



WESTERN JOINT MOCK EXAMINATIONS

Uganda Advanced Certificate Of Education

CHEMISTRY

Paper 1

2 hours 45 minutes.

INSTRUCTIONS TO CANDIDATES:

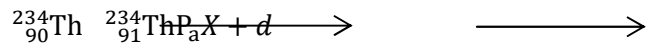
- Answer all questions in section **A** and six questions in section **B**.
- All questions must be answered in the spaces provided.
- The periodic table with relative atomic masses is attached at the end of the paper.
- Mathematical tables are provided.
- Non-programmable scientific calculators may be used.
- Illustrate your answers with equations where applicable.

For Examiner's use only																	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	TOTAL

SECTION A (46 marks)

Answer all questions in this section

1. (a) The following equations show part of the radioactive decay of thorium.



- (i) Name the particle emitted to the first stage of the reaction. (½ mark)

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- (ii) State the atomic number and the mass number of X. (1 mark)

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- (b) The activity of ${}^{234}_{90}\text{Th}$ was reduced to 25% in 50 days. Determine the half-life of ${}^{234}_{90}\text{Th}$. (2½ mark)

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2. The exothermic reaction between nitrogen and hydrogen takes place according to the equation. $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightleftharpoons 2\text{NH}_3(\text{g})$

- (a) Write the expression for the equilibrium constant K_c for the forward reaction. (1 mark)

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- (b) At 500°C the equilibrium concentration of hydrogen is 0.250 mol l^{-1} and of nitrogen is 2.7 mol l^{-1} . Calculate the equilibrium concentration of ammonia at the same temperature given $K_c = 6.0 \times 10^{-2} \text{ mol}^2 \text{ mol}^{-2}$ at 500°C. (3 marks)

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- (c) What would happen to the ammonia if;

- (i) Helium was added to the equilibrium mixture at 500°C? (1 mark)

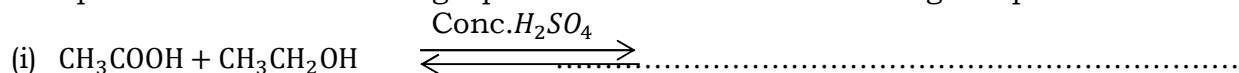
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(ii) The temperature was increased? (1 mark)

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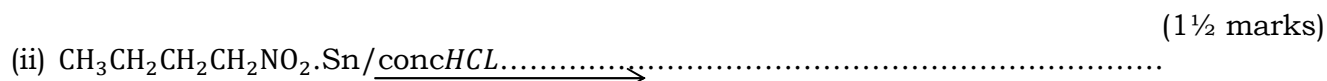
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3. Complete each of the following equations and name the main organic product.



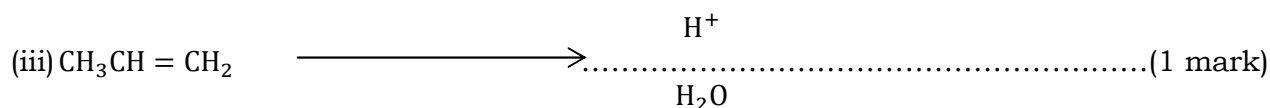
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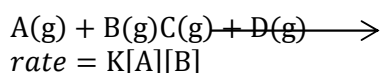
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4. The rate equation for the homogeneous reaction



(a) What is the overall order of the reaction? (1 mark)

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(b) If the rate of reaction is r for certain pressures of A and B (at constant temperature), write expression in terms of r for the rate of reaction when

(i) The pressure of B is doubled but that of A is kept constant. (1 mark)

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(ii) The pressure of A and B are both doubled. (1 mark)

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(iii) The volume of the system is doubled without changing the amount of A and B.

(1 mark)

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(iv) The amount of A and B remain unchanged but argon gas is added (at constant volume) to double the overall pressure. (1 mark)

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5. Potassium manganate (vii) is often used in volumetric analysis.

(a) Write the equation for the reaction between potassium manganate (vii) and hydrogen peroxide in acid solution. (2 marks)

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(b) Explain why potassium manganate (viii) is not used as a primary standard volumetric analysis..... (2 marks)

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(c) Give two compounds that are used to standardise potassium manganate(vii)(1 mark)

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6. A hydrocarbon (containing 14.3% by mass of hydrogen) is a gas of density 2.50 g l^{-1} At s.t.p.

(a) Calculate its empirical formula.(2 marks)

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(b) Calculate its relative formula mass.(1½ marks)

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(c) Draw three possible structures formulae for the compound.(1½ marks)

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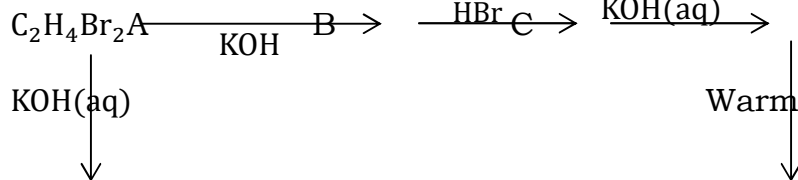
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7. Complete the following reaction scheme by identifying all the compounds and giving their structural formulae.

(05 marks)

hot ethanolic



D gives a silver mirror with Tollen's reagent whereas E does not.

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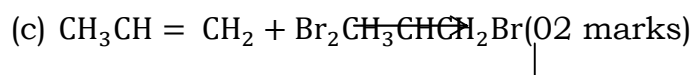
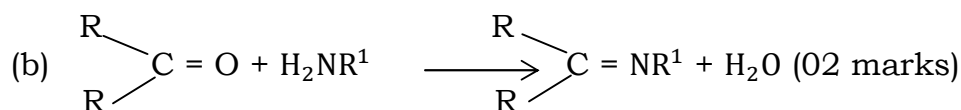
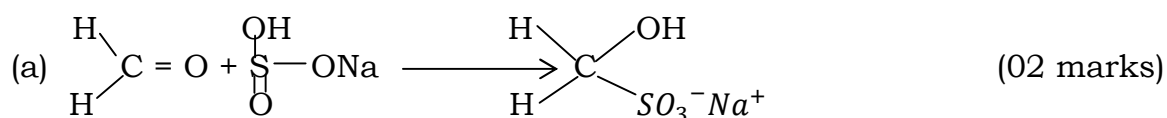
8. Explain the following observations.

(a) Sodium chloride melts at 800°C whereas aluminium chloride sublimes at 180°C.
(02 marks)

(b) Nitrogen is a gas at room temperature whereas phosphorous exists in several solid forms at room temperature.
(02 marks)

(c) Graphite and copper both conduct electricity.
(02 marks)

9. Give the mechanism in each of the following.



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SECTION B (54 marks)

Attempt six questions only from this section

10. (a) Draw the structure and name the shape of the folowing species. State the oxidation state of sulphur in each species. (06 marks)

species	structure	Name of shape	Oxidation state
SO ₂			
SO ₃ ²⁻			
SO ₄ ²⁻			

(b) SO₂ is a gas at room temperature whereas H₂O is a liquid at the same temperature. Explain (1½ marks)

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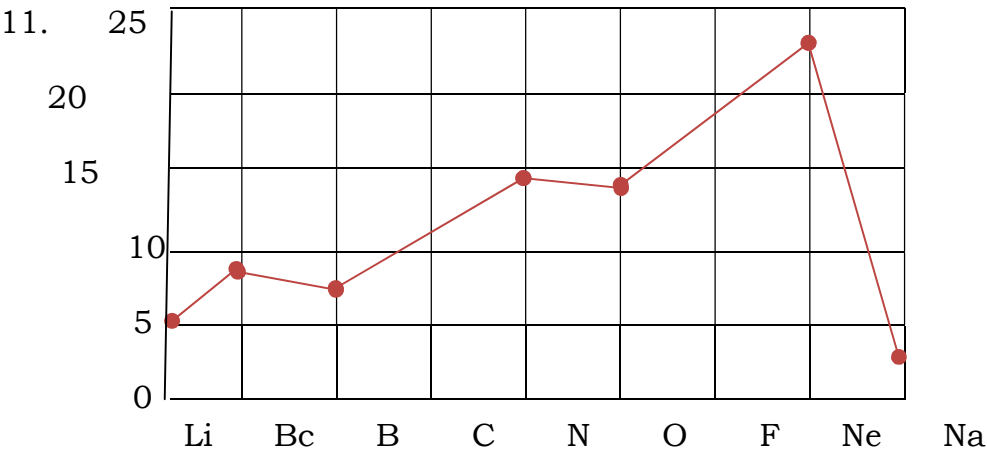
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(c) State briefly how one would identify SO₃²⁻ and SO₄²⁻ (1½ marks)



First ionization energy of the elements Li — Na. Using the diagram above the following.

(a) There is a general increase in ionisationenergies from lithium to Neon (1½ marks)

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(b) The ionisation energy of beryllium is higher than that of Boron.(1½marks)

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(b) The ionisation energy of oxygen is lower than that of nitrogen. (1½marks)

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(c) There is almost linear increase in ionisation energy from boron to nitrogen.
(1½marks)

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(d) There is a sudden drop of first ionisation energy from Neon to Sodium.
(1½marks)

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(e) The first ionisation energy of sodium is slightly lower than that of lithium.
(1½marks)

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12. Explain clearly each of the following.

(a) The aqueous solutions of chromium (ii) and chromium (iii) are coloured whereas that of copper (I) is not. (03 marks)

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(b) Manganese , iron, cobalt and nickel form coins in the oxidation state (+2)
Which decrease in size from manganese to nickel. (02 marks)

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(c) Carbondioxide CO_2 is a gas whereas silicon dioxide SiO_2 is a solid at room temperature. (02 marks)

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(d) Two possible oxy acids of H, O and Cl are $HClO$ and $HClO_4$. $HClO_4$ is a strong acid than $HClO$. (02 marks)

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13. (a) Explain what is meant by the terms;
(i) Standard electrode potential. (01 mark)

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(ii) First ionization energy. (01 mark)

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(c) The first ionization energies and the standard electrode potentials of group(i) elements of the periodic table are given in the table below;

Element	Li	Na	K	Rb	Cs
First I.E. / $KJmol^{-1}$	518.8	497.9	422.6	401.7	380.7
Standard electrode potential/ E^0 volts	-3.05	-2.71	-2.93	-2.99	-3.02

(i) Explain the trend in first ionization energy of group one elements. (02 marks)

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(ii) Why is the standard electrode potential of lithium anomalously high? (02 marks)

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(iii) What would you expect to be the trend in the ionic radii of the univalent cations formed by group I elements? Explain your answer. (03 marks)

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14. Enthalpies of combustion of some substances are given below.

Substance	$\Delta H_c / \text{KJmol}^{-1}$
Hydrogen	242
Benzene	3302
Cyclohexene	3746
Cyclohexane	3940

(a) Calculate the enthalpy of hydrogenation of :-

(i) Cyclohexene (03 marks)

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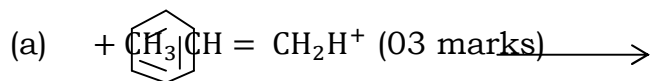
(ii) Benzene (03 marks)

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(b) Comment on the difference in the enthalpies of hydrogenation of cyclohexene and benzene you have calculated in (a) with reference to the structures of the two compounds. (03 marks)

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15. Complete the following organic reactions and outline the mechanism in each case.



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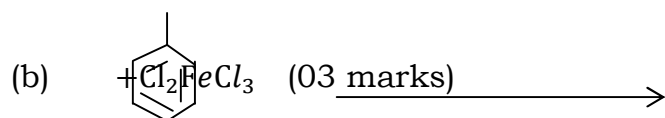
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CH₃



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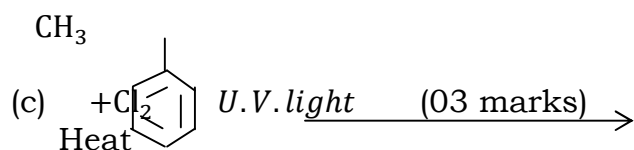
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16. Lead (ii) chloride is sparingly soluble in cold water.

(a) (i) Write the equation for the solubility of lead(II)chloride in water.(01 mark)

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(ii) Give the expression for the solubility product K of lead(II)chloride.
(01 mark)

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(b) At 25°C a saturated solution of lead(II)chloride in water contains 1.1g
per litre. Calculate its solubility product at this temperature. (03 marks)

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(c) Crystals of lead(II)chloride can be prepared in the laboratory by heating lead(II)oxide with dilute hydrochloric acid and cooling. When lead(II)oxide is treated with concentrated hydrochloric acid and the same conditions, no crystals are of the salt are formed. Give reasons for this observation and illustrate your answer with equation. (04 marks)

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17. A compound 'P' having composition of carbon 12.8%, hydrogen 2.1% and Bromine 85.1% is hydrolysed by aqueous potassium hydroxide to compound 'Q'. This compound is oxidized in several stages by nitric acid, the final product being acid 'R' of relative formula mass 90. On warming, acid 'R' decolourises an acidified solution of potassium manganate(VII).
(a) Calculate the molecular formula of P. (04 marks)

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(b) Identify compounds Q and R (02 marks)

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(c) Write the equation for the reaction of 'R' with acidified potassium manganate(VII).
(02 marks)

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(d) Write the structural formula of compound isomeric with compound 'P'
(01 mark)

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END