

Candidates Name:

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Signature:

Centre No.					Personal No.		

P525/1

CHEMISTRY

PAPER 1

JULY/AUGUST 2022

2 ¾ Hours



TORORO ARCHDIOCESE EXAMINATIONS BOARD

Uganda Advanced Certificate of Education

MOCK EXAMINATIONS – AUGUST 2022

CHEMISTRY

Paper 1

3 hours 45 minutes

INSTRUCTIONS TO CANDIDATES

Answer *all* questions in Section A and only *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 (3 – figure tables) and non-programmable scientific electronic calculators may be used.

Molar gas constant, $R = 8.314 \text{ JK}^{-1} \text{ mol}^{-1}$

Molar volume of gas at s.t.p is 22.4 dm^3

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

Turnover

SECTION A: (46 MARKS)

Answer **all** questions from this section.

1. (a) Define:

(i) Bond energy.

(1 mark)

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(ii) Heat of formation.

(1 mark)

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(b) Given the following bond energies.

Bond	Bond Energy (Kj/mole)
C—C	337
C—H	414
C—O	360
O—H	123

Calculate the heat of conversion of gaseous methoxymethane to gaseous ethanol.

(2 marks)

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2. (a) An alkyne **Q** has molecular formula C_4H_6 . Write the names and structural formulae of all possible isomers of **Q**.

(2 marks)

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(b) **Q** reacts with an ammoniacal solution of silver nitrate.

(i) State what is observed.

(½ marks)

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(ii) Write the equation for the reaction in b (i) above.

(1 ½ marks)

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(c) Write equations to show how **Q** can be synthesized from ethane. (4 marks)

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3. (a) Explain briefly why chlorine is a stronger oxidizing agent than bromine. (2 marks)

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(b) Write equation (s) for the reactions of:

(i) Bromine with cold dilute sodium hydroxide.

(1 ½ marks)

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(ii) Chlorine with hot concentrated sodium hydroxide.

(1 ½ marks)

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4. The standard electrode potentials for some half-cell reactions are given below.

Half-cell reaction	E^0/V
$\text{MnO}_4^- (\text{aq}) + e \longrightarrow \text{MnO}_4^{2-} (\text{aq})$	+0.56
$\text{MnO}_4^{2-} (\text{aq}) + 2\text{H}_2\text{O} (\text{l}) + 2e \longrightarrow \text{MnO}_2 (\text{s}) + 4\text{OH}^- (\text{aq})$	+0.60
$\text{MnO}_4^- (\text{aq}) + 8\text{H}^+ (\text{aq}) + 5e \longrightarrow \text{Mn}^{2+} (\text{aq}) + 4\text{H}_2\text{O} (\text{l})$	+1.52
$\text{Br}_2 (\text{aq}) + 2e \longrightarrow 2\text{Br}^- (\text{aq})$	-1.06

(a) Write the:

- (i) Cell convention of the cell formed when bromine half-cell is combined with the half-cell of acidified potassium manganate (VII). (1 mark)

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- (ii) Overall cell reaction in a (i). (1 ½ marks)

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- (b) Calculate the electromotive force of the cell in (a). (1 ½ marks)

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- (c) State whether the reaction in (b) above is feasible or not. Give a reason for your answer. (1 marks)

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- (d) State what would happen when a solution of potassium manganate (VI) is exposed to air and write equation for the reaction that took place. (2 marks)

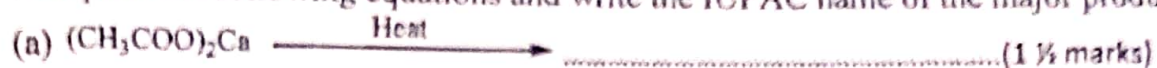
Observation

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Equation

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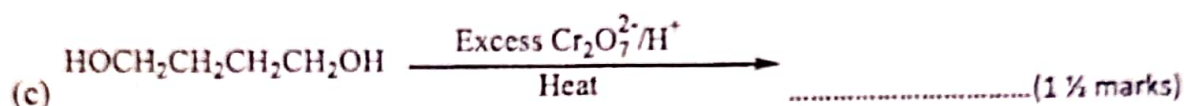
5. Complete the following equations and write the IUPAC name of the major product.



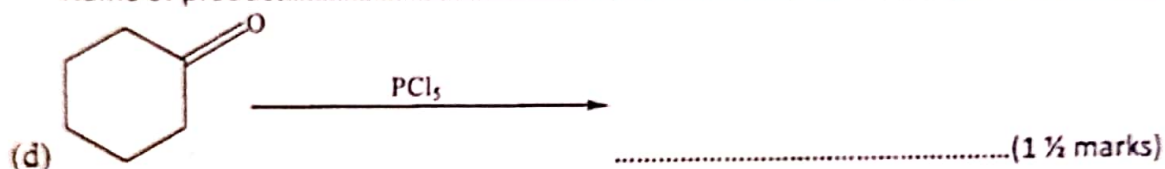
Name of product.....



Name of product.....



Name of product.....



Name of product.....

6. (a) Write the:

(i) Equation for the ionization of ethylamine in water. (1 ½ marks)

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(ii) Expression for the ionization constant, K_b , of ethylamine. (1 mark)

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(b) A solution containing 0.1 moles of ethylamine per litre of solution at 25°C.

(i) Calculate the pH of the solution.

(the ionization constant of ethylamine is $5.4 \times 10^{-4} \text{ mol dm}^{-3}$ at 25°C, $K_w = 1.0 \times 10^{-14} \text{ mol}^2 \text{ dm}^{-3}$) (2 ½ marks)

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(ii) State the assumptions made in b (i) above. (1 mark)

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7. (a) State what would be observed and write equation for the reaction that would take place if potassium iodide was added to acidified potassium dichromate (VI) solution.

Observation (1marks)

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Equation (1 ½ marks)

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(b) Sodium thiosulphate solution was added to the mixture in (a), state what was observed and write equation for the reaction that took place.

Observation (1 mark)

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Equation (1 ½ marks)

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8. (a) Define a 'complex ion'

(1 mark)

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(b) Complete the following table about complexes of chromium and cobalt. (2 marks)

Complex	Oxidation state of metal ion	Coordination number
$[\text{Co}(\text{NH}_3)_4(\text{H}_2\text{O})_2]\text{Cl}_2$		
$[\text{Cr}(\text{NH}_3)_6]^{3+}$		

9. Name the reagent that can be used to distinguish between the following pairs of compounds. In each case state what you would observe when the reagent is treated with each member of the pair.

(a) $\text{CH}_3\text{CH}_2\text{OH}$ and CH_3OH (2 marks)

Reagent

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Observation

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(b) HCOOH and CH_3COOH (2 marks)

Reagent

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Observation

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SECTION B: (54 MARKS)

Answer any six questions from this section.

*Any additional question(s) answered will **not** be marked.*

10. An organic compound T consists of 48.6% carbon, 8.1% hydrogen and the rest oxygen.

(a) Determine the empirical formula of T. (2 ½ marks)

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(b) 0.453g of a vaporized sample of T occupied 200cm³ at 100°C and 95.0kPa pressure.

(i) Calculate the molecular mass of T. (2 ½ marks)

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(ii) Determine the molecular formula of T. (1 ½ marks)

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(c) T reacts with magnesium metal with evolution of a gas. Write:

(i) The structural formula of T.

(1 mark)

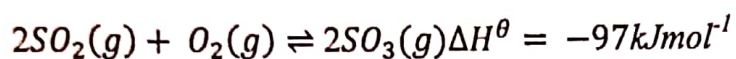
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(ii) The equation for the reaction between T and magnesium metal.

(1 ½ marks)

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11. During manufacture of sulphuric acid by contact process, Sulphur dioxide is catalytically oxidized to Sulphur trioxide according to the following equation:



(a) Name one source of dioxide and one source of oxygen used in the contact process.

(1 mark)

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(b) State the industrial conditions used to obtain the maximum yield of Sulphur dioxide.

(1 ½ marks)

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(c) State the conditions under which sulphuric acid reacts with tin and copper and in each case write equation for the reaction that takes place.

(i) Tin

(2 marks)

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(ii) Copper

(2 marks)

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(d) Concentrated sulphuric acid is 98% w/w and has a density of 1.84gcm^{-3} . Calculate the molarity of the concentrated sulphuric acid. (2 ½ marks)

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12. (a) State three properties exhibited by chromium as a transition metal. (3 marks)

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(c) An aqueous solution of iron (II) salt was added to an acidified solution of chromium in the oxidation state of +6.

(i) State what was observed.

(1 mark)

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(ii) Write half equations and the overall equation for the reaction that took place. (3 ½ marks)

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- (d) (i) State one application of chromium in the oxidation state of +6 in organic synthesis. (½ mark)

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- (iii) Write the equation to illustrate your answer. (1 mark)

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13. (a) What is meant by the term **common ion effect**? (2 marks)

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- (b) Magnesium hydroxide is sparingly soluble in water.

Write:

- (i) The equation for the solubility of magnesium hydroxide in water. (1 ½ marks)

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- (ii) The expression for the solubility product, K_{sp} , of magnesium hydroxide.

(1 mark)

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- (d) If the solubility product of magnesium hydroxide at 25°C is $4.2 \times 10^{-12} \text{ mol}^3 \text{ dm}^{-9}$. Calculate the solubility in mole per litre at 25°C of magnesium hydroxide in:

- (i) Water (1 ½ marks)

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(ii) 0.01M sodium hydroxide.

(2 marks)

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(iii) Comment on your answer in (c) above.

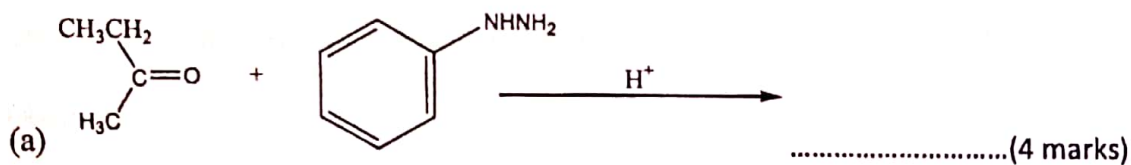
(1 mark)

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14. Complete each of the following equations and write a mechanism for the reaction in each case.



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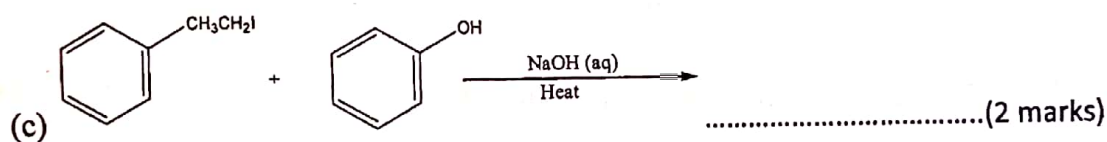
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15. (a) Define

(i) Conductivity

(1 mark)

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(ii) Molar conductivity

(1 mark)

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(b) The electrolytic conductivity of a 0.1M ethanoic acid at 20°C is $1.96 \times 10^{-2} \text{ Sm}^{-1}$. Its molar conductivity at infinite dilution is $3.52 \times 10^{-2} \text{ Sm}^2\text{mol}^{-1}$.

Calculate:

(i) The molar conductivity of ethanoic acid at 20°C.

(2 marks)

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(ii) The degree of ionization of the acid at 20°C.

(1 mark)

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(iii) The pH of the acid

(2 marks)

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(d) State two other factors other than concentration that can affect the pH of the acid.
(2 marks)

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16. (a) Compare the thermal stabilities of silicon (IV) chloride and tin (IV) chloride.
[Include equations of reactions if any]. (2 marks)

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- (b) State conditions of reaction between tin and chlorine and write equation of the reaction that took place. (2 ½ marks)

Condition

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Equation

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- (c) Silicon (IV) chloride was dissolved in water.

- (i) State what was observed. (1 mark)

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- (ii) Write equation for the reaction that took place. (1 ½ marks)

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- (e) When 0.325g of silicon (IV) chloride was dissolved in water, the resultant solution required 48 cm³ of 0.1 M sodium hydroxide for complete neutralization. Calculate the percentage purity of silicon (IV) chloride. (2 marks)

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17. Write equations and indicate the conditions under which the following conversions can be effected.

(a) $\text{CH}_3\text{CH}_2\text{OH}$ from bromomethane (2 ½ marks)

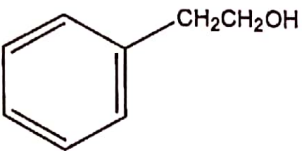
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(b)  from phenylethanone (4 ½ marks)

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(c) $\text{CH}_3\text{CH}_2\text{CH}_3$ from 1-iodobutane (2 marks)

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END

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 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 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 Eu 152	64 Gd 157	65 Tb 159	66 Dy 163	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 Cf 251	99 Es (254)	100 Fm (257)	101 Md (256)	102 No (254)	103 Lw

1. $\frac{1}{H}$ - indicates Atomic number.
2. $\frac{H}{1.0}$ - indicates relative Atomic number.