LONDIANI SUBCOUNTY JOINT EXAMINATIONS
CHEMISTRY PAPER 2(THEORY)
TIME 2 HOURS

INSTRUCTIONS TO CANDIDATES

1. *Write your name and index no in the spaces provided above.*
2. *Sign and write the date of exam in the spaces provided above.*
3. *Answer all the questions in the spaces provided after each.*
4. *Mathematical tables and silent electronic calculators may be used.*
5. *All working must be clearly shown where necessary.*
6. *This paper consists of 12 printed pages. Candidates should check to ensure that all pages are printed as indicated and that no questions are missing.*
7. *All answers should be written in English.*

Marking Scheme.

FOR EXAMINER'S USE ONLY

Question	Maximum score	Candidate's score
1		10
2		12
3		14
4		11
5		12
6		09
7		**12**
Total		**80**

1. The table below shows the positions of some elements in the periodic table. The letters are not the actual symbols of the elements.

					A			
	B		C		D		E	
F	G							
							H	

a) Select an element that can form an ion with a charge of +2. Explain your answer (2mks)

B or G ✓1 — due to lose of 2 electrons in the outermost energy level ✓1

b) What type of structure would the oxide of C have? Explain your answer. (2mks)

Giant ionic structure ✓1 — this results in forming of ✓1 ionic bond and builds up to form giant ionic structure

c) How does the reactivity of H compare with that of E? Explain your answer. (2mks)

E is more reactive than H ✓1. E is more electronegative/ smaller in size than H/easily gains an electron than H ✓1

d) Explain how you would expect the following to compare.

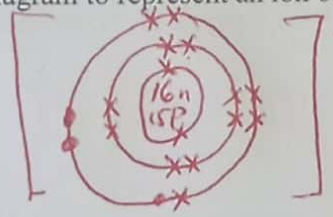
(i) Atomic radii of F and G (1mk)

F has a bigger/larger atomic radius ½ than G since G has a stronger nuclear charge attraction/more protons than F. ½

(ii) The pH values of aqueous solution of the oxide of B and D. (1mk) ½

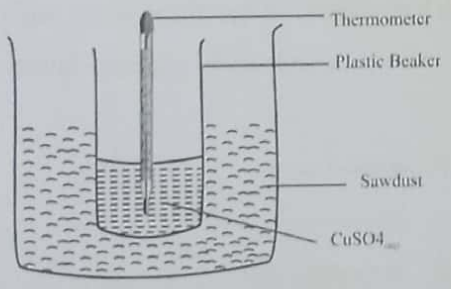
PH of B is more ½ than 7 and D is less than 7

e) Draw a diagram to represent an ion of element D. — 2.8.5 D^{3-} 2.8.8 (2mks)



- distribution of es ✓1
- showing the charge ✓1.

2. The diagram below shows a set up for the determination of enthalpy of displacement for the reaction between zinc metal and copper (II) sulphate solution



(a) Define molar heat of displacement (1 mark)

is the enthalpy change that occurs when one mole of a substance is displaced from a solution of its ions

(b) Write an ionic equation for the reaction that takes place in this experiment (1 mark)

$Zn_{(s)} + Cu^{2+}_{(aq)} \longrightarrow Zn^{2+}_{(aq)} + Cu_{(s)}$

(c) What is the function of the saw dust in the set up (1 mark)

To prevent heat loss or absorbed by the apparatus.

(d) State and explain two observations made at the end of this experiment other than rise in temperature (3 marks)

- The blue colour of the soln turns to colourless and brown solid is seen - Zinc displaces Cu^{2+} ions from the solution and get deposited. The plastic beaker becomes warm - due to heat absorbed by the apparatus.

(e) 4 g of the zinc powder were added to 50cm^3 of 0.25M copper (II) sulphate solution. The mixture was stirred with the thermometer and the highest temperature recorded.

Final temperature = 34.5°C

Initial temperature = 22.0°C

Calculate the molar heat of displacement of copper by zinc (Zn=65) S.H.C = 4.2KJ/g/k. (4marks)

Heat change = $mc\theta = \left(\frac{50 \times 4.2 \times 12.5}{1000}\right)$ KJ

$= 2.625$ KJ

Moles of Cu^{2+} ions = $\frac{50 \times 0.25}{1000}$

$= 0.0125$

0.0125 moles = 2.625 KJ

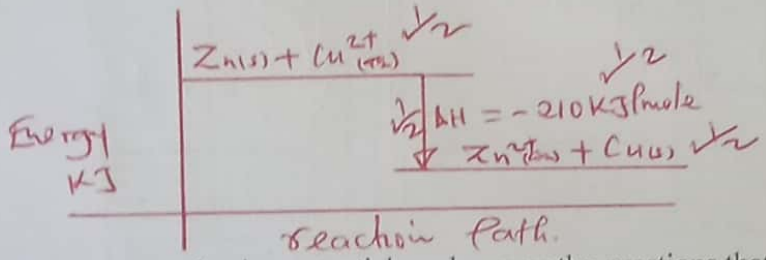
1 mole = ?

$\left(\frac{1}{0.0125} \times 2.625\right)$ KJ/mole

= 210 KJ/mole

= − 210 KJ/mole.

(f) Sketch an energy level diagram for the above reaction (2 marks)



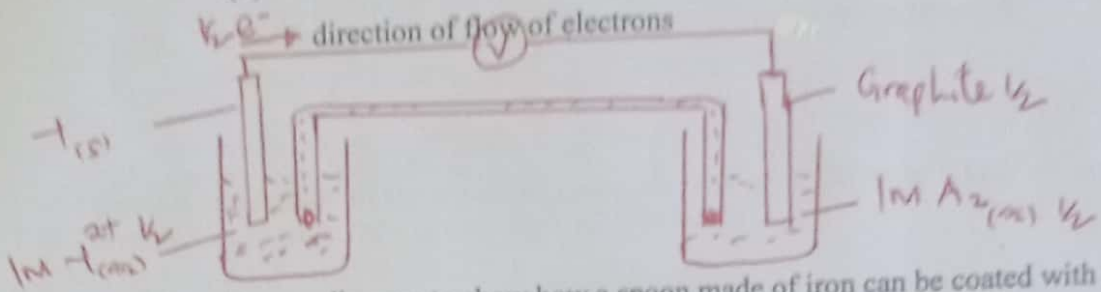
3.(a)Study the given reduction potentials and answer the questions that follow. The letters do not represent actual symbols of elements.

			E^0(V)
$X^{2+}_{(aq)}$ +	$2e^-$	⟶ $X_{(s)}$	-2.90
$Y^{2+}_{(aq)}$ +	$2e^-$	⟶ $Y_{(s)}$	-2.38
$Z^{2+}_{(aq)}$ +	$2e^-$	⟶ $Z_{(s)}$	0.00
½ $A_{2(g)}$ +	e^-	⟶ $A_{(aq)}$	+2.87

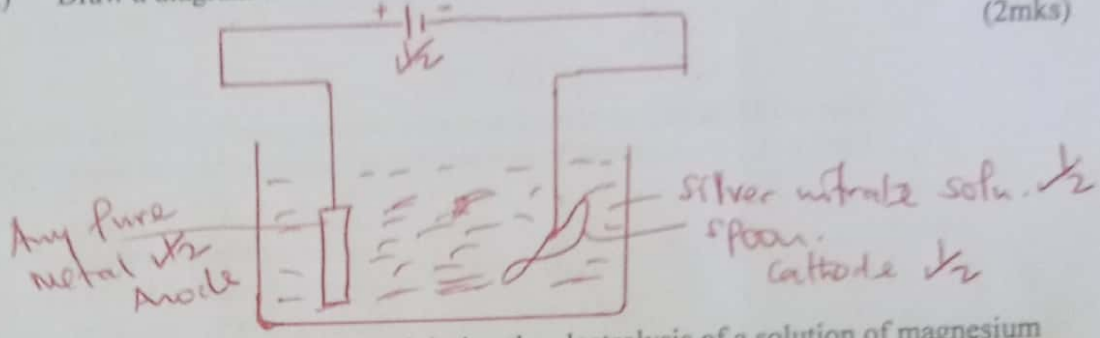
(i) Which element is likely to be hydrogen? (1mk)

Z - It has $E^{\theta} = 0.00V$ ½

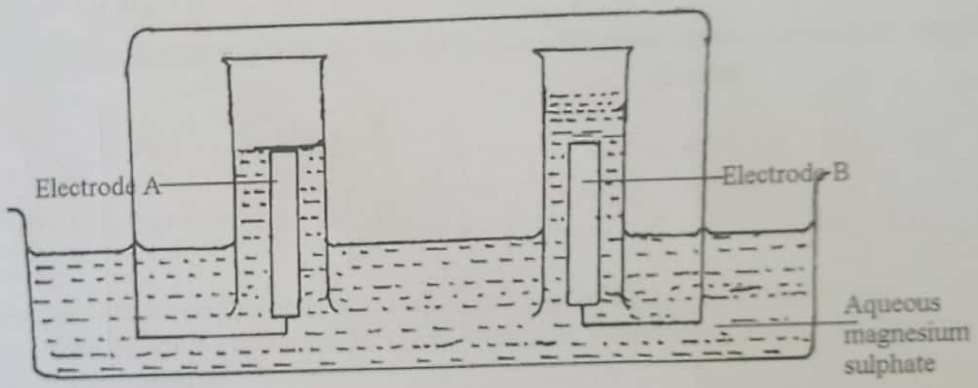
(ii) Draw an electrochemical cell when Y and A are combined. Show the direction of flow of electrons (2mks)



(iii) Draw a diagram to show how a spoon made of iron can be coated with silver metal (2mks)



(b) The set – up below was used during the electrolysis of a solution of magnesium sulphate using inert electrodes.



(i) Identify the ions present in the electrolyte (1mk)

Mg^{2+}, SO_4^{2-}, H^+, OH^- All correct ✓1

(ii) Write half equations at the anode and at the cathode:

Cathode: (1mk)

$4H^+_{(aq)} + 4e \rightarrow 2H_{2(g)}$ ✓1

Anode (1mk)

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

(iii) Which electrode is the cathode? Explain (2mks)

Electrode A ✓1 – From the eqn 2 moles of H_2 : 1mole of O_2 ✓1

(c) Explain the pH changes of the electrolyte during the experiment (2mks)

The pH remained the same ✓1

Since equal amount of OH^- and H^+ are removed during electrolysis ✓1

d) Calculate the quantity of electricity (in coulombs) that would liberate 1.2dm³ of oxygen gas at R.T.P (take 1 mole of gas at r.t.p = 24dm³, 1F = 96500C) (2mks)

$4OH^-_{(aq)} \rightarrow 2H_2O + O_2 + 4e$ ✓1

$4e = 4f = 4 \times 96500$ ✓½

24dm³ = 1.2dm³

$\frac{4 \times 96500 \times 1.2}{24}$ C ✓½

= 19,300 C

4.(a) Crude oil is a source of many compounds that contain carbon and hydrogen only.

(i) Name the process used to separate the components of crude oil. (1mk)

Fractional distillation ✓1

(ii) On what basis does separation occur (1mk)

- Miscibility of the components/fractions ✓½
- Close range of boiling points ✓½

(b) Under certain conditions, hexane can be converted to two products, one of them being butane. Write the formula of the other product (1mk)

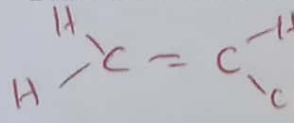
$CH_2=CH_2$ / C_2H_4 / $H_2C=CH_2$

(ii) Describe a simple chemical test to show the differences between the two products formed in (b) above. (2mks)

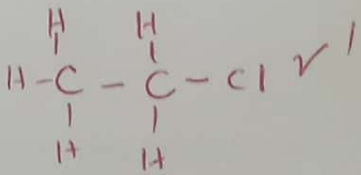
Pass the two gases separately through acidified $KMnO_4$ ✓1 the one decolourises the purple soln while C_4H_8 doesn't ✓1 or through bromine water / acidified $K_2Cr_2O_7$ / burning the gas (any of them).

c) Ethyne is another compound found in crude oil. One mole of hydrogen chloride gas reacted with one mole of ethyne and a product P was formed. P was then reacted with excess hydrogen gas to form product Q.

Draw the structure of P and Q (2mks)

P –  ✓1

$CH_2=CHCl$

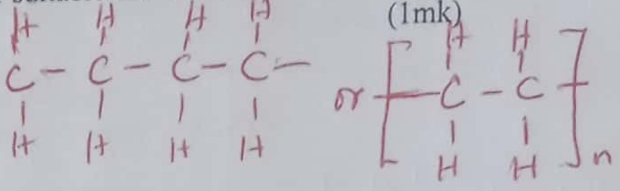
Q  ✓1

CH_3CH_2Cl.

(d) Ethyne may be collected over water during preparation. Explain why this is possible. (1mk)

Insoluble in water.

(e) (i) When one mole of ethyne is reacted with one mole of hydrogen, the product formed may undergo addition polymerization under suitable conditions. Write an equation for addition polymerization of the product. (1mk)

$CH_2 = CH_2 + CH_2 = CH_2 \rightarrow$  or

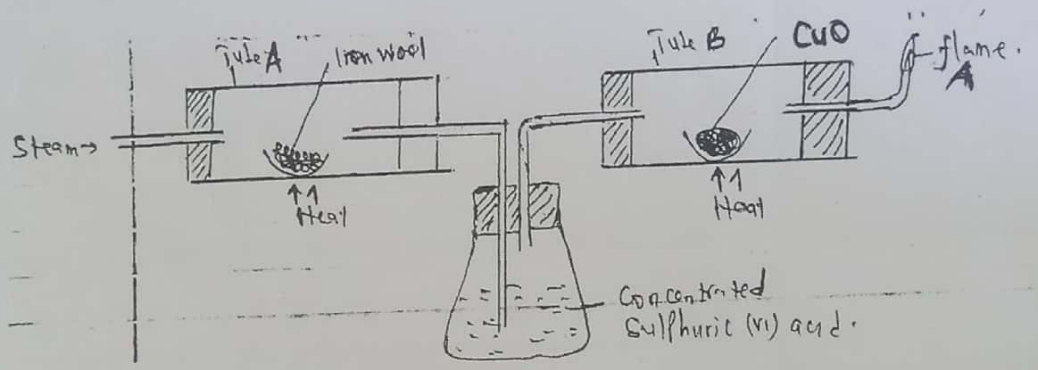
(ii) Give one disadvantage of the polymer in e(i) above (1mk)

non-biodegradable / does not rot easily.

(f) State one commercial use of ethyne (1mk)

- Oxy-acetylene flame for welding.
- Manufacture of synthetic fibres e.g rayons.
- Manufacture of PVC

5. In the experiment, steam was passed over heated iron wool as shown in the diagram below. The gas produced was then dried and passed through heated copper (ii) oxide



a) Write an equation for the reaction between steam and iron 1mk

$3Fe_{(s)} + 4H_2O_{(g)} \rightarrow Fe_3O_{4(s)} + 4H_{2(g)}$

b) What observation would be made in tube B at the end of reaction? Explain 2mks

Black solid turns brown ✓1 H_2 reduces CuO to Cu metal ✓1

c) What precaution should be taken into consideration before lighting the gas at A 1mk

Excess H_2 should be passed before lighting it to avoid explosion ✓1

d) What type of reaction takes place in the tube B 1mk

Reduction

e) Give two uses that are for both carbon(ii) oxide and hydrogen gases 2mks

- both are reducing agents of metallic oxides.
- both are used as fuels.

f) i)Give the name of the process described below 3mks

Substance	condition	Name of the process
Iron(ii) sulphate heptahydrate	Exposed to air ,changes from crystalline to powder form	Efflorescence
Concentrated sulphuric(vi) acid	Exposd to air, volume of the acid increases	hygroscopy
Zinc nitrate	Exposed to air changes in solution	deliquescence.

ii) Name another substance that can undergo the same process as zinc nitrate above 1mk

Sodium hydroxide, Potassium hydroxide, Iron(II) chloride, Iron(III) Chloride any one. 1mk

iii) Write the formula of copper (ii) sulphate crystals

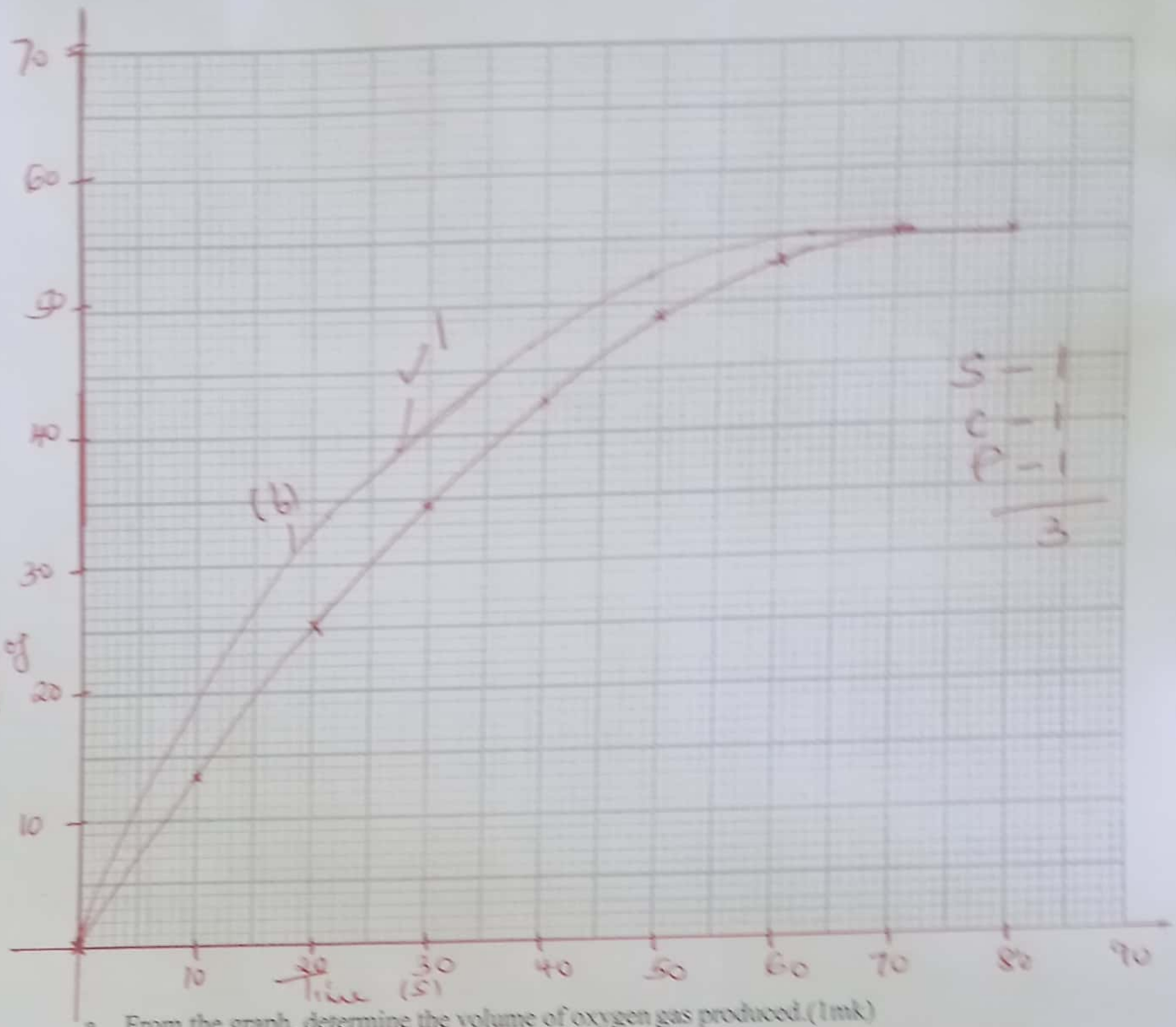
$CuSO_4 \cdot 5H_2O$

6 3.06g of Manganese (IV) oxide was placed in a flask and 25cm^3 of hydrogen peroxide added.

Time (s)	0	10	20	30	40	50	60	70	80
Volume (cm^3)	0	13.5	25	34.5	42.5	49	53	55	55

The volume of oxygen gas produced was recorded after every 10 seconds. The results obtained were recorded in the table below.

Plot a graph of volume (cm^3) against time (sec). (3mks)



a. From the graph, determine the volume of oxygen gas produced.(1mk)

55 cm^3 (must be shown on the graph)

b. The experiment was repeated using more concentrated hydrogen peroxide. On the same axis; sketch the curve that was obtained. (1mk)

c. Write an equation for catalytic decomposition of hydrogen peroxide.(1mk)

$2H_2O_{2(l)} \xrightarrow{MnO_2} 2H_2O_{(l)} + O_{2(g)}$

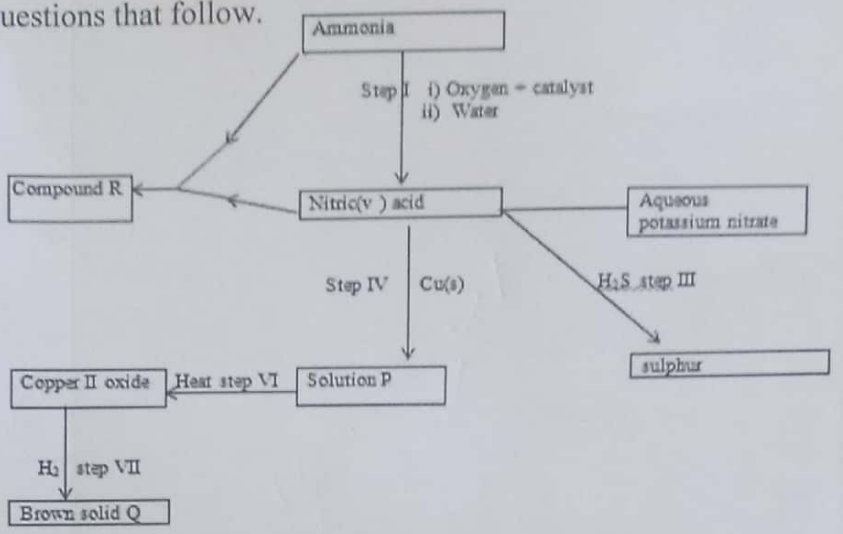
d. Give the test for oxygen gas.(1 mk)

relights / reignites / rekindles a glowing splint

e. State two commercial uses of oxygen gas. (2 mks)

- In hospital to patients with breathing problems.
- oxyacetylene flames in welding.
- In mountain climbing
- In sea diving.

7 The scheme below shows various reactions starting with ammonia. Study it and answer the questions that follow.



a) Name:

i) Compound R Ammonium nitrate (1mk)

ii) Solid Q Copper (1mk)

iii) Catalyst used in step I (1mk)

Platinum – Rhodium / Platinum

iv) Process taking place in step II (1mk)

Neutralization.

b) i) What property of nitric (V) acid is demonstrated in step III (1mk)

Oxidising property.

ii) State the precaution to be taken when carrying out reaction in step III? Give a reason (2mks)

Carry out in fume chamber / in the open air ✓1

H_2S is poisonous. ✓1

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

$CuO_{(s)} + H_{2(g)} \longrightarrow Cu_{(s)} + H_2O_{(l)}$

d) i) Give one use of compound R (1mk)

As a fertizer / making of explosives

ii) Calculate the percentage of nitrogen by mass in compound R (N=14, H=1, 0= 16 (2mks)

$NH_4NO_3 = 80$ ✓½

% N = $28/80 \times 100$ ✓1 = 35 % ½

e) State one commercial use of Nitric (V) acid apart from making nitrogenous fertilizers (1mk)

- Making Synthetic fibres
- Making aqua regia
- used in extraction of gold
- making explosives TNT.

any one