

NAME: SIGNATURE:

P525/1
Chemistry
July/August, 2024
2 ¼ hours



WENSSEC

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 supplied.

Mathematical tables (3-figure tables) are adequate or non-programmable scientific electronic calculators may be used

Illustrate your answers with equations where applicable.

Where necessary, use the following:

- Molar gas constant $R = 8.314 \text{ JK}^{-1}\text{mol}^{-1}$
- Molar volume of a gas at s.t.p is 22.4 litres.
- Standard temperature = 273 K
- Standard pressure = 101325 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

WENSSEC 2024

SECTION A (46 Marks)

1. (a) What is meant by the term freezing point constant of a solution? (01 marks)

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- (b) A solution containing 25.6g of sulphur dissolved in 1000g of naphthalene gave a freezing point lowering of 0.680°C . (*the freezing point and freezing point constant of Sulphur are 80.1°C and $6.8^{\circ}\text{Cmol}^{-1}\text{Kg}^{-1}$ respectively*)

- (i) Determine the molecular formula of sulphur in naphthalene. (02 marks)

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- (ii) Write down the structural formula of the Sulphur in b) (i) above. (01 mark)

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- (c) State any two assumptions made in determining the molecular formula of Sulphur using this method. (01 mark)

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2. Name the following complex ions and in each case state the coordination number and oxidation state of the central metal atom. (06 marks)

Complex ion	Name	Oxidation state	Co-ordination number
$Ag(NH_3)_2^+$			
$Fe(OH)_2(H_2O)_4^+$			
$CoCl_42-$			

3. (a) Distinguish between soap and soapless detergent. (02 marks)

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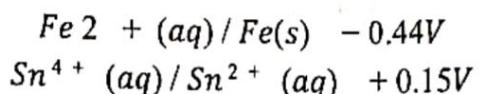
- (b) Using equations only, describe how an alkylbenzene sulphonate can be prepared from benzene. (1½ marks)

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- (c) Briefly explain the cleansing action of a soapless detergent. (02 marks)

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4. The standard electrode potential for some half cells are shown below:



- (a) Write the cell notation. (01 mark)

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- (b) Calculate the emf for the cell. (2½ marks)

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5. The table below shows the boiling points of some of the chlorides of Period 3 elements.

Elements	Mg	Al	Si	P	S
Boiling point of the chlorides/°C	1418	180	57	76	136
Formula of the chlorides					

- (a) Write the formula of each of the chlorides in the space provided. (02 marks)

- (b) State and explain the trend of the melting points of the chlorides above. (03 marks)

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6. Explain the following observations.

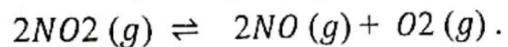
- (a) the basic strength of ammonia, methylamine and ethylamine is in the order
ammonia < methylamine < ethylamine. (03 marks)

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- (b) Iron (III) chloride is strongly attracted in magnetic field than Zinc (II) chloride.
(02 marks)

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7. At 1000K, a sample of pure nitrogen dioxide gas decomposes as;



- (a) Write an expression for the equilibrium constant, k_p . (01 mark)

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- (b) The equilibrium constant, k_p is 156.25 atm. Analysis shows that the partial pressure of oxygen is 0.25 atm at equilibrium. What is the partial pressure of nitrogen dioxide gas at equilibrium? (03 marks)

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8. (a) What is meant by the term "an ore". (01 marks)

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(b) Describe using equations only, describe how pure copper can be extracted from copper pyrites. (04 marks)

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9. Write equations to show how the following compounds can be synthesized. Indicate the reagent and conditions for the reactions.

(a) $\begin{array}{c} \text{OH} \\ | \\ (\text{CH}_3)_2\text{CHSO}_3^- \text{Na}^+ \end{array}$ from ethane (03 marks)

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(b) Nitrobenzene to benzoic acid (2½ marks)

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SECTION B (54 Marks)

10. (a) State what is meant by the term buffer solution. (02 marks)

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(b) Describe how you would prepare a buffer solution of pH 5 using ethanoic acid. (k_a for ethanoic acid is $1.85 \times 10^{-5} \text{ mol dm}^{-3}$) (3½ marks)

- b) A solution made by adding 4.1g of sodium ethanoate to 1.0dm³ of 0.035M ethanoic acid has a pH 4.91. Calculate the change in pH of the resultant solution if 1.2cm³ of 1.0 M sodium hydroxide solution was added to the resultant solution in (a) above. (2½ marks)

- c) State one biological application of a buffer solution. (01 mark)

1. When 0.236g of organic compound *S* on combustion gave 0.528g of carbon dioxide and 0.324g of water and the rest being nitrogen gas. If the same mass of *S* at 16°C and 2.12 atmospheres gave 44.8cm³ of nitrogen gas;

(a) Calculate;

(i) the simplest formula of *S* (2½ marks)

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(ii) the molecular formula of *S* (03 marks)

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(b) Write down all the possible isomers of substance *S*. (1½ marks)

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(c) *S* forms a yellow oily film when treated with a mixture of sodium nitrite and concentrated hydrochloric acid at 0°C.

(i) Identify *S*. (½ marks)

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(ii) Write an equation for the reaction between *S* and the above named reagent. (1½ marks)

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12. (a) The melting point of 4-nitrophenol is much higher than that of 2-nitrophenol.

The two compounds can be separated by steam distillation.

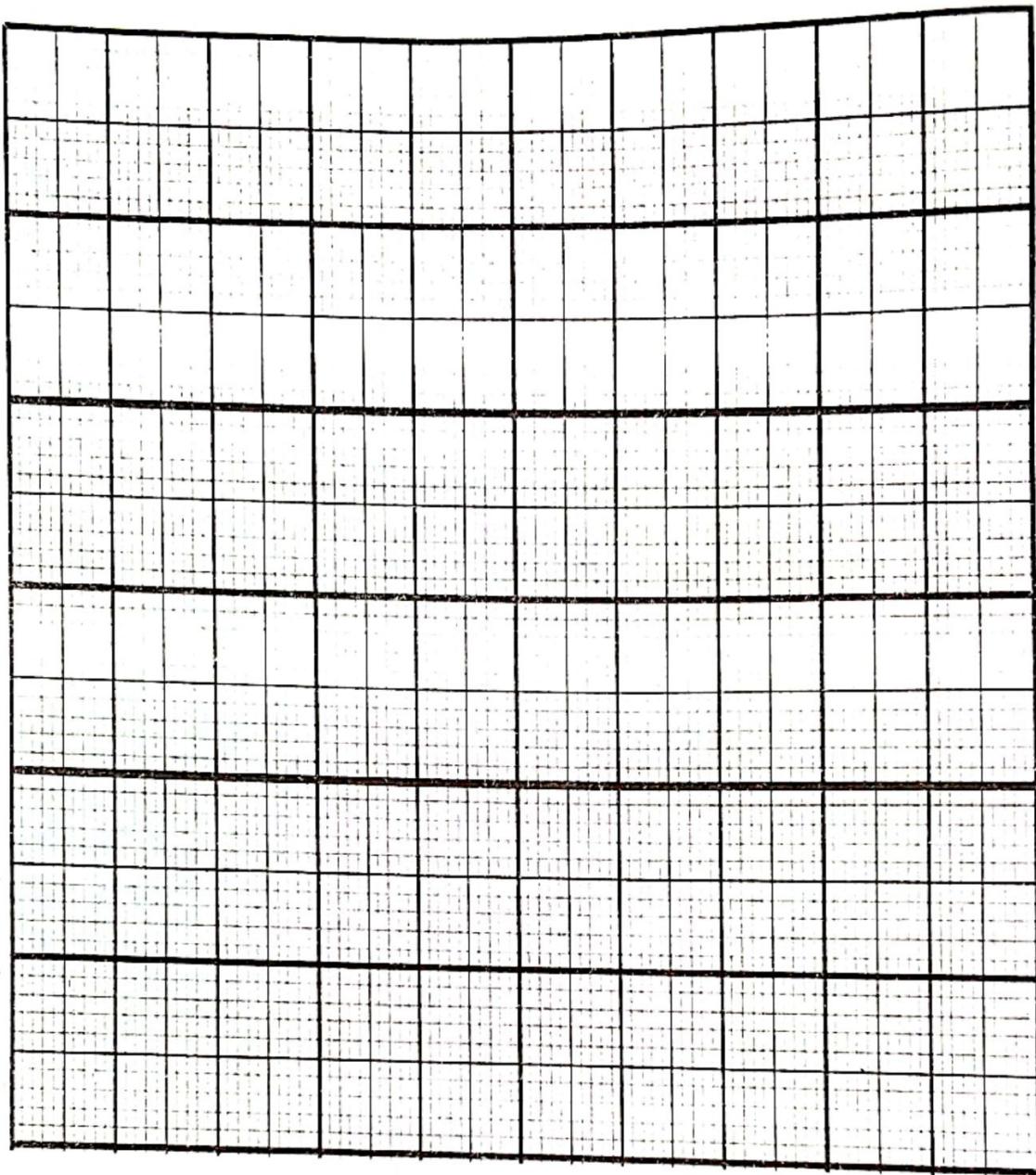
- (i) Explain why the melting point of 4-nitrophenol is higher than that of 2-nitrophenol. (01 mark)

- (ii) Explain the principles of steam distillation. (1½ marks)

(b) Aminobenzene and water are immiscible liquids. The saturated vapour pressures of pure water and pure aminobenzene at various temperatures are given in the table below.

Temperature (°C)	85	90	95	100	105
Vapour pressure of aminobenzene	3.0	4.0	5.0	6.0	7.0
Vapour pressure of pure water (mmHg)	58	70	84.6	101. 3	120. 7
Vapour pressure of mixture (mmHg)					

- (i) Plot on the same axes, graphs of vapour pressure of aminobenzene, water and the mixture against temperature. (3½ marks)



- (ii) Using the graphs, determine the boiling point of the mixture of aminobenzene and water at atmospheric pressure. (01 mark)
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- (iii) Calculate the percentage by mass of aminobenzene in the distillate if the mixture was steam distilled. (02 marks)
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13. Name a reagent which can be used to distinguish between the following pairs of compounds and in each case state what would be observed if each compound is separately treated with reagent.

(a) Methanol and ethanal.

(03 marks) Reagent:

Observation:

(b) Ethanoate ion and phosphate ion

(03 marks) Reagent:

Observation:

(c) Nickel (II) ion and Cobalt (II) ion

(03 marks)

Reagent:

Observation:

14. Although Lithium is in Group I of the Periodic table, it resembles elements of Group II in particular Magnesium in some of its properties.

(a) (i) With equation, explain any two properties in which Lithium and Magnesium are similar. (04 marks)

(ii) Give reason(s): 12 ~~ir~~ similarity in their chemical properties. (01 mark)

(iii) Name one other pair of elements that shows similarity like Lithium and

Magnesium (01 mark)

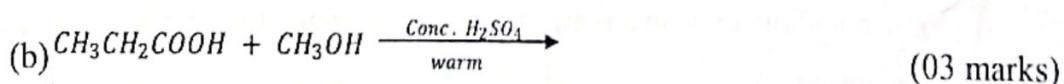
(b) Write equations

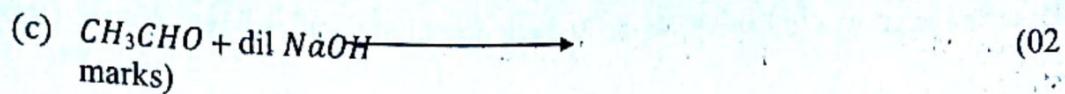
(i) to show how magnesium chloride can be synthesized. (1½ marks)

(ii) for the reaction that takes place when hydrated magnesium chloride,

$MgCl_2 \cdot 6H_2O$ is gently heated. (1½ marks)

Complete the following equations and suggest a mechanism for it.





16. (a) Explain what is meant by the term *ideal solution*. (02 marks)

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(b) At standard atmospheric pressure, hydrochloric acid and water form a constant boiling point mixture having a boiling point of $110^\circ C$ and composition 20% by mass of hydrochloric acid.

(i) Define the term constant boiling mixture. (01 mark)

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(ii) Sketch a labeled diagram of the boiling point composition for hydrochloric acid and water system. (02 marks)

(The boiling points of water and hydrochloric acid are $100^\circ C$ and $85^\circ C$ respectively)

- (c) Describe what would happen when 10% hydrochloric acid is fractionally distilled. (2½ marks)

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- (d) A constant boiling mixture of hydrochloric acid and water has a density of 1.18gcm^{-3} . Calculate the volume of this acid required to prepare 2litres of 2M hydrochloric acid solution. (1½ marks)

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17. (a) Distinguish between a transition element and a d – block element. (01 mark)

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- (b) State properties in which zinc differs from nickel. (1½ marks)

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- (c) When ammonium dichromate was strongly heated, a green solid R was formed. Write an equation for the reaction that took place. (1½ marks)

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(d) Solid R was heated with sodium hydroxide in contact with air.

(i) State what was observed.

(0½ mark)

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

(1½ marks)

(e) The compound in d) above when treated with water and hydrogen peroxide solution gives a yellow solution which turned orange when acidified with dilute sulphuric acid; Write an ionic equation for the reaction leading to the formation of the orange colour. (03 marks)

PERIODIC TABLE

1	2					3	4	5	6	7	8
1						1	2				
H						H	He				
1.0						1.0	4.0				
3	4										
Li	Be										
6.9	9.0										
11	12										
N ₂	Mg										
23.0	24.3										
19	20	21	22	23	24	25	26	27	28	29	30
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn
39.1	40.1	45.0	47.9	50.9	52.0	54.9	55.9	58.9	58.7	63.5	65.
37	38	39	40	41	42	43	44	45	46	47	48
Rb	Sr	T	Zr	Nb	Mo	Tc	Ru	Rb	Pd	Ag	Cd
85.5	87.6	88.9	91.2	92.9	95.9	98.9	101	103	103	108	112
55	56	57	58	59	74	75	76	77	78	79	80
Cs	Ba	La	Hf	Ta	W	Re	Ds	Ir	Pr	Au	Hg
133	137	139	176	181	184	186	190	192	195	197	201
57	83	89									
Fr	Ra	Ac	(223)	(226)	(227)						
57	58	59	60	61	62	63	64	65	66	67	68
La	Ce	Ff	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er
139	140	141	144	(145)	150	152	157	159	162	165	167
89	90	91	92	93	94	95	96	97	98	99	100
Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Ea	Fm
(227)	132	131	238	137	(244)	(243)	(247)	(247)	251	(254)	(257)