

Candidate's Name:

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Signature:

Random No.					Personal No.		

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

P525/1

CHEMISTRY

Paper 1

Jul./Aug. 2019

2 ³/₄ hrs

Uganda Advanced Certificate of Education

MOCK Examinations 2019

CHEMISTRY

Paper 1

2 hours 45 minutes

INSTRUCTIONS TO CANDIDATES

Answer **all** questions in Sections **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 table) 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, $R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$.

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

Standard temperature = 273K.

Standard pressure = 101325 N m⁻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. (a) State **Graham's law** of gaseous diffusion. (01 mark)

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- (b) A sample of concentrated amine solution was placed at one end of a 1.0m glass tube held horizontally. At the other end was placed a sample of concentrated hydrochloric acid and both ends of the tube sealed. When the tube was left for some time, a white ring was observed 0.52m from the end containing the amine. Calculate the molecular mass of the amine. (04 marks)

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2. (a) Sketch the shapes of the following molecules.

(i) BF_3

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(ii) NH_4^+

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(iii) CO_2

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(1½ marks)

(b) Give reasons why molecules in (a)(i) and (a)(ii) adapt the shape you have sketched.

(03 marks)

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3. One property of chromium as a transition metal is its ability to form complexes, for example $[\text{Cr}(\text{NH}_3)_6]^{3+}$.

(a) State **two** other properties of chromium as a transition metal. (02 marks)

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(b) Chromium(III) chloride-6-water, $\text{CrCl}_3 \cdot 6\text{H}_2\text{O}$, is an example of hydrate isomerism. Write the structural formulae of **three** possible isomers of $\text{CrCl}_3 \cdot 6\text{H}_2\text{O}$.

(1½ marks)

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- (c) The coordination number of chromium is the same in the isomers of $\text{CrCl}_3 \cdot 6\text{H}_2\text{O}$.

(i) What is meant by the term **coordination number**. (01 mark)

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(ii) What is the coordination number of chromium in $\text{CrCl}_3 \cdot 6\text{H}_2\text{O}$? (01 mark)

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4. Complete the following equations and give the systematic (IUPAC) name of the organic product in each case.

(a) $\text{CH}_3\text{CH}_2\text{COOH} + \text{PCl}_5 \rightarrow$ (01 mark)

Name of product

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(b) $(\text{CH}_3)_2\text{C}=\text{CH}_2 + \text{HCl} \rightarrow$ (01 mark)

Name of product

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(c) $\text{CH}_3\text{COCH}_3 \xrightarrow{\text{H}_2/\text{Ni}}$ (01 mark)

Name of product

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(d) $\text{CH}_3\text{CH}_2\text{NH}_2 \xrightarrow[0^\circ\text{C}]{\text{NaNO}_2/\text{HCl}}$ (01 mark)

Name of product

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5. (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 solution. (2½ marks)

Observation

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Equation

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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. (2½ marks)

Observation

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Equation

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6. (a) Define the term **ionisation energy**. (01 mark)

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- (b) The data given below are for the elements P, Q and R which belong to the same group in the Periodic Table.

Element	P	Q	R
First ionisation energy(kJ mol ⁻¹)	580	790	1255

- (i) Which one of the elements P, Q and R is a metal? Explain your answer. (02 marks)

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- (ii) The second, third and fourth ionisation energy of element P are 1500, 7700 and 10500 kJ mol⁻¹ respectively. To what group in the Periodic Table does P belong? Give reasons for your answer. (03 marks)

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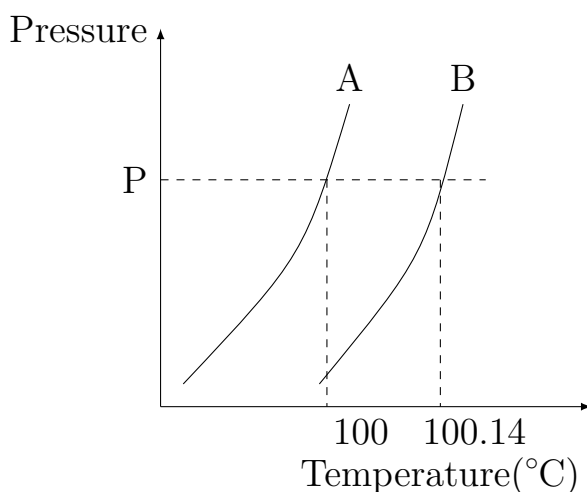
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7. 5.5g of a non-volatile substance L was dissolved in 125g of a solvent. The vapour pressure curve of the solution and the pure solvent at constant pressure P are shown below.



- (a) Identify the curve for the solution and the solvent. (01 mark)
- solution

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solvent

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- (b) Calculate the molecular mass of L (boiling point elevation constant for the solvent, K_b , is 0.52°C kg⁻¹ mol⁻¹). (03 marks)

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8. Name **one** reagent that can be used to distinguish between each of the following pairs of compounds. In each case, state what is observed if the reagent is separately treated with each member of the pair.

(a) Bromobenzene and bromoethane (03 marks)

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(b) Propan-1-ol and propan-2-ol (03 marks)

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9. (a) (i) State **two** important oxidation states exhibited by carbon, silicon, tin and lead. (01 mark)

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(ii) Describe how the stability of the two oxidation states vary from carbon to lead. Use carbon(IV) oxide and lead(IV) oxide to illustrate your answer. (03 marks)

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- (b) State what would happen if silicon(IV) chloride is shaken with water.
Write equation to illustrate your answer. (02 marks)

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SECTION B: (54 MARKS)

Answer six questions in this section

- 10.** In an experiment, 1cm^3 of a hydrocarbon W requires 4cm^3 of oxygen for complete combustion to give 3cm^3 of carbon dioxide, all gas volumes being measured at s.t.p.

- (a) Determine the molecular formula of W . (02 marks)

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- (b) Write the structural formulae and names of all possible isomers of W . (02 marks)

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- (c) When W was reacted with ammoniacal silver nitrate solution, white precipitate of compound X was formed. Identify W . (0½ mark)

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- (d) Outline a mechanism for the reaction between W and water in the presence of sulphuric acid and mercury(II) sulphate. (4½ marks)

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- 11.** Phosphorus(V) chloride when heated decomposed according to the following equation.



A sample of pure phosphorus(V) chloride was heated in a closed vessel to 250°C. When equilibrium was attained, the vessel was found to contain 40.7% of chlorine.

- (a) Calculate the
(i) molar concentration of phosphorus(V) chloride. (4½ marks)

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(ii) equilibrium constant, K_c for the reaction at 250°C. (2½ marks)

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(b) Explain what would happen to the concentration of chlorine if the pressure in the vessel was decreased while the temperature was maintained at 250°C. (02 marks)

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

(a) $\text{CH}_3\text{CH}_2\text{Cl} + \text{OH}^-(\text{aq}) \xrightarrow{\text{heat}}$ (02 marks)

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(b) $(\text{CH}_3)_3\text{C}-\text{Br} \xrightarrow[\text{ethanol; heat}]{\text{CH}_3\text{CH}_2\text{ONa}}$ (03 marks)

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(c) $\text{CH}_3\text{COCH}_3 \xrightarrow{\text{NH}_2\text{NH}_2}$ (04 marks)

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13. (a) (i) State **three** factors that can affect bond energy. (1½ marks)

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(ii) Explain how the factors you have stated in (a)(i) affect bond energy. (3½ marks)

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(b) The standard enthalpy change of formation of tin(IV) chloride is -508kJ mol^{-1} . The standard enthalpy changes of atomization of tin and chlorine are $+301$ and $+121\text{kJ mol}^{-1}$ respectively. Use these values to construct a Born-Haber cycle for the formation of tin(IV) chloride from its elements. (02 marks)

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(c) Calculate the average bond energy of the Sn–Cl bond. (02 marks)

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14. (a) (i) Write the general outermost electronic structure of Group VII elements. (01 mark)

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(ii) State **two** reasons why fluorine differs in its properties from the other elements of Group VII. (02 marks)

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(b) Write equations for reactions of fluorine with

(i) water (1½ marks)

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(ii) cold concentrated sodium hydroxide solution (1½ marks)

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(iii) hot concentrated sodium hydroxide solution (1½ marks)

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(c) Write an equation for the reaction between hydrofluoric acid and silicon dioxide. (1½ marks)

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15. Write equations to show how the following conversions can be carried out. Indicate the reagents and conditions for the reactions.

(a) Phenylethanol to phenylethyne (05 marks)

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(b) Chloroethane to ethanoic acid. (02 marks)

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(c) Benzene to aminobenzene (02 marks)

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16. (a) Element A with atomic number 84 and mass number 216 decays by loss of an alpha particle to give element B. B decays further by loss of a beta particle to give element C and C also decays by loss of a beta particle to give element D. State the mass number and atomic number of the element B, C and D. (04 marks)

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- (b) (i) State what is meant by the term **half-life**. (01 mark)

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- (ii) A sample of Y had an initial activity of 260 counts per second on a Geiger counter. After 30 minutes the activity had declined to 250 counts per second. Calculate the half-life of Y. (04 marks)

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17. In the extraction of iron, haematite, Fe_2O_3 is mixed with coke and limestone and the mixture heated in a blast furnace.

- (a) State the purpose of adding
(i) limestone (01 mark)

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- (ii) coke (01 mark)

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- (b) Write equations for the reactions in which haematite is converted to iron in the blast furnace. (03 marks)

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- (c) Explain why it is possible to extract iron by method described above. (02 marks)

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- (d) (i) Name **one** other method that could be used to extract iron from its ore. (01 mark)

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- (ii) Suggest a reason why the method you have name in (d)(i) is **not** commonly used in the extraction of iron. (01 mark)

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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