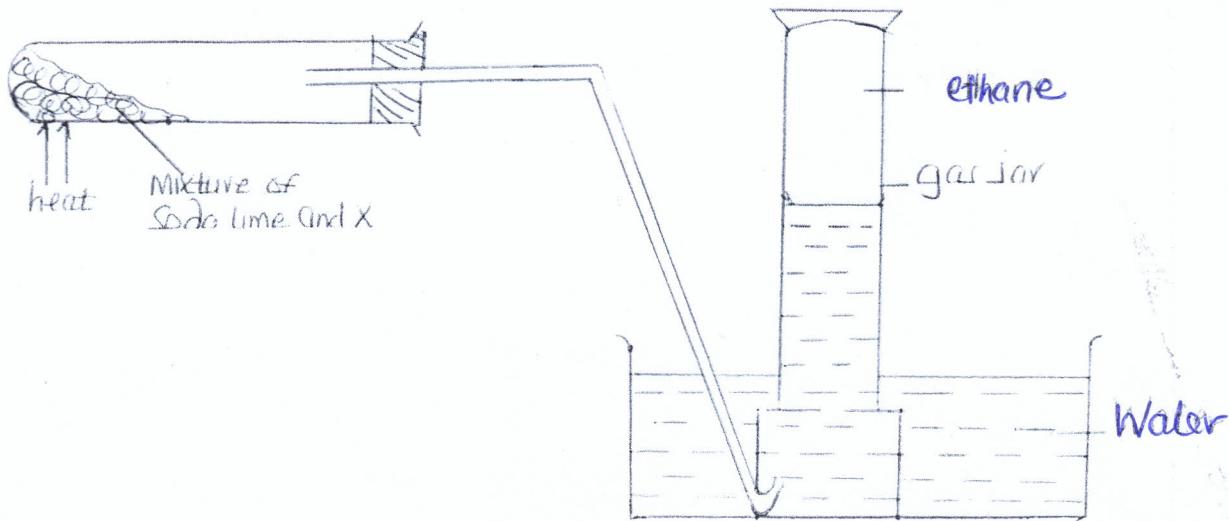
(1 mark)

$$2(-393) + 3(-286) = \Delta H_f + -1368 \quad \checkmark$$

$$\Delta H_f = -276 \text{ kJmol}^{-1} \quad \checkmark$$

Penalise k
for missing units

22. The diagram below shows the apparatus used to prepare ethane in the laboratory. Study it and answer the questions that follow.



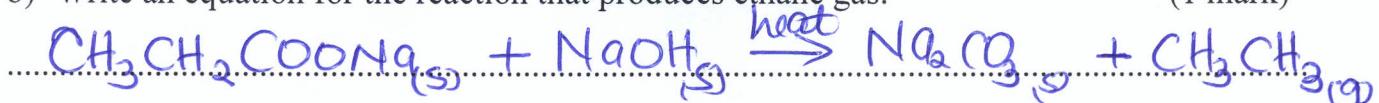
a) Identify X

(1 mark)



b) Write an equation for the reaction that produces ethane gas.

(1 mark)



accept
without
statesymbols

c) Give a reason why the gas was collected over water.

(1 mark)

Insoluble in water.

reject Slightly soluble
in water.

23. The decomposition of methanol to form hydrogen and carbon (II) oxide can be represented by the equilibrium $\text{CH}_3\text{OH}_{(g)} \rightleftharpoons 2\text{H}_{(g)} + \text{CO}_{(g)}$ $\Delta H = +92 \text{ kJmol}^{-1}$

What would be the effect on the equilibrium when

(i) The temperature is decreased.

(1 mark)

equilibrium shifts to the left.

reject backward
rxn is favoured.

(ii) The pressure is decreased

(1 mark)

Equilibrium shifts to the right.

24. a) State Graham's law of diffusion

(1 mark)

The rate of diffusion of a gas is inversely proportional to the square root of its density provided temperature and pressure are kept constant.

b) A sample of an unknown gas W is shown by analysis to contain sulphur and oxygen. The gas requires 28.3 seconds to diffuse through a hole into a vacuum. An identical number of oxygen molecules pass through the same hole in 20 seconds. Determine the molar mass of W. ($O = 16$, $S = 32$) (2 marks)

$$\frac{28.3}{20} = \sqrt{\frac{x}{32}} \quad \checkmark$$

$$x = 32 \left(\frac{28.3}{20} \right)^2 \checkmark$$

$$= 64 \checkmark$$

25. Write the chemical formula of the major component in the ore of;

(i) Sodium

(1 mark)

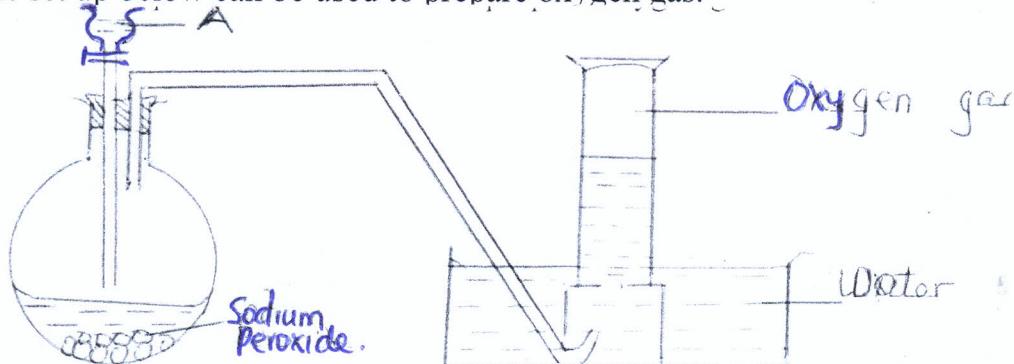
NaCl

(ii) Aluminium

(1 mark)

$\text{Al}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$

26. The set up below can be used to prepare oxygen gas.



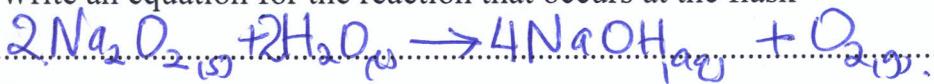
a) Identify A

(1 mark)

Water.

b) Write an equation for the reaction that occurs at the flask

(1 mark)



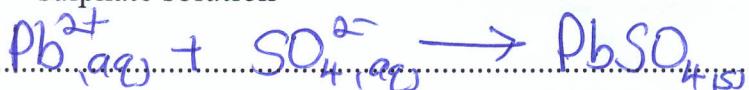
c) Give one industrial use of oxygen

(1 mark)

27. 0.52g of lead powder were dissolved in excess nitric (v) acid to form lead(II) nitrate solution.

a) Write an ionic equation for the reaction between lead(II) nitrate and potassium sulphate solution

(1 mark)



b) Determine the mass of the lead (II) sulphate formed in (a) above

(Pb = 207.0, S = 32.0, O = 16.0)

(2 marks)

$$\text{Mass g Lead ions} = \frac{0.52}{207} \times 1000 = 0.0025 \times 1000 = 0.025 \text{ g}$$

$$\text{R.F.M of PbSO}_4 = 303$$

$$\text{Mass g PbSO}_4 = 0.0025 \times 303 = 0.7575 \text{ g}$$

28. The table below shows the standard reduction potentials for four half-cells. Study it and answer the questions that follow.

$E^\circ(\text{volts})$



(i) Identify the strongest reducing agent

(1 mark)

Al⁻

reject Al³⁺ at -1.66V

(ii) Calculate the E° value from the two half-cells that produces the highest potential difference when combined.

(2 marks)

$$+0.80 - (-1.66) = +2.44 \text{ V}$$

29. When a candle was burnt completely, the total mass of products was found to be greater than the original mass of the candle. (2 marks)

Products formed are CO_2 and H_2O . ✓

It involves addition of oxygen. ✓

30. On complete combustion of 0.5g of a hydrocarbon, 1.257g of carbon (IV) oxide and 0.514g of water were produced. If the molecular mass of the hydrocarbon is 84. Determine the molecular formula ($\text{C} = 12$, $\text{H} = 1$, $\text{O} = 16$) (3 marks)

$$\text{Mass of C in } \text{CO}_2 = \frac{12}{44} \times 1.257 \text{ g} = 0.3428$$

$$\text{Mass of H in } \text{H}_2\text{O} = \frac{2}{18} \times 0.514 = 0.0571$$

Element C

R.A.M 12

Mass 0.3428

$$\text{M.M. } \frac{0.3428}{12} = 0.0286 \quad \frac{0.0571}{1} = 0.0571$$

H.

1

0.0571

\checkmark

Molar ratio 1

2. ✓

\therefore E.F is CH_2 . ✓

$$(\text{CH}_2)_n = 84 \quad \checkmark$$

$$14n = 84$$

$$n = 6. \quad \checkmark$$

\therefore M.F is C_6H_{12} . ✓