P525/1
Chemistry
Paper 1
Jan - Feb 2021
2¾ hours

UGANDA MUSLIM TEACHERS 'ASSOCIATION

UMTA RESOURCE PAPERS – 2021

NAME…….

INDEX NO…….SIGNATURE…..…….

UGANDA ADVANCED CERTIFICATE OF EDUCATION
Chemistry

Paper 1

2 hour 45 minutes

INSTRUCTIONS TO CANDIDATES;

*Answer **all questions in Section A** and **any six in Section B**.*

All questions must be answered in spaces provided.

Illustrate your answers with equations where applicable.

Molar gas constant, $R=8.314jk^{-1}mol^{-1}$

Molar volume for a gas at s.t.p is $22400cm^3$

Standard temperature =273k

Standard pressure =101325 Nm^{-2}

FOR EXAMINERS USE ONLY																	Total
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	

SECTION A (46 marks)

1. (a) At 25^0C a 0.02M solution of ammonia is 4.5% ionized.

(i) Write the equation for the ionization of ammonia in water.

(01 mark)

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(ii) Calculate the concentration of ammonium ions in the solution.

(01 mark)

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(iii) Calculate the ionization constant of ammonia in water. (01 mark)

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(b) 0.05 mole of ammonium chloride was added to one litre of the ammonia solution in (a). Calculate the concentration of hydroxide ions in the solution.

(02 marks)

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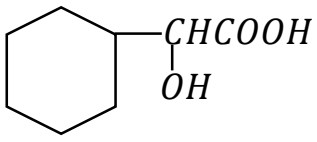
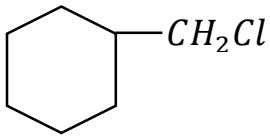
2. Using equations show how the following conversions can be brought about.

(a)  from  (2½ marks)

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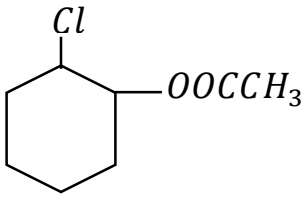
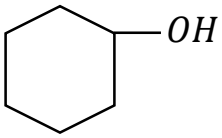
(b) 

from 

(2½ marks)

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3. Write equations for the reactions that take place between the following substances and aqueous sodium hydroxide.

(a) Chromium (VI) oxide. (1½ marks)

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(b) Zinc oxide. (1½ marks)

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(c) Trilead tetraoxide (red lead oxide) (1½ marks)

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4. (a) (i) Define the term **nuclear stability**. (01 mark)

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(ii) State how any **two** factor affect nuclear stability. (02 marks)

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(b) The half-life for beta decay of potassium – 40 is 1.83×10^9 years.

(i) Write an expression for the transformation that occurs when potassium decays. (01 mark)

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(ii) Calculate the percentage of potassium which will have decayed after 9.5×10^8 years. (02 marks)

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5. (a) For each of the following species, draw the structure, name the shape and state the oxidation state of central atoms. (03 marks)

Species	Structure	Shape	Oxidation state
(i) NO_2^-			
(ii) PO_4^{3-}			

(b) (i) State what would be observed if an aqueous solution of the species in (a) (i) above was added to an acidified solution of potassium dichromate (VI). (01 mark)

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(ii) Write equation for the reaction that takes place. (1½ marks)

……

6. Complete the following organic reactions and in each case name the main organic product. (04 marks)

(a) $CH_3CH = CH_2 \xrightarrow{MnO_4^-/\overline{O}H}$

Name : ……

(b) $(CH_3COO)_2Ca \xrightarrow{\text{heat}}$

Name : ……

(c) $CH_3CH_2CONH_2 \xrightarrow[\text{warm}]{Br_2/NaOH}$

Name : ……

(d) $CH_3CH_2OH \xrightarrow[140^0C]{\text{Conc. } H_2SO_4}$

Name : ……

7. (a) (i) Define the term **diagonal relationship**. (01 mark)

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(ii) Other than Beryllium and aluminium, name another pair of elements that exhibit diagonal relationship in periodic Table. (01 mark)

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(b) Both beryllium and calcium belong to group II of the periodic Table.

(i) Give **two** reasons why Beryllium differs from calcium in some of its properties. (02 marks)

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(ii) State any **one** property in which beryllium differs from calcium. (01 mark)

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8. Some bond energies are given in the table below:

Bond	Energy (KJ mol^{-1})
C – C	- 337
C – H	- 414
C – O	- 360
O – H	- 123

Calculate the heat of formation of gaseous ethanol. (03 marks)

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(b) Carbon monoxide burns in oxygen according to the equation.

$2\,CO(g) + O_2(g) \longrightarrow 2CO_2(g)$

Calculate the enthalpy of combustion of carbon monoxide.
(Heats of formation of carbondioxide and carbon monoxide are -393KJ mol^{-1} and -108KJ mol^{-1} respectively) (2½ marks)

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9. (a) A compound **A** contains Fe, 28%, O,48% and S, 24%. Calculate the empirical formula of **A**. (02 marks)

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(b) If the molecular mass of **A** is 400, determine the molecular formula of **A**. (01 mark)

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(c) A solution of **A** in water was added onto a piece of magnesium ribbon in a test tube. State what was observed and write equation for the reaction that took place. (01 mark)

Observation

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Equation (1½ marks)

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SECTION B (54 marks)

10. The two common oxidation states of chromium are +3 and +6.

(a) Write the electronic configuration of chromium ions in which chromium shows the above two oxidation states. (02 marks)

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(b) A dilute solution of chrome alum, $K_2Cr_2(SO_4)_4.2H_2O$ was prepared and divided into two portions.

(i) To the first portion sodium hydroxide solution was added dropwise until in excess. State what was observed and write equation(s) for the reaction(s) that took place. (03 marks)

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(ii) To the second part, a few drops of sodium hydrogen carbonate were added. Explain what was observed. (04 marks)

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11. Name a reagent that can be used to distinguish the following species. In each case state what would be observed if each member of the pair is treated with the named reagent.

(a) $HCOOH$ and $(HOOC)_2$ (03 marks)

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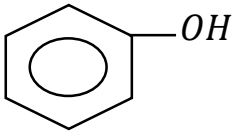
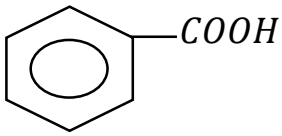
(b)  and  (03 marks)

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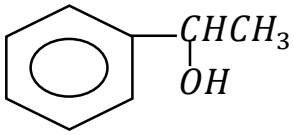
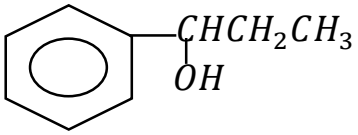
(c)  and  (03 marks)

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12. Explain what would be observed if the following substances were allowed to react.
(09 marks)

(a) Copper (II) ethanoate solution and potassium iodide solution.

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(b) Sodium chromate (VI) solution and dilute sulphuric acid.

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(c) Lead (IV) oxide and manganese (II) chloride acidified with dilute sulphuric acid when heated.

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13. Nitrogen monoxide reacts with oxygen to form nitrogen dioxide according to the equation below:

$2NO(g) + O_2(g) \rightleftharpoons 2NO_2(g)$

(a) Write the expression for the equilibrium constant, kc. (01 mark)

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…….

(b) (i) 3 moles of nitrogen monoxide and 1.5 moles of oxygen were put into a vessel that was heated to 400^0C. When equilibrium was established the vessel was found to contain 0.5 moles of oxygen. Calculate the value of Kc at this temperature. (02 marks)

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(ii) When the temperature was raised to 500^0C the mixture in (i) was found to contain 25% of the initial nitrogen monoxide. Calculate the equilibrium constant at this new temperature. (03 marks)

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(c) From your answers in (b) above explain whether the process is endothermic or exothermic. (02 marks)

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(d) What would be the effect on Kc if an inert gas like helium is added to the reaction mixture. (01 mark)

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14. 0.5g of compound **P** at a pressure of 209.94 kPa when vaporized at 127^0C occupied a volume of $90cm^3$.

(a) (i) Calculate the relative molecular mass of **P**. (2½ marks)

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(ii) The empirical formula of **P** is C_2H_4O
Determine its molecular formula. (01 mark)

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……

(iii) Write the structures of possible isomers of **P**. (01 mark)

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……

(b) When heated with methanol and a little sulphuric acid compound P formed sweet smelling substance **Q** and when reacted with phosphorus pentachloride, **P** gave white fumes and another organic substance **R** formed.

Identify compounds

(i) **P** **:** …… (½ marks)

(ii) **Q** **:** …… (½ marks)

(iii) **R** **:** …… (½ marks)

(c) Write equation and outline a mechanism of the reaction that takes place when substance **R** is reacted with concentrated ammonia. (3½ marks)

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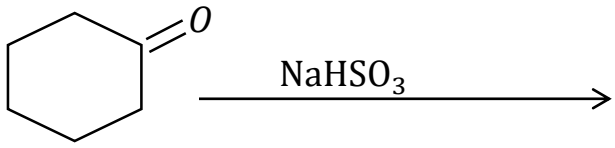
15. Complete the following equations and in each case write a mechanism.

(a) 

(3½ marks)

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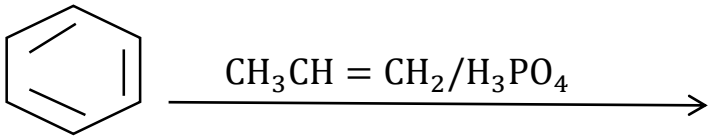
(b) 

(03 marks)

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(c) $CH_3CH(Br)CH_2CH_3 \xrightarrow[\text{heat}]{\text{NaOH(aq)}}$ (2½ marks)

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16. Some half reactions and their reduction potentials are given below $MnO_4^-(aq) + 8H^+(aq) + 5e \longrightarrow Mn^{2+}(aq) + 4H_2O(i)$ $E^\theta = +1.51V$

$MnO_2(s) + 4H^+(aq) + 2e \longrightarrow Mn^{2+}(aq) + 2H_2O(i)$ $E = +1.23V$

$Sn^{2+}(aq) + 2e \longrightarrow Sn(s)$ $E = -0.136V$

$Sn^{4+}(aq) + 2e \longrightarrow Sn^{2+}(aq)$ $E = +0.15V$

(a) State what would be observed when excess tin powder is added to acidified solution of potassium manganate (VII). Explain your answer. (03 marks)

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(b) For the reaction in (a) write equation for the reactions that occur at the negative and positive electrodes.

(i) **- Positive electrode**. (01 mark)

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- Negative electrode. (01 mark)

……

(ii) Calculate the emf of the cell in (a). (01 mark)

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(c) Solid manganese (IV) oxide was added to acidified solution containing tin (II) ions.
Explain what was observed. (03 marks)

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17. (a) Distinguish between **addition** and **condensation polymerization**.

(02 marks)

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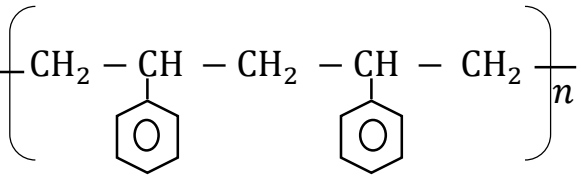
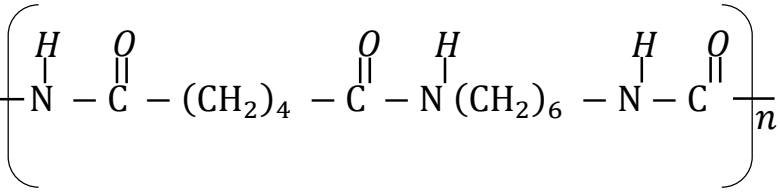
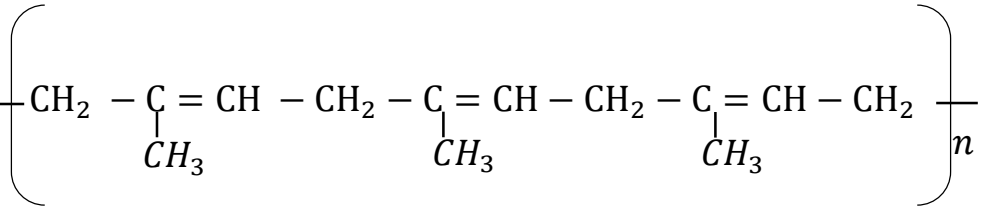
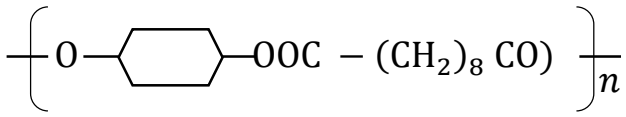
(b) The structural formulae of polymers **P, Q, R** and **S** are given below:

P: 

Q: 

R: 

S: 

In the table below, write the structural formula of the monomer(s) in each case and name the type of polymerization that leads to the formation of each polymer.

(05 marks)

	Structural formula of monomer(s)	Types of polymerisation
P		
Q		
R		
S		

(c) (i) Give one use **Q**. (½ mark)

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……

(ii) **R** exists as natural rubber. State how it is treated before putting it to industrial use. (1½ 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 TI 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