P525/1
Chemistry
Paper 1
August 2023
2 hours 45 minutes



UGANDA ADVANCED CERTIFICATE OF EDUCATION

Chemistry

PAPER ONE

DURATION: 2 HOURS 45 minutes

Candidate's Name	Signature	
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INSTRUCTIONS TO CANDIDATES

- Answer all questions in Section A and six questions in Section B.
- All your answers <u>must</u> be written 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 dequate or non-programmable scientific electronic calculators may be used.
- · Where necessary, use the following:
 - Molar gas constant, R = 8.31JK⁻¹mol⁻¹.
 - Molar volume of a gas at s.t.p is 22.4 litres.
 - Standard temperature = 273K.
 - Standard pressure = 101325NM⁻².

	For Examiner's 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 from this Section

1.	a)	What is meant by the term colligative property.	(O1 mark)
	b)	Propane - 1,2,3 - triol, HOCH₂CH(OH)CH₂OH, is used as an	anti-freeze for
		water in car radiators. Calculate the freezing point of th	e solution when
		1000g of propane - 1,2,3 - triol are dissolved in 5 litres of w	ater. (Freezing
		point constant for water is $1.86^{\circ}C~Kg^{-1}mol^{-1}$ and density of wat	er is 1gcm ⁻³)
			(3 ½ marks)
2.	Со	mplete the equation below and write the mechanism for the reac	tion.
		CH3COCH3 + H2NNH—	(04 marks)
3	S+/	2 to what would be all and a second s	
٠.	wor	ate what would be observeed and write equation(s) for the real	ction(s) that
	exc	uld take place when each of the following solutions is added drop	-wise until in
		cess to chromium (III) sulphate solution.	
	٠, ١	Concentrated ammonia solution	(03 marks)

		Observation							
7		,							
		Equation							
	b)) Sodium carbonate solution (2	½ marks)						
		Observation							
		Equation							
4.	Th	he following reagents can be used to distinguish between members o	of classes						
	of	f organic compounds; nitrous acid, and anhydrous zinc chlor	ride and						
	COI	oncentrated hydrochloric acid.							
	Fo	or each reagent state, the class of compounds and briefly describe wl	nat would						
	be	observed when the reagent is reacted with each member of the class.							
		(2½	marks)						
	a)) nitrous acid							
		i) Class of compounds							
		ii) Observations							

	0)	anı	rydrous zinc chloride and concentrated try at better te dela	V
		i)	Class of compounds	`
		ii)	Observations	
5.	a)	De	etermine the oxidation state of sulphur in each of the following	ng species;
		i)	$S_2O_3^{2-}$	(01 mark)
		ii)	$S_4O_6^{2-}$	(01 mark)
				(OI mai K)
				••••••
	b)	W	rite an equation for the reaction between $S_2O_3^{2-}$ and:	•••••••••••••••••••••••••••••••••••••••
			Iodine	(1½ marks)
		ii)	excess chlorine	(1½ marks)
6.	a)	W	'rite	
		i)	equation for the hydrolysis of sodium ethanoate in water.	(1½ marks)

(11) the expression	for the n	iyaroiysis	constant, K	or socium e	odium ethanoate.	
				(1/2	mark)	
b) 50cm ³ of a 0.02	ethanoic	acid was	added to	an equal vol	ume of a 0.02M	
sodium hydroxide	solution.	Calculate	the PH of t	he solution.		
(K _h of ethanoic ac	cid is 1.8 ×	10 ⁻⁵ mol	dm ⁻³ , K _W = 1.	$0 \times 10^{-14} \text{ mol}^3$	² dm ⁻⁶)	
•					(05 marks)	
					,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	
	,,,,,,,,					
. write equations to s	show how 1	the follow	ing compound	ds can be syr	ithesized.	
			соон			
a) Br	to				(2½ marks)	
	, 0					
					(01	
b) CH₃CH=CHCH₃	to Ch	13CH2OH			(2½ marks)	

	eryllium is an elem			ible,					
	ferently from the o		-						
State thre	e reasons why ber	yllium behaves o	differently from the	oth					
members.			$(1\frac{1}{2} \text{ m})$	arks)					
b) Write equa	ation for the react	ion between conc	entrated sodium hyd	roxd					
solution wit									
i) berylliu	n oxide		$(1\frac{1}{2} \text{ m})$	iarks)					
ii) aluminiu	ii) aluminium oxide $(1\frac{1}{2} \text{ marks})$								
				······································					
		obtained for the	reaction between prop	panon					
A and Iodine									
Experiment	[A] (mol dm ⁻³)	[I ₂] (mol dm ⁻³)	Initial rate (mol s ⁻¹)					
1	0.10	0.10	1 × 10 ⁻⁴						
2	0.10	0.20	1 × 10 ⁻⁴						
3	0.30	0.10	3 × 10 ⁻⁴						
a) State the or	der of reaction with	respect to A and	Iodine (I_2).						
Α.			(½ m	ark)					
Iodine (I_2)			(½ m	ark)					

,	Give a reason for your answer in (a).	(02 marks)
c)	Determine the overall order of the reaction.	(½ mark)
d)	Calculate the value for the rate constant for the reaction and indica	te its units.
		(1½ marks)

JLC. ION B (54 MARKS)

Answer six questions from this Section.

10. Complete the following equations and in each case, write the accepted mechanism.

****	certainom.	
a)	$+ \xrightarrow{Br_2/Fe} \xrightarrow{heat}$	(03 marks)

(2½ marks)	$\xrightarrow{Conc.H_2SO_4} \longrightarrow 140^{0}C$	b) CH₃CH₂OH
		••••••

$OH \xrightarrow{Conc.H_2SO_4} 170^{\circ}C $ (2½ marks)	c)

7

11	a)	State:
	ω_J	

i)	what is meant by the term first electron affinity.	(OI mark)
ii)	three factors which affect the magnitude of first electron of element.	affinity of an (1½ marks)

b) The table below shows the atomic numbers and their electron affinities.

Element	Na	Mg	Al	Si	Р	5	Cl
Atomic number	11	12	13	14	15	16	17
First electron	5.3	-0.6	4.3	13.4	4.8	20.0	34.9
affinity (KJ mol ⁻¹)							

i)	Draw a graph of first electron affinity versus atomic number.	(U3 marks)
ii)	Explain the shape of the graph.	(3½ marks)
		-
		••••••

	Write the equation for the:					
i) solubility of silver oxalate in water	(1½ marks)				
i	i) solubility constant, Ksp, for silver oxalate.	(01 mark)				
b) .	The solubility of silver oxalate at $25^{\circ}C$ is 3.27×10^{-2} g dm ⁻³ .	Calculate the				
:	solubility constant for silver oxalate at 25° C.	(03 marks)				
•						
	Determine the molar concentration silver ions required to pre					
	oxalate from an aqueous solution containing 0.005M oxalate ions	s. (02 marks)				
		······································				
1						
	A solution containing silver ions was added to a solution conta exalate ions and 0.005M chloride ions. State which of th					
(chloride or silver oxalate was precipitated first. Give a rec answer.					
	(Ksp for $AgCl = 1.96 \times 10^{-10} \text{ mol}^2 \text{ dm}^{-6}$).	(1½ marks)				

13.a)	State:	
	i) the common oxidation states of group (IV) elements of the p	periodic table.
		(01 mark)
	ii) how the stability of the oxidation states of the elements	vary down the
	group (illustrate your answer with chlorides of carbon and le	ad)
		(03 marks)
b)	Explain your answer in (a)(ii).	(21 manks)
		(2½ marks)
		(2 g mar K5)
		(2 g marks)
		(2 g mar K5)

									N. C.

c) A	sample of	lead (IV)	oxide	was	treated	with	warm	concentrate
hy	drochloric ac	id.							
i)	State what w	was obse	erved	l.					(01 mark)
		••••••		•••••					
ii)	Write equat	ion for t	the re	eaction	that	took place	2.		(1½ marks)
		••••••					•••••	······	
		•••••••							
14.The e	electrode pota	entiale o	of con	m n h = 1.0					
	70 род	ennais o	1 501	ne nait	-cells	are shown			
							E _e \	<u>volts</u>	
Α	$Zn_{(aq)}^{2+} + 2$	$e \rightleftharpoons Zn_{(s)}$)				-0.	76	
В	$MnO_{4(aq)}^-$	+ 8H ⁺ _(aq) -	+ 5e	$\rightleftharpoons Mn_{(a)}^{2}$	+ (q) + 4	$H_2O_{(l)}$	+1.	52	
С	$MnO_{4(aq)}^{-}$	$\vdash e \rightleftharpoons M$	nO _{4(a}	q)			+0.	56	
D	$Cu_{(aq)}^{2+} + 2c$	$e \rightleftharpoons Cu_{(s)}$	5)				+0.	34	

a) Giving reasons, name the species that is the strongest:

 $MnO_{4(aq)}^{2-} + 4H_{(aq)}^{+} + 2e \rightleftharpoons MnO_{2(s)} + 2H_{2}O_{(l)}$

i) reducing agent	(01 mark)

ii)oxidising agent

Ε

(01 mark)

+2.26

b)	i) Write the cell convention for the cell made by combining the	electrodes of
	the half-cell reactions A and B.	(01 mark)
	ii) Write equation for the overall cell reaction.	(1½ mark)
	iii) Determine the e.m.f of the cell.	(01 mark)
	iv) State whether the reaction in (ii) is possible or not. Give a re	eason for
	your answer.	(01 mark)
Ca	rbondioxide was bubbled through a solution containing manganate	(VI) ions.
	i) State what was observed.	(1½ marks)

c)

ii) Write equation for the reaction that took place	e. (1½ marks
15.a) An organic compound Q contains Carbon 80%, Hy	drogen 6.7% the rest being
oxygen. Calculate the empirical formula of Q.	(O2 marks)
••••••	
b) 0.25g when vapourised at 150°C and 760mmHg occ	
the molecular formula of Q.	
	(03 marks)
c) Q burns with a yellow sooty flame, forms a yellow	v-orange solid with Brady's
reagent and reacts with a solution of iodine in so	odium hydroxide to form a
pale yellow solid.	, and to form d
Write the structural formula of Q.	(01 mark)
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d)	Wı	rite equation for the reaction between Q and sodium hydrogen	sulphite. (01 mark)
e)		now how Q can be synthesized from an alkene.	(02 marks)
16	.St	tate what would be observed and write equation for the r	eaction that
		ould take place when	
	a)	Sulphur dioxide gas is bubbled through an acidified solution	
		dichromate (VI). Observation	(2 ½ marks)
		Equation	
		b) Dilute hydrochloric acid is added to a solution of sodium th	hiosulphate. (02 marks)
		Observation	(= ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,

		Equation	
	c)	A mixture of propanal and ammoniacla silver nitrate solution v	varmed.
		Observation	(02 marks)
		Equation	
			•••••••••••••••••••••••••••••••••••••••
	d)	Aqueous solution of ethanol is warmed with an aqueous solut	ion of iodine
		and sodium hydroxide.	(02 marks)
		Observation	
		Equation	
17.a)	Dis	stinguish between addition and condensation polymerisation.	(02 marks)
	•••••		•••••••
	•••••		••••••
			••••••

b) The structural formulae of polymers X, Y and Z are shown below.

$$X : -CH_2 - C - CH_2 - C - CH_3$$
 $CH_3 - CH_3$
 $CH_3 - CH_3$

$$CI$$
 CI I I $Z: -CH_2-C=CHCH_2C+CHCH_2 ---$

In the table below, write the structural formula(e) of the monomer(s), name(s) of the monomer(s) and type of polymerisation.

 $(7\frac{1}{2} \text{ marks})$

	Structural formula(e) of monomer(s)	Name of monomer(s)	Type of polymerisation
X			
У			
Z			

c) 6	ive one use of:	(1½ marks)
>		
У		
Z		

THE PERIODIC TABLE

\prod	2							-				3	4	- 1	6	7	8	
I H		, i.e.			į,				٠,							1 H L0	2 Be 4.0	
3 11	4 Be 9.0					,						5 B 10.8	6 C 12.0	7 N 149	0 0 8	9 F 19.0	10 No 20.	1
11 Na 13.0	12 Mg 243	. 1	٠.									13 Ai 27.0	14 51 28_1	15 P 31.0	16 S 32.1	17 G 35	13 A:	- {
19 K	20 Ca 40.1	21 Se 45,0	22 TI 47.9	23 V 50.9	24 Cr 520	25 Ma 54.9	26 Fe 55.8	27 Co 58.9	28 Ni 58.7	29 Ca හි.5	3-0 Z.≃ 65.7	31 G± 69.7	32 Ge 72.6	33 Au 74.9	34 Se 79.0	35 Br 79.	K	
37 Rb 85.5	38 Sr 87.6	39 Y 83.9	40 Zr 91.2	41 Nb 92.9	42 Mo 95.9	43 Tc 98.9	44 Ra 101	45 Rh 103	46 Pd 106	47 Ag 108	48 Cd 112	49 I= 115	50 Sa 119	51 Sb 122	52 Te 128	1 12	1 >	بر (دو 31
55 Cs 133	56 Ba 137	57 La 139	72 Hf 178	73 Ta 181	74 W 184	75 Re 156	76 Os 190	77 Ir 192	78 Pt 195	79 A= 197	80 Hg 201	81 Tl 204	82 ·Pb 207	83 B1 209	84 Po (209	A A	: 1	36 Ra 117
87 Fr (223	88 Ra (726)	89 Ac (227)		1	1										-		- 1	_
	ا	: .	57 La 139	58 Ce 140		60 Nd 144	61 Pm (145)	67 5m 152	ය Sm 150	64 En .157	T	D	H	o E	- T	59	70 935 173	71 L: 17
			89 Ac (227	Th	91 Pa 2 231	92 U 238	93 Np 237	94 PE (244	95 Am (24)	96 Ca	n B	k C	f E	, F	m h		102 No 254)	L

- 1. 1 indicates Atomic number.
- 2. H indicates relative Atomic number.

END.

END