

NAME: STREAM:

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P525/1

CHEMISTRY

Paper 1

(Theory)

Oct. / Nov. 2024

2 $\frac{3}{4}$ hours

CHEMISTRY DEPARTMENT
UGANDA ADVANCED CERTIFICATE OF EDUCATION
END OF TERM III EXAMINATIONS
S.5 CHEMISTRY
Paper 1
(Theory)

2 hours 45 minutes

Instructions:

- All questions must be answered in the spaces provided.
- Answer **all** questions in section A and **six** questions in section B.
- Silent non-programmable scientific electronic calculators may be used.
- **Illustrate your answers with equations where applicable.**
- Where necessary use the following:
Universal gas constant, $R = 8.314 \text{ J/Kmol}$
[H = 1; C = 12; O=16]

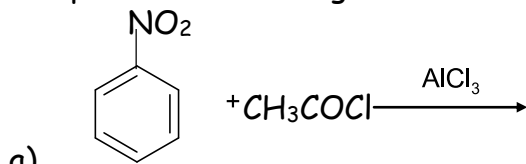
For Examiner's Use Only																	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	TOTAL

Section A (46 marks)

Attempt **all** questions in this section

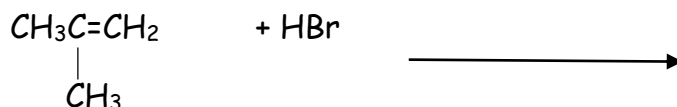
1. Complete the following reactions and give the name of the organic reaction.

(@ 02 marks)



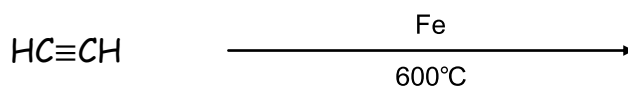
Name of organic reaction:

b)



Name of organic reaction:

c)



Name of organic reaction:

2.

a)

- i. State the conditions under which phosphorous reacts with sodium hydroxide solution (01 mark)

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- ii. Write equation for the reaction that occurs. (01 $\frac{1}{2}$ marks)

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- b) Phosphorous forms a hydride with a formula PH_3 .

- i. Comment on the solubility of the hydride of phosphorous in water.

(0 $\frac{1}{2}$ mark)

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- ii. Give a reason for your answer in b (i) above. (02 marks)

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3.

a) Distinguish between critical point and triple point. (02 mark)

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b) A liquid substance Y has its melting point and freezing point decreasing with increase in pressure. Draw a well labeled phase diagram for the liquid showing how pressure varies with temperature for the system. (03 marks)

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4. An organic compound R has a molecular formulae C_7H_7Br . 4.0g of R was divided into two portions.

a) The first portion of R burnt with a yellow sooty flame. Write the names and structural formulae of all possible isomers of R. (02 marks)

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b) The second portion was dissolved in sodium hydroxide solution, warmed and acidified with dilute nitric acid. The resultant solution was tested with silver nitrate solution. Name the isomer present if;

i. A pale yellow precipitate was formed (01 mark)

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ii. No observable changes were noticed (01 mark)

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c) Write equation(s) for reaction(s) showing the formation of yellow precipitate.
(02 marks)

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5. The table below shows the standard electrode potentials of some elements in group (II) of periodic table.

Element	Mg	Ca	Sr	Ba
Standard electrode Potential (V)	-2.37	-2.87	-2.89	-2.91

a) State the trend in standard electrode potentials of group (II) elements. (01 mark)

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b) Explain the trend. (03 marks)

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6. Bismuth undergoes beta decay according to the following nuclear reaction.

a) Identify the nuclide formed. (01 mark)

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- b) The time taken for 50% of Bismuth to decay is 19.7 minutes. Determine the time taken for 43% Bismuth to decay. (03 marks)

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7. During extraction of aluminium, Bauxite is roasted in air and dissolved in concentrated sodium hydroxide.

- a) Write equation(s) for the reaction(s) that take place when the roasted ore is dissolved in concentrated sodium hydroxide. (03 marks)

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- b) Pure aluminium is obtained by electrolysis of aluminium oxide. Aluminium obtained can be used to manufacture utensils. Explain why it is not advised to wash aluminium utensils with soap. (02 marks)

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8.

- a) Define the term relative atomic mass. (01 mark)

b) Chlorine has two isotopes, Chlorine-35 and Chlorine-37. Given that the atomic mass of chlorine is 35.5. Calculate the ratio of the two isotope in a natural sample.

c) State one disadvantage of using mass spectrometer in determining atomic mass of elements (01 mark)

9. Explain the following observations.

a) Nitrobenzene undergoes electrophilic substitution reactions in Meta position where as methyl benzene undergoes the same reactions in ortho or para position. (1.5 marks)

b) When an aqueous solution of lead (IV) ions is added to iodide ions, lead (IV) iodide is not precipitated. (1.5 marks)

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Section B (56 marks)

Attempt only **six** questions in this section

10. Fluorine, chlorine, Bromine and iodine are elements of group (VII). Briefly describe how

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i. Fluorine reacts with water

(02 marks)

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ii. Iodine reacts with dilute sodium hydroxide.

(02 marks)

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- b) The hydrides of elements in (a) above boil at different temperatures as shown in table below.

Hydride	HF	HCl	HBr	HI
Boiling Point (°C)	+20	-85	-67	-35

- Plot a graph of boiling points of hydride of group (VII) against molecular mass (02 marks)
- Using your graph, explain the difference in boiling points of hydrides of group (VII) (03 marks)

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11. Sulphur dioxide reacts with oxygen to establish the equilibrium below.



- a) Write the characteristics of the above equilibrium mixture. (01 $\frac{1}{2}$ marks)

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- b) State what would happen to the partial pressures of sulphur dioxide in the above equilibrium if;

- 0.9 moles of Helium was added at constant pressure (01 $\frac{1}{2}$ marks)

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- ii. 0.8 moles of sulphur trioxide formed was removed. (01 $\frac{1}{2}$ marks)

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- c) The equilibrium mixture of the above reaction at 700°C was found to contain 0.40 moles of sulphur dioxide, 0.3 moles of oxygen and 1.00 moles of sulphur trioxide at 1 atm.

- i. Write the expression for the equilibrium constant K_p : (01 mark)

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- ii. Calculate the value of equilibrium constant K_p at 700°C. (03 $\frac{1}{2}$ marks)

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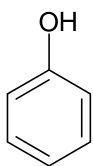
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12. Write equations to show how the following compound can be synthesized. Indicate the reagents for the reaction.

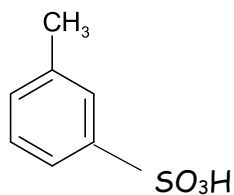
a) CH_3Cl to CH_3COOH (02 marks)

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b) (03 marks)



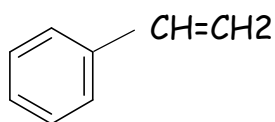
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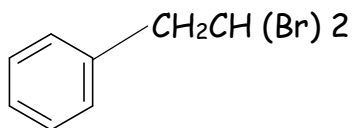
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c)

(04 marks)



To



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13. Carbon and lead are some of the elements in group (IV) of the periodic table.

a) Describe the following reactions of the elements.

i. Lead reacts with water. (01 $\frac{1}{2}$ marks)

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ii. Carbon reacts with dilute hydrochloric acid. (0 $\frac{1}{2}$ mark)

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b) A dark brown solid W decomposes on gentle heating to form solid B, when solid B was heated with excess oxygen, solid Z was formed.

i. Identify solids (01 $\frac{1}{2}$ marks)

W.....

B.....

Z.....

ii. Solid Z was dissolved in dilute nitric acid, and resultant solution filtered.

Write equation for reaction that occurred. (01 $\frac{1}{2}$ marks)

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iii. The filtrate was divided into two portions. To first portion, potassium chromate solution was added.

State what was observed. (01 mark)

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To the second portion, concentrated hydrochloric acid was drop wise until excess. Write equation(s) for the reaction (s) that occurred. (03 marks)

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14.

a) Draw the structures and name the shapes for the following species, identifying the oxidation state of the central atom. (06 marks)

Species	Structure	Name	Oxidation state
(i) SO_3^{2-}			
(ii) H_2S			
(iii) SO_4^{2-}			

b) Name the reagent which can be used to distinguish between the species in a (i) and a (iii) above. In each case state what would be observed if the reagent was treated separately with species. (03 marks)

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15. Methylbenzene undergoes electrophilic substitution reaction to form 4-Bromomethylbenzene or Phenylbromomethane depending on the conditions of the reaction.

a) State conditions under which methylbenzene reacts to form

i. 4-Bromomethylbenzene

(01 mark)

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ii. Phenylbromomethane

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b) Write equation and indicate mechanism for formation of 4-Bromomethylbenzene from Benzene. (03 marks)

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c) Without using equations, describe how Phenylbromomethane can be obtained from 1,2-dibromoethane. (04 marks)

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16.

- a) Beryllium, calcium and Barium are some of the elements in group (II) of periodic table. Briefly describe how the hydroxide of beryllium reacts with concentrated potassium hydroxide and hydrochloric acid

Potassium hydroxide

(02 marks)

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Hydrochloric acid

(02 marks)

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- b) The table shows the solubility of some group (II) hydroxides in water at 20°C.

Hydroxide	Be(OH) ₂	Ca(OH) ₂	Ba(OH) ₂
Solubility (g/100g at 20°C)	insoluble	0.15	40

- i. State and explain the trend in solubility of hydroxides of group (II) elements in the table above. (03 $\frac{1}{2}$ marks)

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- ii. 3.2g of calcium hydroxide and 4.0g of barium hydroxide were separately shaken with an equal volume of water at 25°C. With a reason, identify the solution of the hydroxide with a lower pH
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17. In an experiment to determine enthalpy of hydration of an ionic salt XSO_4 , 4.0g of the anhydrous salt was added to 50g of water and the temperature rose by 8.0°C. when 4.0g of the hydrated salt; $\text{XSO}_4 \cdot n\text{H}_2\text{O}$ was added to 50g of water, the temperature dropped from 25.0°C to 23.7°C. (Specific heat capacity of solution is 4.2J/g/°C).

a) Calculate the enthalpy of solution of;

- i. The anhydrous salt (02 marks)
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- ii. Hydrated $\text{XSO}_4 \cdot n\text{H}_2\text{O}$ (02 marks)
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[illegible]

KRISMASI NJEMA.

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THE PERIODIC TABLE

1	2											3	4	5	6	7	8
1 H 1.0																1 H 1.0	2 He 4.0
3 Li 6.9	4 Be 9.0											5 B 10.8	6 C 12.0	7 N 14.0	8 O 16.0	9 F 19.0	10 Ne 20.2
11 Na 23.0	12 Mg 24.3											13 Al 27.0	14 Si 28.1	15 P 31.0	16 S 32.1	17 Cl 35.4	18 Ar 40.0
19 K 39.1	20 Ca 40.1	21 Sc 45.0	22 Ti 47.9	23 V 50.9	24 Cr 52.0	25 Mn 54.9	26 Fe 55.8	27 Co 58.9	28 Ni 58.7	29 Cu 63.5	30 Zn 65.7	31 Ga 69.7	32 Ge 72.6	33 As 74.9	34 Se 79.0	35 Br 79.9	36 Kr 83.8
37 Rb 35.5	38 Sr 87.6	39 Y 88.9	40 Zr 91.2	41 Nb 92.9	42 Mo 95.9	43 Tc 98.9	44 Ru 101	45 Rh 103	46 Pd 106	47 Ag 108	48 Cd 112	49 In 115	50 Sn 119	51 Sb 122	52 Te 128	53 I 127	54 Xe 131
55 Cs 133	56 Ba 137	57 La 139	72 Hf 178	73 Ta 181	74 W 184	75 Re 186	76 Os 190	77 Ir 192	78 Pt 195	79 Au 197	80 Hg 201	81 Tl 204	82 Pb 207	83 Bi 209	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra (226)	89 Ac (227)															
			57 La 139	58 Ce 140	59 Pr 141	60 Nd 144	61 Pm (145)	62 Sm 152	63 Sm 150	64 Eu 152	65 Tb 159	66 Dy 162	67 Ho 165	68 Er 167	69 Tm 169	70 Yb 173	71 Lu 175
			89 Ac (227)	90 Th 232	91 Pa 231	92 U 238	93 Np 237	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cr 251	99 Es (254)	100 Fm (257)	101 Mv (256)	102 No (254)	103 Lw

1.  Indicates atomic number.
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2.  Indicates relative atomic mass.
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1.0