

P525/1  
Chemistry  
Paper 1  
August 2023  
2 hours 45 minutes

# UNNASE MOCK EXAMINATIONS

UGANDA ADVANCED CERTIFICATE OF EDUCATION

Chemistry

PAPER ONE

DURATION: 2 HOURS 45 minutes

Candidate's Name: .....Signature .....

## INSTRUCTIONS TO CANDIDATES

- Answer all questions in Section A and six questions in Section B.
- All your answers must be written in the spaces provided.
- The periodic table, with relative atomic masses, is attached at the end of the paper.
- Mathematical tables (3 - figure tables) are dequate or non-programmable scientific electronic calculators may be used.
- Where necessary, use the following:
  - Molar gas constant,  $R = 8.31 \text{ JK}^{-1} \text{ mol}^{-1}$ .
  - Molar volume of a gas at s.t.p is 22.4 litres.
  - Standard temperature = 273K.
  - Standard pressure =  $101325 \text{ NM}^{-2}$ .

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 from this Section

1. a) What is meant by the term colligative property. (01 mark)

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- b) Propane - 1,2,3 - triol,  $\text{HOCH}_2\text{CH}(\text{OH})\text{CH}_2\text{OH}$ , is used as an anti-freeze for water in car radiators. Calculate the freezing point of the solution when 1000g of propane - 1,2,3 - triol are dissolved in 5 litres of water. (Freezing point constant for water is  $1.86^\circ\text{C Kg}^{-1}\text{mol}^{-1}$  and density of water is  $1\text{gcm}^{-3}$ )

(3  $\frac{1}{2}$

marks)

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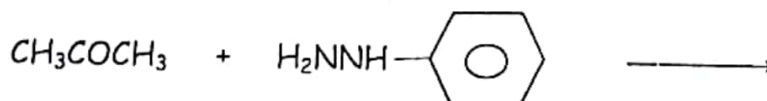
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2. Complete the equation below and write the mechanism for the reaction.

(04 marks)



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3. State what would be observed and write equation(s) for the reaction(s) that would take place when each of the following solutions is added drop-wise until in excess to chromium (III) sulphate solution.

a) Concentrated ammonia solution

(03 marks)

Observation

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Equation

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b) Sodium carbonate solution

(2½ marks)

Observation

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Equation

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4. The following reagents can be used to distinguish between members of classes of organic compounds; nitrous acid, and anhydrous zinc chloride and concentrated hydrochloric acid.

For each reagent state, the class of compounds and briefly describe what would be observed when the reagent is reacted with each member of the class.

(2½ marks)

a) nitrous acid

i) Class of compounds

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ii) Observations

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b) anhydrous zinc chloride and concentrated hydrochloric acid

i) Class of compounds

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ii) Observations

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5. a) Determine the oxidation state of sulphur in each of the following species;

i)  $S_2O_3^{2-}$  (01 mark)

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ii)  $S_4O_6^{2-}$  (01 mark)

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b) Write an equation for the reaction between  $S_2O_3^{2-}$  and:

i) Iodine

(1½ marks)

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ii) excess chlorine

(1½ marks)

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6. a) Write

i) equation for the hydrolysis of sodium ethanoate in water. (1½ marks)

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ii) the expression for the hydrolysis constant,  $K_h$  of sodium ethanoate.

(½ mark)

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b) 50cm<sup>3</sup> of a 0.02 ethanoic acid was added to an equal volume of a 0.02M sodium hydroxide solution. Calculate the PH of the solution.

( $K_h$  of ethanoic acid is  $1.8 \times 10^{-5} \text{ mol dm}^{-3}$ ,  $K_w = 1.0 \times 10^{-14} \text{ mol}^2 \text{ dm}^{-6}$ )

(05 marks)

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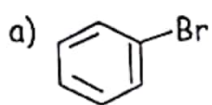
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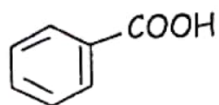
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7. write equations to show how the following compounds can be synthesized.



to



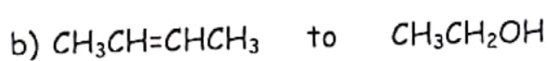
(2½ marks)

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(2½ marks)

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8. a) Although beryllium is an element in group (II) of the periodic table, it behaves differently from the other members of the group.

State three reasons why beryllium behaves differently from the other members.

(1½ marks)

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b) Write equation for the reaction between concentrated sodium hydroxides solution with

i) beryllium oxide

(1½ marks)

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ii) aluminium oxide

(1½ marks)

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9. The data in the table below was obtained for the reaction between propanone, A and Iodine solution.

Experiment	[A] (mol dm <sup>-3</sup> )	[I <sub>2</sub> ] (mol dm <sup>-3</sup> )	Initial rate (mol s <sup>-1</sup> )
1	0.10	0.10	1 × 10 <sup>-4</sup>
2	0.10	0.20	1 × 10 <sup>-4</sup>
3	0.30	0.10	3 × 10 <sup>-4</sup>

a) State the order of reaction with respect to A and Iodine (I<sub>2</sub>).

A. .... (½ mark)

Iodine (I<sub>2</sub>) .... (½ mark)

b) Give a reason for your answer in (a). (02 marks)

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c) Determine the overall order of the reaction.

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

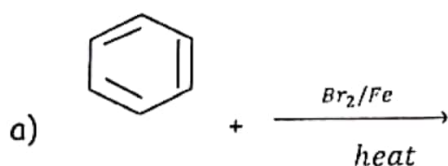
d) Calculate the value for the rate constant for the reaction and indicate its units.

( $1\frac{1}{2}$  marks)

### SECTION B (54 MARKS)

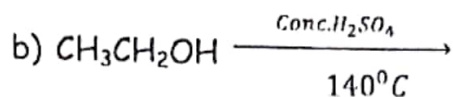
Answer six questions from this Section.

10. Complete the following equations and in each case, write the accepted mechanism.



(03 marks)





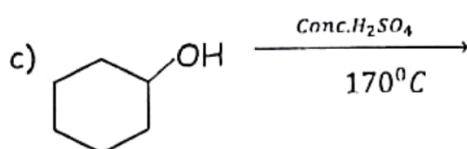
(2½ marks)

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(2½ marks)

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11. a) State:

i) what is meant by the term first electron affinity. (01 mark)

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ii) three factors which affect the magnitude of first electron affinity of an element. (1½ marks)

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b) The table below shows the atomic numbers and their electron affinities.

Element	Na	Mg	Al	Si	P	S	Cl
Atomic number	11	12	13	14	15	16	17
First electron affinity (KJ mol <sup>-1</sup> )	5.3	-0.6	4.3	13.4	4.8	20.0	34.9

i) Draw a graph of first electron affinity versus atomic number. (03 marks)

ii) Explain the shape of the graph. (3½ marks)

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12.a) Write the equation for the:

i) solubility of silver oxalate in water (1½ marks)

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ii) solubility constant, K<sub>sp</sub>, for silver oxalate. (01 mark)

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- .....
- b) The solubility of silver oxalate at  $25^{\circ}\text{C}$  is  $3.27 \times 10^{-2} \text{ g dm}^{-3}$ . Calculate the solubility constant for silver oxalate at  $25^{\circ}\text{C}$ . (03 marks)

- .....
- .....
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- c) Determine the molar concentration silver ions required to precipitate silver oxalate from an aqueous solution containing 0.005M oxalate ions. (02 marks)

- .....
- .....
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- .....
- .....
- d) A solution containing silver ions was added to a solution containing 0.005M, oxalate ions and 0.005M chloride ions. State which of the salts silver chloride or silver oxalate was precipitated first. Give a reason for your answer.

( $K_{\text{sp}}$  for  $\text{AgCl} = 1.96 \times 10^{-10} \text{ mol}^2 \text{ dm}^{-6}$ ). (1½ marks)

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13.a) State:

i) the common oxidation states of group (IV) elements of the periodic table.

(01 mark)

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ii) how the stability of the oxidation states of the elements vary down the group (illustrate your answer with chlorides of carbon and lead)

(03 marks)

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b) Explain your answer in (a)(ii).

(2½ marks)

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c) A sample of lead (IV) oxide was treated with warm concentrated hydrochloric acid.

i) State what was observed. (01 mark)

ii) Write equation for the reaction that took place. (1½ marks)

14. The electrode potentials of some half-cells are shown below.

		<u>E°/volts</u>
A	$Zn_{(aq)}^{2+} + 2e \rightleftharpoons Zn_{(s)}$	-0.76
B	$MnO_4^{-}(aq) + 8H^{+}(aq) + 5e \rightleftharpoons Mn_{(aq)}^{2+} + 4H_2O_{(l)}$	+1.52
C	$MnO_4^{-}(aq) + e \rightleftharpoons MnO_4^{2-}(aq)$	+0.56
D	$Cu_{(aq)}^{2+} + 2e \rightleftharpoons Cu_{(s)}$	+0.34
E	$MnO_4^{2-}(aq) + 4H^{+}(aq) + 2e \rightleftharpoons MnO_{2(s)} + 2H_2O_{(l)}$	+2.26

a) Giving reasons, name the species that is the strongest:

i) reducing agent (01 mark)

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ii) oxidising agent

(01 mark)

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b) i) Write the cell convention for the cell made by combining the electrodes of the half-cell reactions A and B. (01 mark)

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ii) Write equation for the overall cell reaction.

(1½ mark)

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iii) Determine the e.m.f of the cell.

(01 mark)

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iv) State whether the reaction in (ii) is possible or not. Give a reason for your answer. (01 mark)



c) Carbondioxide was bubbled through a solution containing manganate (VI) ions.

i) State what was observed. (1½ marks)

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ii) Write equation for the reaction that took place. (1½ marks)

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15.a) An organic compound Q contains Carbon 80%, Hydrogen 6.7% the rest being oxygen. Calculate the empirical formula of Q. (02 marks)

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b) 0.25g when vapourised at 150°C and 760mmHg occupies 122.3cm<sup>3</sup>. Determine the molecular formula of Q. (03 marks)

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- c) Q burns with a yellow sooty flame, forms a yellow-orange solid with Brady's reagent and reacts with a solution of iodine in sodium hydroxide to form a pale yellow solid.

Write the structural formula of Q. (01 mark)

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- d) Write equation for the reaction between Q and sodium hydrogen sulphite. (01 mark)

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- e) Show how Q can be synthesized from an alkene. (02 marks)

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16. State what would be observed and write equation for the reaction that would take place when

- a) Sulphur dioxide gas is bubbled through an acidified solution of potassium

dichromate (VI).

(2  $\frac{1}{2}$  marks)

Observation

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Equation

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b) Dilute hydrochloric acid is added to a solution of sodium thiosulphate.

(02 marks)

Observation

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Equation

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c) A mixture of propanal and ammoniacal silver nitrate solution warmed.

(02 marks)

Observation

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Equation

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d) Aqueous solution of ethanol is warmed with an aqueous solution of iodine

and sodium hydroxide.

(02 marks)

Observation

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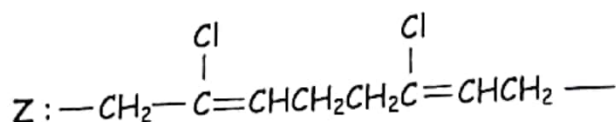
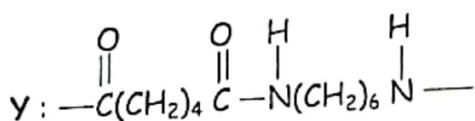
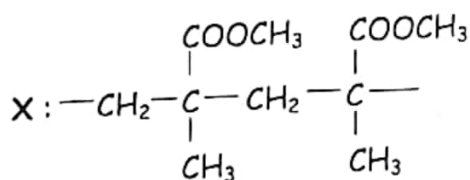
Equation

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17.a) Distinguish between addition and condensation polymerisation. (02 marks)

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b) The structural formulae of polymers X, Y and Z are shown below.



In the table below, write the structural formula(e) of the monomer(s), name(s) of the monomer(s) and type of polymerisation.  
(7½ marks)

	Structural formula(e) of monomer(s)	Name of monomer(s)	Type of polymerisation
X			
Y			
Z			

c) Give one use of:

(1½ marks)

X. ....

Y.

Z.

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 35.5	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 65.4
						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 85.5	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 101	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	58 Ce 140	59 Pr 141	60 Nd 144	61 Pm (145)	62 Sm 152
						63 Eu 152	64 Gd 157
						65 Tb 159	66 Dy 162
						67 Ho 165	68 Er 167
						69 Tm 169	70 Yb 173
						71 Lu 175	
87 Fr (223)	88 Ra (226)	89 Ac (227)					
			89 La 139	90 Ce 140	91 Pr 141	92 Nd 144	93 Pm (145)
			94 Ce 140	95 Pr 141	96 Nd 144	97 Pm (145)	98 Sm 152
			99 Eu 152	100 Gd 157	101 Tb 159	102 Dy 162	103 Ho 165
			104 Er 167	105 Tm 169	106 Yb 173	107 Lu 175	
			108 La 139	109 Ce 140	110 Pr 141	111 Nd 144	112 Pm (145)
			113 Sm 152	114 Eu 152	115 Gd 157	116 Tb 159	117 Dy 162
			118 Ho 165	119 Er 167	120 Tm 169	121 Yb 173	122 Lu 175

1.  $\frac{I}{II}$  - Indicates Atomic number.2.  $\frac{H}{1.0}$  - Indicates relative Atomic number.

END.

END