SUCCESS PATH JOINT EXAMINATION

Kenya Certificate of Secondary Education

233/2 – CHEMISTRY (Theory) – Paper 2 **FORM FOUR**

121 / 2 - Chemistry Paper 2

March/April 2026

Time: 11.00 a.m – 1.00 p.m

Name …… Index Number…..……..……...

Class ……..…… School ……..……...……Signature……...…..

Instructions to candidates

(i) Write your name, adm number and class in the **spaces provided above**.
(ii) Sign and write the date of examination in the spaces provided above.
(iii) Answer **all** the questions in in the spaces provided in the question paper.
(iv) **Non – programmable** silent electronic calculators and KNEC Mathematical tables may be used.
(v) All workings **must** be clearly shown where necessary
(vi) This paper consists of 12 printed pages.
(vii) **Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.**
(viii) **Candidates should answer the questions in English.**

For Examiner's Use Only

Questions	Maximum Score	Candidates' Score
1	10	
2	14	
3	12	
4	10	
5	11	
6	11	
7	12	
TOTAL	80	

1 Study the information in the **Table 1** which shows the periodic properties of certain elements. The letters do not represent the actual symbols of the elements.

Table 1

Element	Ion	Electron arrangement of ion	Atomic radius	Ionic radius
M	M^{2+}	2.8	1.97	0.88
N	N^{+}	2.8.8	1.99	0.89
O	O^{-}	2.8	0.72	1.36
P	P^{2-}	2.8.8	0.99	1.46

(a) Give the period and group to which element P belongs;

Period..... (1 mark)

Group..... (1 mark)

(b) Using dots $(\bullet)$ and crosses $(\times)$ to represent electrons show the bonding in a compound formed between N and O (2 marks)

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(c) Compare and explain the reactivity of element M and N with water. (2 marks)

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(d) Explain why the atomic radius of O is smaller than its ionic radius. (1 mark)

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(e) Element M react with chlorine according to the equation; $M_{(s)} + Cl_{2(g)} \longrightarrow MCl_{2(s)}$

Determine the mass of solid MCl_2 formed when 0.002 moles of M is reacted with excess chlorine. (R.A.M of M = 25, Cl= 35.5) (3 marks)

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2 (a) Carbon (IV) oxide is present in soft drinks. State two roles of carbon (IV) oxide in soft drinks. (2 marks)

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(b) The flow chart in **Figure 1** summarises the steps involved in the production of sodium carbonate. Use it to answer the questions that follow.

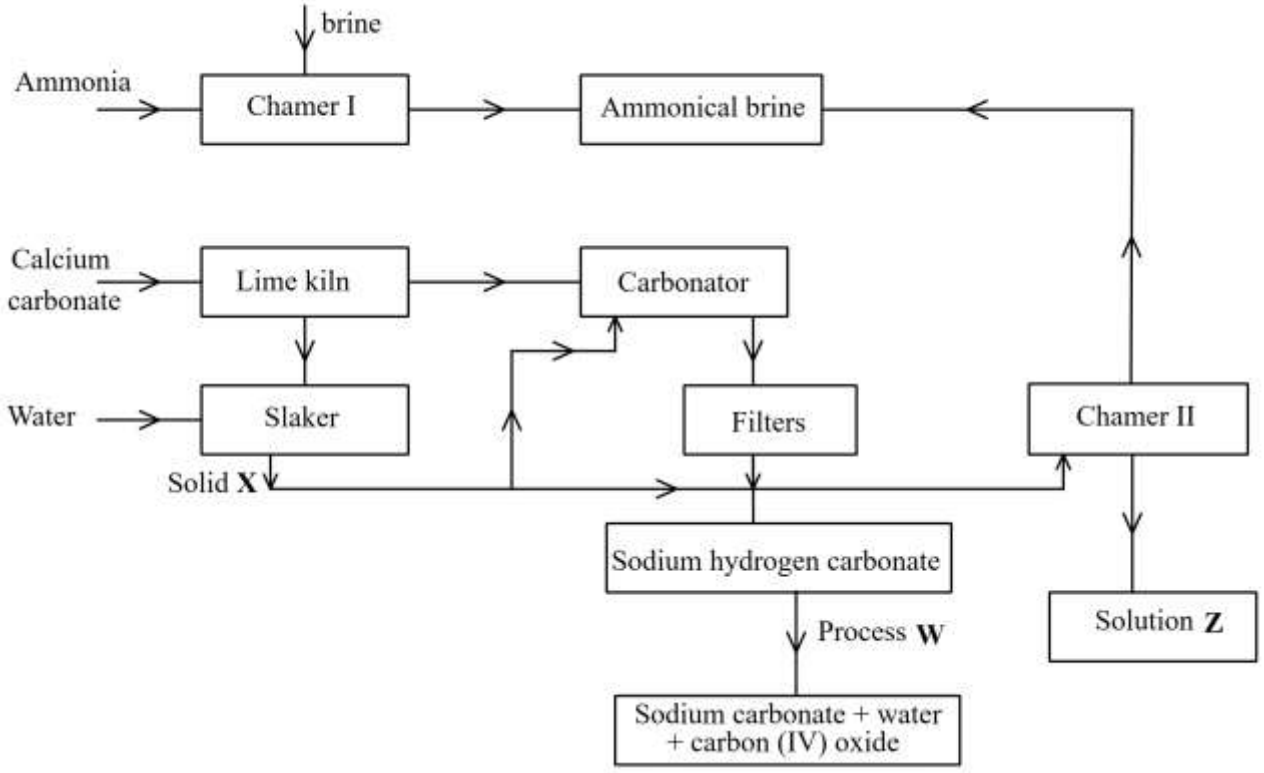

Figure 1

(i) Name the process illustrated in **Figure 1**. (1 mark)

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(ii) Identify the starting materials required in the production of sodium carbonate. (2 marks)

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……...

(iii) Write equations for the two reactions that occur in the carbonator. (2 marks)

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(iv) Name ***two*** substances that are recycled in the process shown in Figure 1. (2 marks)

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(v) Identify;

Solid **X**; …… (1 mark)

Process **W**. …… (1 mark)

(vi) Write an equation for the reaction that produces solution **Z**. (1 mark)

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(vii) Apart from softening hard water, state ***two*** other uses of sodium carbonate. (2 marks)

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3 (a) Name the compounds below.

(i) C_6H_{10} (1 mark)

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(ii) CH_3CHCH_2 (1 mark)

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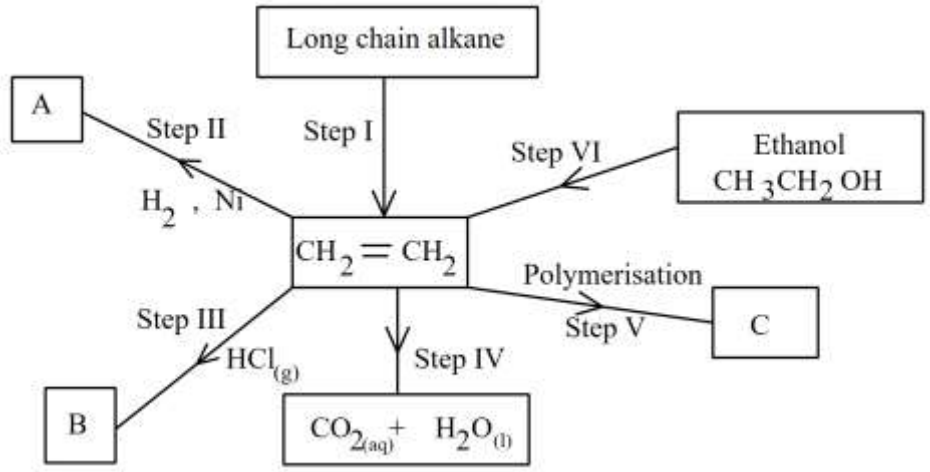
(b) Study the flow chart below and answer the questions that follow:



(i) Name the process taking place in Step I (1 mark)

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(ii) Describe a chemical test that can be used to distinguish between compound A and $CH_2 = CH_2$ (2 marks)

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(iii) Give the name of the following compounds:

(I) A ……..…… (1 mark)

(II) B ……. (1 mark)

(iv) Give the structural formula of substance C (1 mark)

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(v) Name the type of reaction that occurs in:

I) Step IV……..…….. (1 mark)

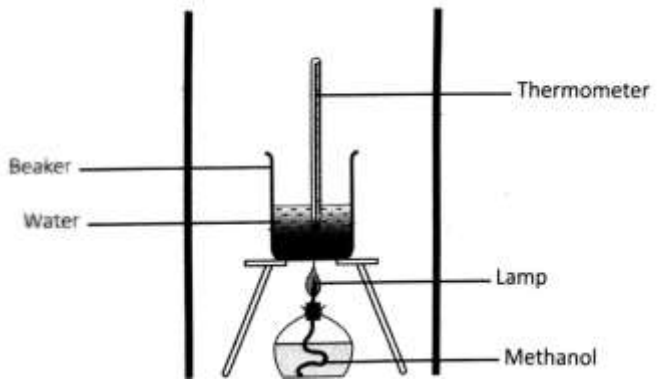
II) Step VI……..…….. (1 mark)

(vi) Give the reagents and the conditions necessary for Step VI (2 marks)

Reagents: ……...…….

Conditions:…..……

4 In an experiment to determine the heat of combustion of methenol, **CH_3OH**, a student used a set-up like the one shown in the diagram below.



- Volume of water = 50 cm^3
- Final temperature of water = 27.0ºC
- Initial temperature of water = 20.0ºC
- Final mass of lamp + Methanol = 22.11g
- Initial mass of lamp + Methanol = 22.9

(a) Calculate;

(i) The number of moles of methanol used in this experiment (C=12; O=16; H=1) (1 mark)

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(ii) The heat of combustion per mole of methanol (Specific heat capacity of solution = 4.2 kJ/kg/K. Density of solution = 1g/ cm^3) (2 marks)

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(b) Write the thermochemical equation for the combustion of methanol. (1 mark)

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(c) Explain why the value of the molar heat of combustion for methanol obtained in this experiment is different from the theorical value. (2 marks)

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(a) Sketch, in the space below, an energy level diagram for the combustion of methanol. (2 marks)

(b) Using the thermochemical data given in the table below, calculate the enthalpy for the reaction:

$CH_4(g) + 2Cl_2(g) \rightarrow CH_2Cl_2(g) + 2CHl(g)$ (2 marks)

Bond	Bond energy (kJ/mol)
C – H	414
Cl – Cl	244
C – Cl	326
H – Cl	431

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5 **Figure 4** is a flow chart showing preparation of and reactions of ammonia gas. Use it to answer the questions that follows.

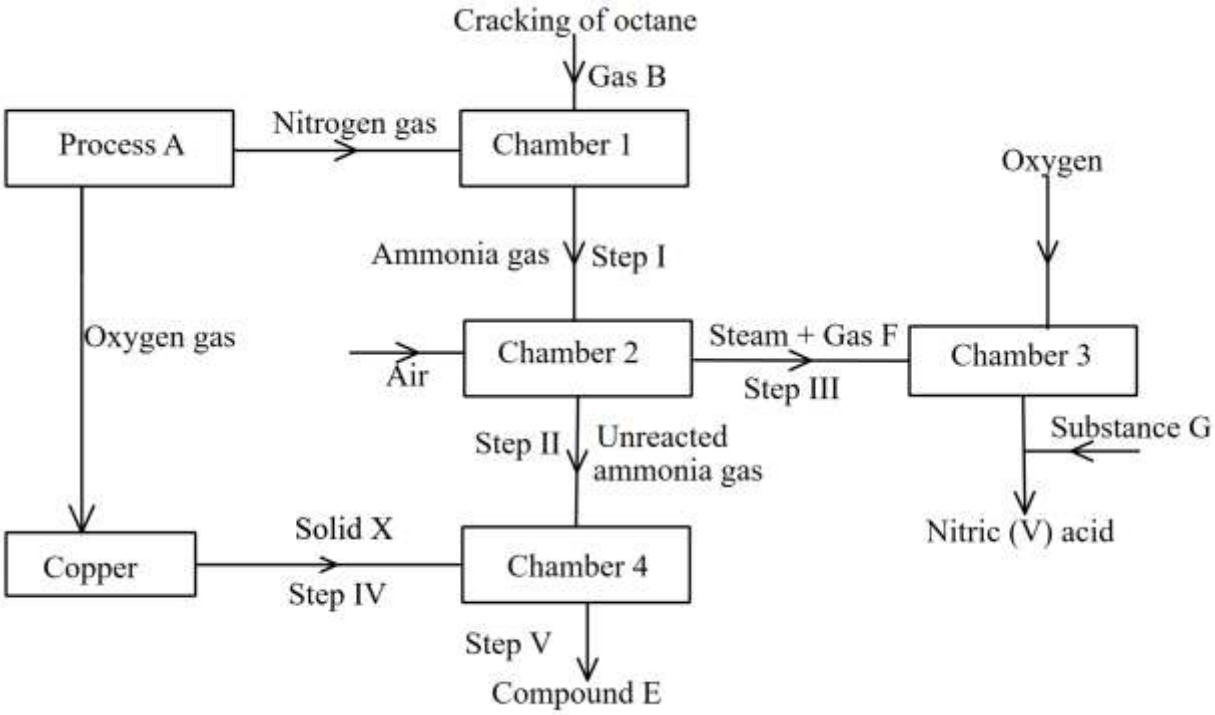

Figure 4

(a) Give the name of;

(i) Gas B; (1 mark)

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(ii) Process A; (1 mark)

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(iii) Substance G. (1 mark)

……..

(b) Name the catalyst used in;

(i) Chamber 1; (1 mark)

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(ii) Chamber 2. (1 mark)

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(c) State the observation made during the reaction taking place in step IV. (1 mark)

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(d) Write equation for the reaction taking place in chamber 2. (1 mark)

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(e) State and explain observations made in chamber 4. (2 marks)

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(f) Give ***two*** use of nitric (V) acid. (2 marks)

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6 (a) State Graham's law of diffusion. (1 mark)

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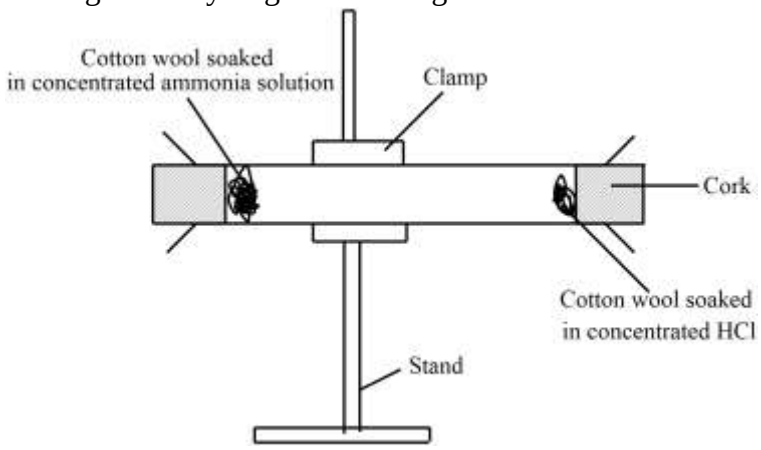
(b) The figure below shows an experiment that was used to investigate the rate of diffusion of ammonia gas and hydrogen chloride gas.



(i) Define the term diffusion. (1 mark)

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(ii) State and explain the observation made during the experiment after few minutes. (3 marks)

Observation.

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Explanation.

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(iii) Determine the molecular masses of ammonia (NH_3) and Hydrogen chloride (HCl). (N = 14.0, H = 1.0, Cl = 35.5). (2 marks)

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(iv) Which gas covered a longer distance? Explain. (2 marks)

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(c) If it takes 20 seconds for 200 cm^3 of oxygen gas to diffuse across a porous plug. How long will it take an equal volume of sulphur (IV) oxide to diffuse across the same plug? (O = 16.0, S = 32.0) (2 marks)

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7 Solubility of potassium nitrate and copper (II) sulphate were determined at different temperatures. The following data was obtained.

Temperature$(^{\circ}C)$		0	20	40	60	80	100
Solubility g / 100g of water	KNO_3	12	30	75	125	185	250
	$CuSO_4$	15	20	35	45	65	80

(a) Define the term solubility as used in salts. (1 mark)

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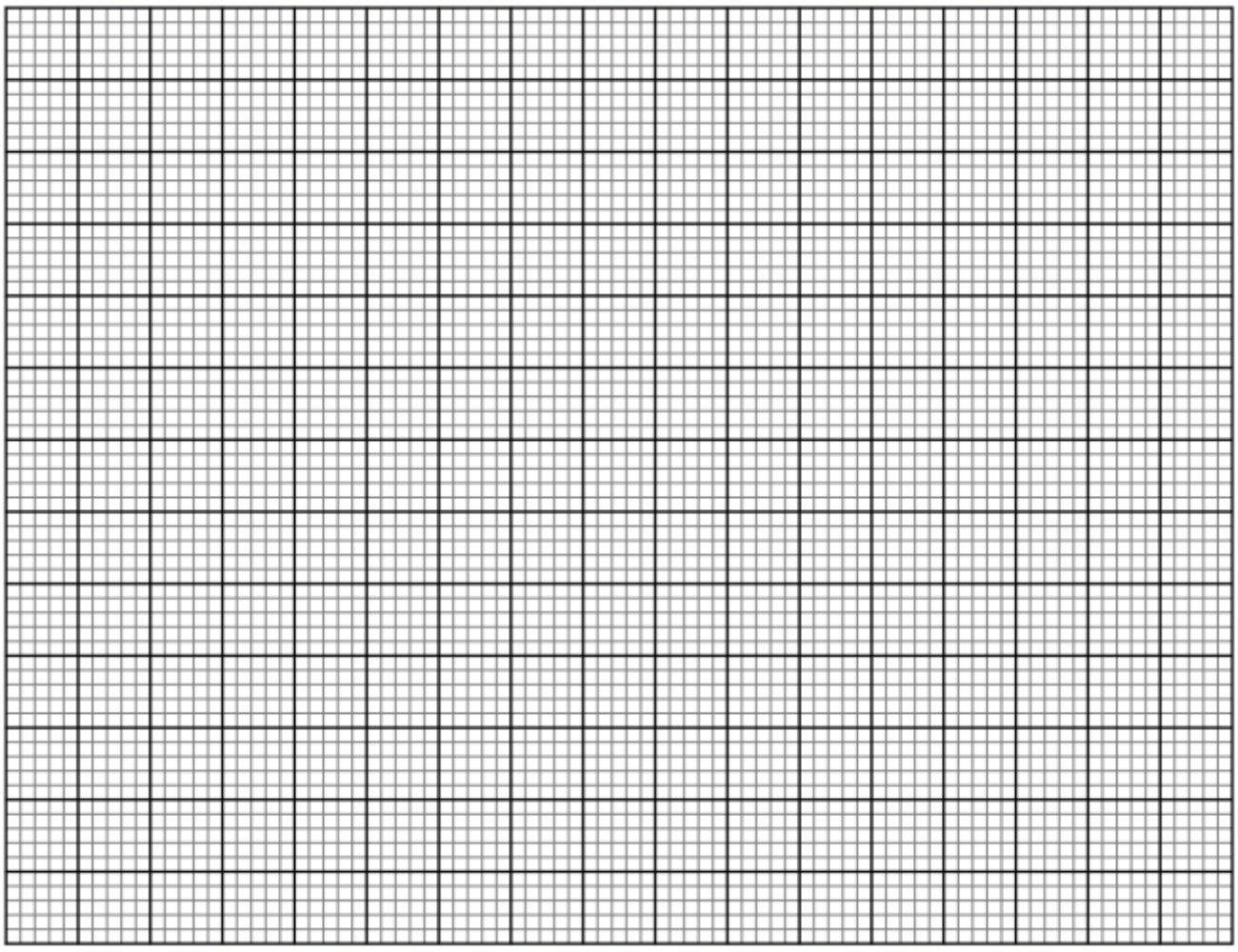
(i) On the grid below, plot solubility curves for both salts: where solubility (vertical axis) is plotted against temperature (horizontal axis) (4 marks)



(ii)Determine from the graph the solubility of each salt at $50^{o}C$.

I) KNO_3 (1 mark)

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II) $CuSO_4$ (1 mark)

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(iii) At what temperature was the solubility of both salts equal? (1 mark)

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(iv) If a hot solution containing 80g of KNO_3 in 100g of water was cooled from 70°C to 25°C; what mass of crystals would be formed? (1 mark)

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(c) (i) What is meant by the permanent hardness of water? (1 mark)

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(ii) State **one** chemicals substance that can be used to remove permanent hardness. (1 mark)

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(iii) State **one** advantage of hard water.. (1 mark)

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