Candidate's Name:

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Signature: …………………………………………………………………..

P525/1
CHEMISTRY
Paper 1

2 ¾ hours

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 = 8.31 JK⁻¹ mol⁻¹

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

Standard temperature = 273 K

Standard pressure = 101325 N m⁻²

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

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SECTION A: (46 MARKS)

1. (a) Complete the following nuclear Equations   (2 marks)

(i) $^{31}_{15}P$ + $^{2}_{1}H$ $\longrightarrow$ ....   + $^{1}_{1}H$

(ii) $^{7}_{3}Li$ + ... $\longrightarrow$ $2\ ^{4}_{2}H$

(ii) $^{14}_{7}C$ $\longrightarrow$ $^{14}_{7}N$ + ...

(iv) $^{214}_{83}Bi$ $\longrightarrow$ $^{0}_{-1}e$ +.....................
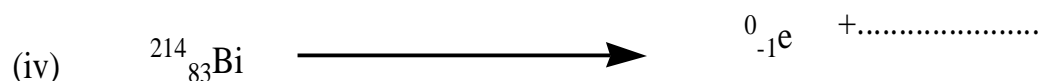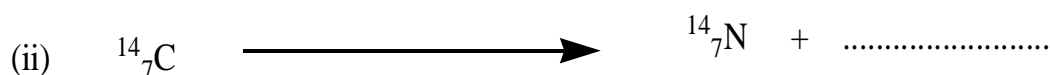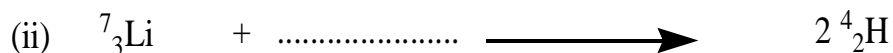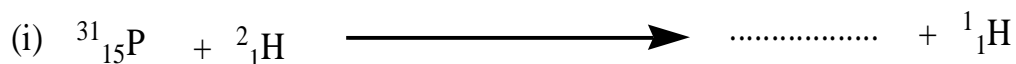
(b) The half-life of bismuth is 19.7 minutes. Determine the time taken for 75% by mass of the bismuth to decay   (3 marks)

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2. (a) Explain what is meant by the term oxidation number   (1 mark)

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(b) Determine the oxidation number of @ 0.5 marks
(i) Sulphur in $S_2O_8^{2-}$ and SO_4^{2-}

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(ii) Manganese in MnO_4^-

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(c) Write the half equation for the conversion of $S_2O_8^{2-}$ to SO_4^{2-} (1 mark)
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(d) Complete the following and balance the equations @ 1.5 marks
(i) $S_2O_8^{2-} + I^- \longrightarrow$
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(ii) $MnO_4^- + Fe^{2+} + H^+ \longrightarrow$

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3. (a) Complete the following equations and in each case give the IUPAC name of the main
organic product @ 1 mark)

(i) $(CH_3)_2CBrCH_3$ $\xrightarrow[\text{Heat}]{C_2H_5OK^+/ C_2H_5OH}$

(ii) $CH_3C\equiv CH$ + H_2O $\xrightarrow[\text{$H_2SO_4$, }60^0C]{\text{Hg^{2+}(aq)}}$

(iii) CH_3CH_2Cl $\xrightarrow[\text{Heat}]{CH_3CH_2OH / NaOH}$
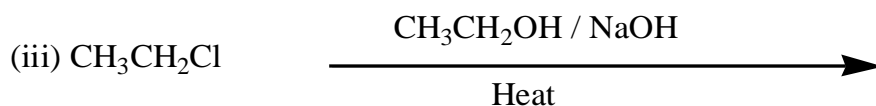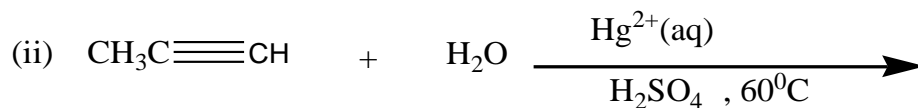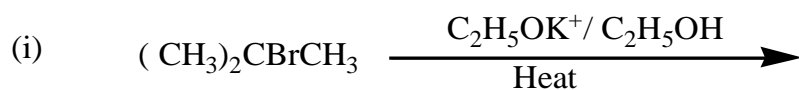
(b) Complete the following equations and in each case write a mechanism for the reaction
(@ 1 ½ marks)

(i) $CH_3CH\!=\!\!CH_2$ + $\xrightarrow{Cl_2 \ / \ H_2O}$

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(ii)   [benzene ring structure]   + Cl_2 $\xrightarrow{AlCl_3}$

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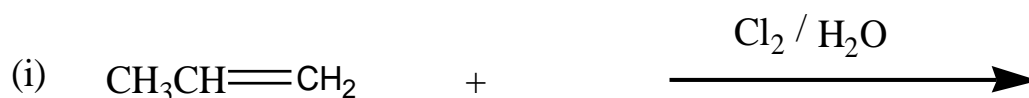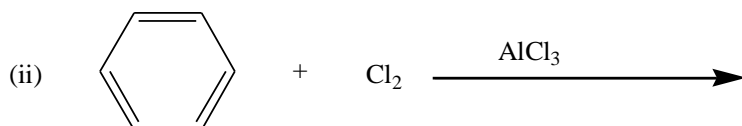
4.   (a) Sketch and name the shape of each of the following species   (4 marks)

Species	Shape	Name of shape
SO_2		
NH_4+		
PCl_5		
NCl_3		

(b) The atomic number of element X is 26.

(i) Write the outermost electron configuration of X   (½ mark)

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(ii) State the possible oxidation states X can show   (1 mark)

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5. (a)Define the term "partial pressure" (1 mark)

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b) The vapour pressures of pure chloroform and carbon tetrachloride are 199.1 and
114.5mmHg respectively at 25^OC.
(Assume that a mixture of the two liquids behave as an ideal gas and that it contains 0.96
mole of each pure liquid). Calculate;
i)   The partial pressure of each component in the mixture. (2 marks)

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ii) The total pressure. (1mark)

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c). Calculate the percentage of carbon tetrachloride in the vapour in equilibrium with the
liquid mixture. (1 mark)

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6.   a) State Graham's law. (01 mark)

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b) A certain volume of oxygen diffused through a porous membrane in 120s. Under the same
conditions the same volume of a gas. X diffuses in 112s. Calculate the relative molecular mass
of X.   (4 marks)

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7. The ionic radii of Na^+, Mg^{2+} and Al^{3+} are 0.095, 0.065 and 0.050 respectively.

a) Calculate the charge/ radius ratio per (@ 1 mark)

i) Na^+

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ii) Mg^{2+}

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iii) Al^{3+}

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b) Which of the ions has

i) The least polarizing power?   Give reason for your answer (2marks)

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8. (a) Why does the vapour pressure of a given mass of solvent decrease when a known mass
    of non-volatile solute is added to the solvent? (2marks)

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(b) A solution was prepared by dissolving 7.5g of propan – 1,2,3- triol (glycerol), $C_3H_8O_3$ in
    200g of water at 25°C and at standard pressure. Calculate the boiling point of the solution at
    standard pressure (Kb of water = 0.52 K kgmol^{-1}) (3 marks)

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9. The empirical formula of a fluoride of Sulphur, Y 1 is SF4. 0.1g of Y occupied 22.10cm3
    when vaporized at 200C and 766mmHg.

a) Determine the molecular formula of Y. (3 ½ marks)

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 b. Draw the structure of Y and name the shape (1 ½ marks)

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SECTION B: (54 MARKS)

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

a) Copper is added to a solution of concentrated nitric acid. (2 ½ marks)

Equation

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Observation

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b) Potassium iodide is added to acidified solution of hydrogen peroxide. (02 marks)

Equation.

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Observation

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c) Sodium sulphite is added to a solution of acidified potassium dichromate (VI)

Observation (2.5marks)

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Equation

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d). Aqueous iron (ii) sulphate is added to acidified potassium manganate (VII) solution. (2 marks)

Equation

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Observation

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11. a)   When 8.8g of a hydrocarbon, Z was burnt in excess air, 14.4g of water and 13.44dm³ of carbon dioxide were obtained at s.t.p. Determine the empirical formula of Z.
                                                            (3 ½ marks)

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b) The vapour density of Z is 22. Write the name and molecular formula of Z.   (1 mark)

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a) i)   Write equation to show how Z can be synthesized from an alcohol   (2 ½ marks)

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i) Indicate a mechanism for the first stage of the reaction ©(i)   (2 marks)

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12. The table below gives the first, second third and fourth ionization energies of elements P,Q and R

ement	hisation energy (KJmol^{-1})			
	First	Second	Third	Fourth
	800	2,400	3,700	25,000
	900	1,800	1,4800	21,000
	500	4,600	6,900	9,500

(a) State and explain the general trend in variation of ionization energies.   (03 marks)

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(b) State the group and period to which element P belongs. In each case give a reason for your answer   (3marks)

Group:

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Reason:

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Period:

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Reason:

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(c) The wavelength at the start of the continuim in the sodium emission spectrum is 242nm. Calculate the first ionization energy of sodium in $KJmol^{-1}$
($C = 3.0 \times 10^8 ms^{-1}$, Planks' constant $= 6.626 \times 10^{-34}$ Js and Avogadro's constant (L) $= 6.023 \times 10^{23}$ mol^{-1})   (03 marks)

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13. Write equations to show how the following conversions can be made
(a) ethyne from ethanol   (4 marks)

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(b) Benzoic acid from benzene   (2 marks)

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(c) Propane from 1 bromobutane   (3 marks)

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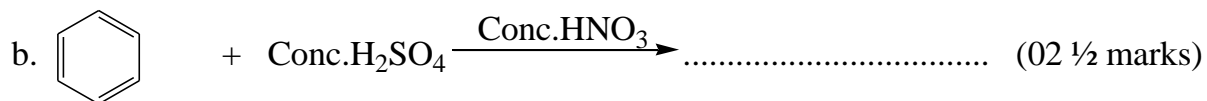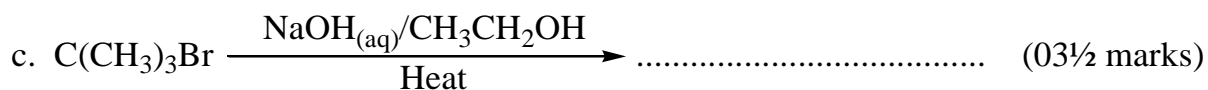...

14.   Complete the following equations and in each case outline a suitable **mechanism** for the reaction.

a. $CH_3CH_2C{\equiv}CH \xrightarrow{\quad 2HBr \quad}$ ....   (03 marks)

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b. [benzene ring] $+ \ Conc.H_2SO_4 \xrightarrow{\quad Conc.HNO_3 \quad}$ ....   (02 ½ marks)

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c. $C(CH_3)_3Br \xrightarrow[\text{Heat}]{\quad NaOH_{(aq)}/CH_3CH_2OH \quad}$ ....   (03½ marks)

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15. The table below gives some data on substances A to D

Substance	A	B	C	D
Melting point (^oC)	1610	– 183	2015	
Conduction of electricity in molten state	Does not	Does not	Does	Does

(a) Classify the solid formed by each substance according to its structure and type of bonding

Substance				
Type of structure				
Type of bonding				

(4marks)

(b) In the series Na, Mg, Al, Si, P, S and Cl

State element with

	Element
highest melting point	
(ii) Smallest atomic radius	
(iii) largest ionisation energy	
(iv) smallest electronegativity	

(2 marks)

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(c) Explain why the element you have stated in (b) (i) has the highest melting point

(3 marks)

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16. (a)Define the following terms s used in periodic table and periodicity (01 mark each)

i. Orbital

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ii. Energy level

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iii. Atomic radius

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(b) Write the electronic configuration of the following   (04 marks)

i. copper

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ii. manganese

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iii. chromium

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iv. iron II

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(c) State the block to which the following belong to   (02 marks)

i. Aluminium

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ii. iron III

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17. (a) What is a dynamic equilibrium   (1 mark)

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(b) 1 mole of ethanol was added to 1 mole of ethanoic acid and the temperature kept at 25oC. At equilibrium 2/3 moles of reactants were converted to products. Calculate the equilibrium constant Kc for the reaction.   (4 marks)

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(c) Calculate the mass of the ester that would be present at equilibrium when 130g of ethanol is added to 120g of ethanoic acid at 25oC (Kc = 3.9)   (04 marks)

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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

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