

Candidate's Name:

Signature:

Random No.					Personal No.		

(Do not write your School/Centre Name or Number anywhere on this booklet.)

P525/1
CHEMISTRY
Paper 1
Nov./Dec. 2018
2¾ hours



UGANDA NATIONAL EXAMINATIONS BOARD

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 (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, $R = 8.31 \text{ JK}^{-1} \text{ mol}^{-1}$.

Molar volume of gas at s.t.p. is 22.4 litres.

Standard temperature = 273 K.

Standard pressure = 101325 Nm^{-2} .

For Examiners' 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. Various concentrations of X and Y were reacted at a constant temperature. The table below shows the initial concentrations of X and Y and their initial rates for the reaction.

Experiment	[X] (mol dm ⁻³)	[Y] (mol dm ⁻³)	Initial rate (mol s ⁻¹)
1	0.2	0.2	3.5×10^{-4}
2	0.4	0.4	1.4×10^{-3}
3	0.8	0.4	5.6×10^{-3}

- (a) State the order of reaction with respect to X and Y.
- (i) X ($\frac{1}{2}$ mark)
- (ii) Y ($\frac{1}{2}$ mark)

- (b) Give reasons for your answers in (a). (02 marks)

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- (c) Determine the overall order of the reaction. ($\frac{1}{2}$ mark)

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- (d) Calculate the value for the rate constant for the reaction. (1½ marks)

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2. (a) A solid Q contains 9.37% by mass of magnesium, 10.39% nitrogen and 42.18% water.

- (i) Calculate the empirical formula of Q. (02 marks)

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- (i) Determine the molecular formula of **Q**. (01 mark)
(RFM of **Q** = 256)

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- (b) Solution of **Q** reacts with iron(II) sulphate in the presence of concentrated sulphuric acid to form a brown ring. Identify **Q**. (½ mark)

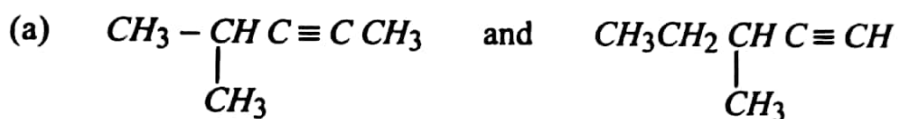
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- (c) Write equation for the reaction that would take place if **Q** was heated. (1½ marks)

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3. Name a reagent that can be used to distinguish between the following pairs of compounds.

In each case, state what would be observed if each member of the pair was treated with the reagent you have named.



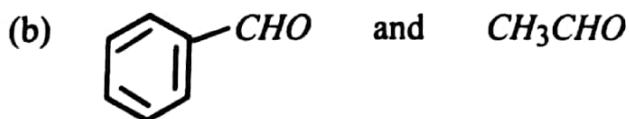
Reagent (01 mark)

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Observation (02 marks)

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Reagent (01 mark)

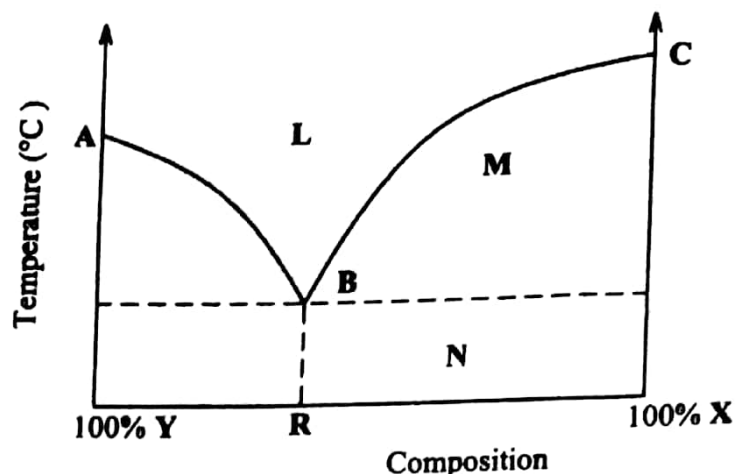
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Observation (02 marks)

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4. The temperature – composition diagram for a system containing two components **X** and **Y** is shown below.



- (a) State what the following represents;

- (i) Regions: **L** ($\frac{1}{2}$ mark)
M ($\frac{1}{2}$ mark)
N ($\frac{1}{2}$ mark)
- (ii) Points: **A** ($\frac{1}{2}$ mark)
B ($\frac{1}{2}$ mark)
C ($\frac{1}{2}$ mark)
- (iii) Curves: **AB** ($\frac{1}{2}$ mark)
BC ($\frac{1}{2}$ mark)

- (b) State what would happen when a mixture of composition **R** is heated. ($\frac{1}{2}$ mark)

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5. Write equation for the reaction between aqueous sodium hydroxide and

- (a) chromium(III) oxide. ($1\frac{1}{2}$ marks)

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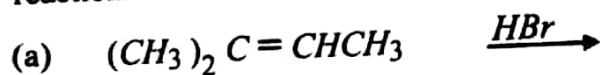
- (b) beryllium oxide. ($1\frac{1}{2}$ marks)

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- (c) tin(II) oxide. ($1\frac{1}{2}$ marks)

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6. Complete the following equations and in each case, write a mechanism for the reaction.



(2½ marks)

Mechanism:

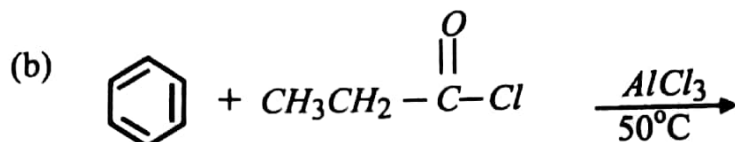
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(2½ marks)

Mechanism:

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7. When a current of 0.65 A was passed through copper(II) sulphate solution using platinum electrodes for 35 minutes, 0.0143 g of hydrogen and 0.113 g of oxygen were evolved.

- (a) Write equation for the reaction that took place at the

(i) anode.

(01 mark)

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(ii) cathode.

(01 mark)

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- (b) Determine the quantity of electricity required to evolve 1 mole of gas at each electrode.

(i) At the anode.

(02 marks)

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(ii) At the cathode.

(01 mark)

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

(a) excess concentrated hydrochloric acid was added to lead(II) oxide. (2½ marks)

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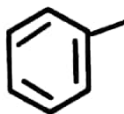
(b) potassium iodide was added to copper(II) sulphate solution. (2½ marks)

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9. Write equation in each case to show how the following conversions can be effected:

(a)  CH_2OH from benzene. (2½ marks)

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(b) CH_3CONH_2 from chloroethane. (2½ marks)

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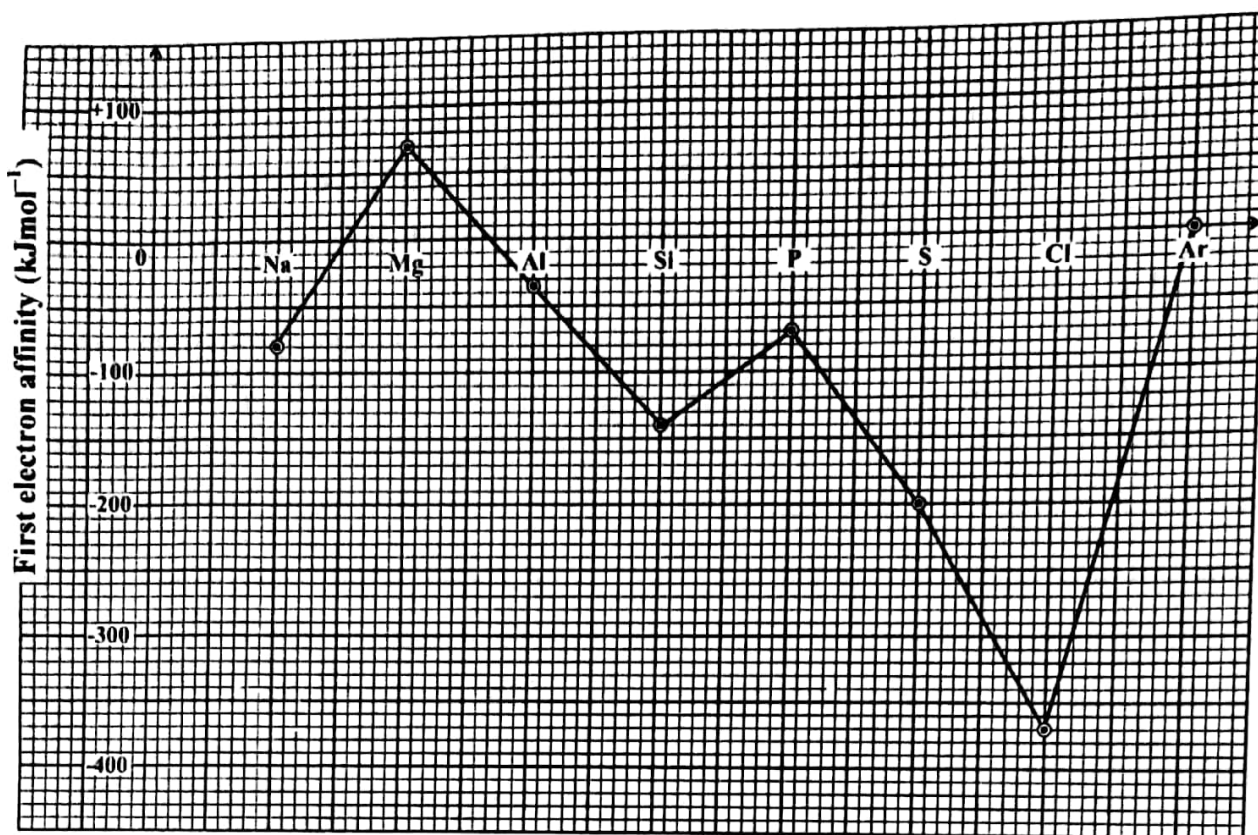
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SECTION B: (54 MARKS)

Answer any six questions from this section.

10. The figure below shows the variation of the first electron affinity of the elements in Period 3 of the Periodic Table.



Explain each of the following observations:

- (i) There is a general increase in the first electron affinity from sodium to argon. (1½ marks)

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- (ii) The first electron affinity of magnesium is higher than that of aluminium. (04 marks)

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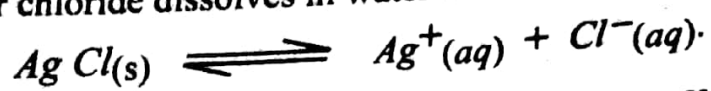
- (iii) The first electron affinity of phosphorous is less than that of sulphur. (3½ marks)

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11. (a) Silver chloride dissolves in water according to the following equation.



Write the expression for the solubility product, K_{sp} of silver chloride.

..... (01 mark)

- (b) The electrolytic conductivity of a saturated solution of silver chloride in water at 25°C is $3.41 \times 10^{-6} \Omega^{-1} \text{cm}^{-1}$ and that of pure water is $1.6 \times 10^{-6} \Omega^{-1} \text{cm}^{-1}$. Calculate the solubility product of a saturated solution of silver chloride at 25°C .

(The molar conductivities at infinite dilution of silver nitrate, potassium nitrate and potassium chloride are 133.4 , 145.0 and $149.9 \Omega^{-1} \text{cm}^2 \text{mol}^{-1}$ respectively at 25°C). (4½ marks)

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- (c) Ammonia solution was added to a solution containing silver chloride.

(i) State how the solubility of silver chloride was affected.

(01 mark)

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(ii) Explain your answer in (c)(i) above.

(2½ marks)

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12. Compound T, C_3H_6O reacts with 2, 4- dinitrophenylhydrazine to form a yellow precipitate.

(a) Write the names and the structural formulae of all possible isomers of T. (03 marks)

(b) T reacts with ammoniacal silver nitrate solution to form silver. Identify T. (01 mark)

(c) Write equation and indicate a mechanism for the reaction between T and 2, 4- dinitrophenylhydrazine under acidic condition. (05 marks)

13. Manganese is a *d*-block element in the Periodic Table.

(a) Define the term *d*-block element. (01 mark)

(b) (i) Write the electronic configuration of manganese. ($\frac{1}{2}$ mark)

(ii) State the common oxidation states exhibited by manganese in its compounds. ($1\frac{1}{2}$ marks)

(iii) Write the formulae of oxides of manganese in each of the oxidation states you have stated in (b)(ii). ($1\frac{1}{2}$ marks)

- (c) A black oxide, Y of manganese was fused with a mixture of potassium hydroxide and potassium nitrate to give a compound which when treated with water gave a green solution.

The green solution turned purple when acidified with sulphuric acid.
Identify:

- (i) Y (01 mark)
- (ii) the ion that gives the green solution its colour. (01 mark)
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- (iii) the ion that gives the purple solution its colour. (01 mark)
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- (d) Write ionic equation for the reaction leading to the formation of the purple solution. (1½ marks)
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14. (a) (i) Sketch a graph to show the pH change when hydrochloric acid is titrated with ammonia solution. (1½ marks)

(ii) Explain the shape of your sketch graph in (a)(i). (3½ marks)

(b) Calculate the pH of a resultant solution formed when 10 cm³ of a 0.1M sodium hydroxide solution is added to 25 cm³ of a 0.1M ethanoic acid at 25 °C.

(Dissociation constant of ethanoic acid at 25 °C = $1.8 \times 10^{-5} \text{ mol dm}^{-3}$). (04 marks)

15. (a) Beryllium, magnesium, calcium and barium are some of the elements that belong to Group II of the Periodic Table.

State how the elements react with sulphuric acid and give the conditions for the reactions. (03 marks)

(b) (i) State how the solubilities of the sulphates of Group II elements vary down the group. (01 mark)

(ii) Explain your answer in (b)(i). (02 marks)

(c) Write equation for the reaction of:

(i) beryllium with sodium hydroxide solution. (1½ marks)

(ii) calcium carbide with water. (1½ marks)

16. In the manufacture of ammonia, nitrogen is catalytically hydrogenated to give ammonia according to the following equation.



(a) (i) Name the catalyst used in the reaction. (½ mark)

(ii) Write the expression for the equilibrium constant, K_p for the reaction. (01 mark)

(b) State what would happen to the position of the equilibrium if:

(i) pressure was increased. (01 mark)

(ii) temperature was increased. (01 mark)

- (c) When 3 moles of hydrogen and 1 mole of nitrogen were mixed and allowed to attain equilibrium at 100 atm and 400°C , the equilibrium mixture contained 25% of ammonia by volume.

Calculate the:

- (i) number of moles of nitrogen and hydrogen at equilibrium. (03 marks)

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- (ii) value of the equilibrium constant, K_p at 400°C . (2½ marks)

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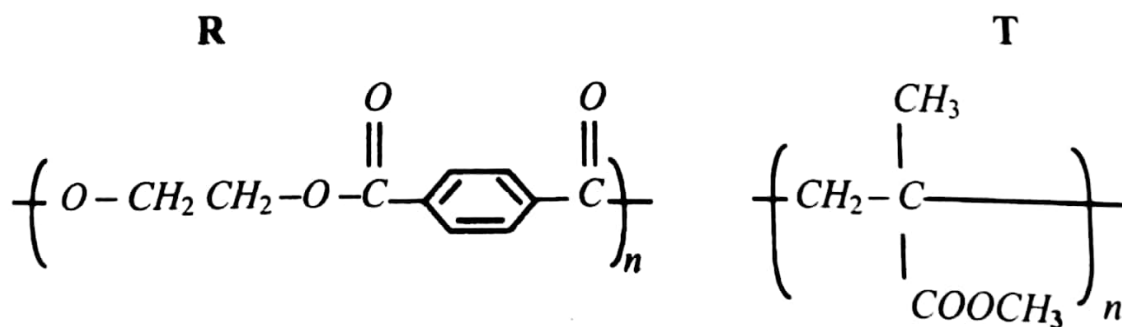
17. (a) Differentiate between **addition** and **condensation** polymers. (02 marks)

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- (b) The structural formulae of two polymers **R** and **T** are shown below.



Name the polymer:

- (i) **R** (01 mark)
- (ii) **T** (01 mark)

(c) Write the structural formula(e) of monomer(s) of the polymers **R** and **T** respectively. (03 marks)

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(d) Give one use of :

(i) **R** (01 mark)

(ii) **T** (01 mark)

THE PERIODIC TABLE

1	2											3	4	5	6	7	8
1.0 H 1																1.0 H 1	4.0 He 2
6.9 Li 3	9.0 Be 4											10.8 B 5	12.0 C 6	14.0 N 7	16.0 O 8	19.0 F 9	20.2 Ne 10
23.0 Na 11	24.3 Mg 12											27.0 Al 13	28.1 Si 14	31.0 P 15	32.1 S 16	35.4 Cl 17	40.0 Ar 18
39.1 K 19	40.1 Ca 20	45.0 Sc 21	47.9 Ti 22	50.9 V 23	52.0 Cr 24	54.9 Mn 25	55.8 Fe 26	58.9 Co 27	58.7 Ni 28	63.5 Cu 29	65.7 Zn 30	69.7 Ga 31	72.6 Ge 32	74.9 As 33	79.0 Se 34	79.9 Br 35	83.8 Kr 36
85.5 Rb 37	87.6 Sr 38	88.9 Y 39	91.2 Zr 40	92.9 Nb 41	95.9 Mo 42	98.9 Tc 43	101 Ru 44	103 Rh 45	106 Pd 46	108 Ag 47	112 Cd 48	115 In 49	119 Sn 50	122 Sb 51	128 Te 52	127 I 53	131 Xe 54
133 Cs 55	137 Ba 56	139 La 57	178 Hf 72	181 Ta 73	184 W 74	186 Re 75	190 Os 76	192 Ir 77	195 Pt 78	197 Au 79	201 Hg 80	204 Tl 81	207 Pb 82	209 Bi 83	209 Po 84	210 At 85	222 Rn 86
223 Fr 87	226 Ra 88	227 Ac 89															
			139 La 57	140 Ce 58	141 Pr 59	144 Nd 60	147 Pm 61	150 Sm 62	152 Eu 63	157 Gd 64	159 Tb 65	162 Dy 66	165 Ho 67	167 Er 68	169 Tm 69	173 Yb 70	175 Lu 71
			227 Ac 89	232 Th 90	231 Pa 91	238 U 92	237 Np 93	244 Pu 94	243 Am 95	247 Cm 96	247 Bk 97	251 Cf 98	254 Es 99	257 Fm 100	256 Md 101	254 No 102	260 Lw 103