233/2

387

Paper 2

CHEMISTRY – (Theory)

Dec. 2022 - 2 hours



Name	Index Number
Candidate's Signature	Date

Instructions to candidates

- (a) Write your name and index number in the spaces provided above.
- (b) Sign and write the date of examination in the spaces provided above.
- (c) Answer all the questions in the spaces provided in the question paper.
- (d) Non-programmable silent electronic calculators and KNEC mathematical tables may be used.
- (e) All working must be clearly shown where necessary.
- (f) This paper consists of 16 printed pages.
- (g) Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.
- (h) Candidates should answer the questions in English.

AND-	Hilly		
For Exa	mine	r's Lice	Only
I OI LA	21111116		4

/ 200 mg/s	Allegation and the San
Maximum Score	Candidate's Score
III ,	
//3/	
/ /12/	Add to A
J3	and and
11	-670 988
10.0	× 6000
Gerio Service	a los a l'Assertad d
80	и та С Эрчина
	Score 11 13 12 13 11 10 10







Aluminium and phosphorus form oxides with general formula M_2O_3 . Complete Table 1 1. (a) by writing the properties of the oxides.

Table 1

Property	Al_2O_3	P_2O_3
Structure		
Bonding		
Acid/base character		

(3 marks)

The grid in Figure 1 shows part of the Periodic Table. Use it to answer the questions that (b) follow.

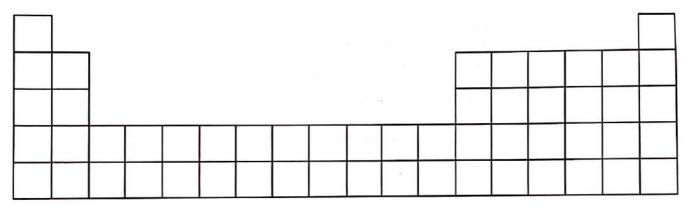


Figure 1

Give the total number of elements that can be placed in: (i)

I.	period I	(½ mark)
II.	period 5	(½ mark)

(ii)

Place	each of the following elements in the grid:	
I.	Element X, whose atomic number is 14	(1 mark)
II.	Element Y, with the highest first ionisation energy	(1 mark)
III.	Element Z, with the lowest first ionisation energy	(1 mark)
IV.	Element L, whose ion L ²⁻ has electron arrangement 2.8	(1 mark)
V.	Element D, whose ion D2+ has electron arrangement 2.8.8	(1 mark)
VI.	Element Q, a halogen with the highest atomic radius	(1 mark)
VII.	Element R, a period 3 element that exists as a monoatomic gas	(1 mark)

	The general	C 1	C	11 1		CITT	OTT
· 7	The general	tormill	2 01 2	ILLanole	10	(H	(1)
2.	The general	IUIIIIIII	auro	inaliuls	10	CIIn .	·UII.

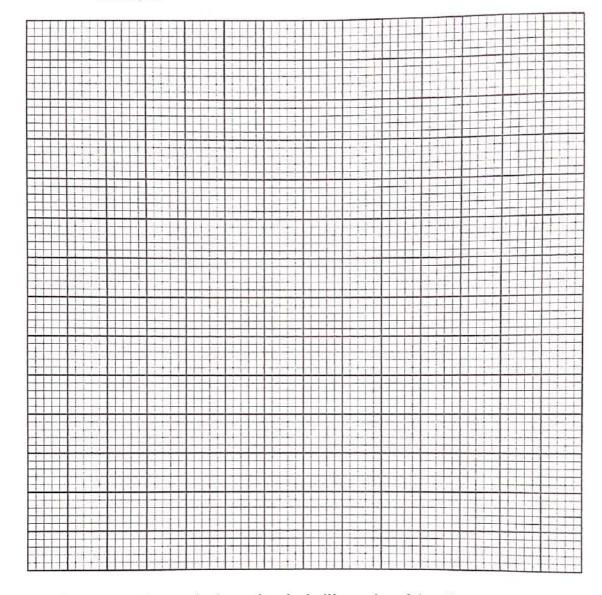
(a)	Draw the structure and give the name of the alkanol with $n = 5$.	(2 marks)
	Structure	
	••••••	
	Name	

(b) Table 2 gives the boiling points of some alkanols.

Table 2

n	n Boiling point/°C	
2	78.5	
3	97.2	
4	117.0	

(i) On the grid provided, draw the graph of boiling point against number of carbon atoms, **n**. (3 marks)



(11)	From the graph, determine the boiling point of the alkanol with $n = 5$.	
(iii)	The boiling point of the alkanol with $n=2$ is much higher than that of Explain (C = 12.0; H = 1.0; O = 16.0).	

Give ar	other use of alkanols	La tel 1986 e 1961 - 1 -		(1 m
Write a	n equation for the con	mbustion of the alkano	ol with $n = 2$.	(1 m
				\
Use the		•••••••••		
	bond energies in Tallkanol with $n = 2$.	ble 3 to calculate the en	nthalpy change of co	
or the a		memor wa		(3 ma
	n tokih maraka 19 Ta	able 3		
	Bond	Energy kJ/mol	712	
	C-C	348		
	C – H	412		
	C – O	360	-2,	
	O – H	463		
	O = O	496	Tribe a hiling	
	C = O	743		
			_	
				••••••
				••••••
••••••	•••••			•••••
•••••				•••••
	•••••			
			20.25. 3237.0344.0055.014.0055.01	



(c)

3.	(a)	Use th	ne following cell notation to answer the questions that follow:	
		Al(s)/	$Al^{3+}(aq) // Pb^{2+}(aq) / Pb(s); E_{cell}^{\theta} = +1.53 V$	
		(i)	State what the symbol / represents.	(1 mark)
		(ii)	Write the equation for the cell reaction.	(1 mark)
		(iii)	Given that E^{θ} value for $Pb^{2+}(aq) / Pb(s)$ is $-0.13 V$ calculate the E^{θ} value $Al^{3+}(aq)/Al(s)$.	e for (2 marks)
				••••••
		(iv)	State one use of electrochemical cells.	(1 mark)
				••••••

(b) Figure 2 shows a cell used to electrolyse water.

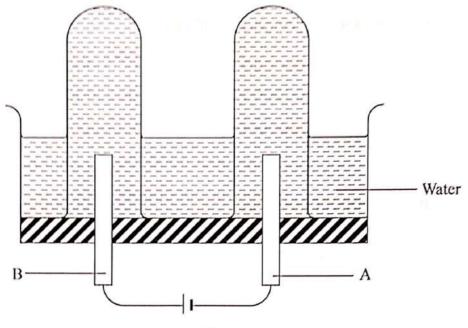


Figure 2

(i)	State why it is necessary to add dilute sulphuric(VI) acid to the water.	(1 mark)
(ii)	State the electrode at which oxygen is produced and give a reason.	
	de agrecia de la companione de la compan	
(iii)	Write an equation for the formation of oxygen.	(1 mark)

		(iv)	After was 22	electrolysing the water for 88 seconds, the volume of oxygen 3.0 cm ³ . Determine the:	n gas collected
			I.	volume of hydrogen gas collected	(1 mark)
			Π.	amount of current used (1 Faraday = 96500C)	(3 marks)
				(11 araday = 50500C)	
				1 1917	
4.	(a)	State	and ex	plain how a catalyst affects:	
		(i)	rate o	of a reaction	(2 marks)
					•••••••
			•••••		
		<u>.</u>			
		(ii)	yield	of the products	(1 mark)
			•••••		
			•••••		••••••
					••••••



(b) Rates of reactions are measured using various methods. In the decomposition of hydrogen peroxide, the rate is measured by recording the volume of oxygen gas produced with time.

Other than measuring volume of gas produced, describe a method that can be used to measure the rates of each of the following reactions.

(i) Sodium thiosulphate with hydrochloric acid.

$S_2O_3^{2-}(aq) + 2H^+(aq) \rightarrow S(s) + SO_2(g) + H_2O(l)$	(2 marks)

(ii) Acidified potassium manganate(VII) with iron(II) sulphate.

		(1 mark)
••••••	, , , , , , , , , , , , , , , , , , ,	

 $MnO_4^-(aq) + 5Fe^{2+}(aq) + 8H^+(aq) \rightarrow Mn^{2+}(aq) + 5Fe^{3+}(aq) + 4H_2O(1)$

Turn over

(c) In an experiment, the rate of decomposition of 50 cm³ of hydrogen peroxide in the presence of manganese(IV) oxide was measured. Figure 3 shows a graph of the results obtained.

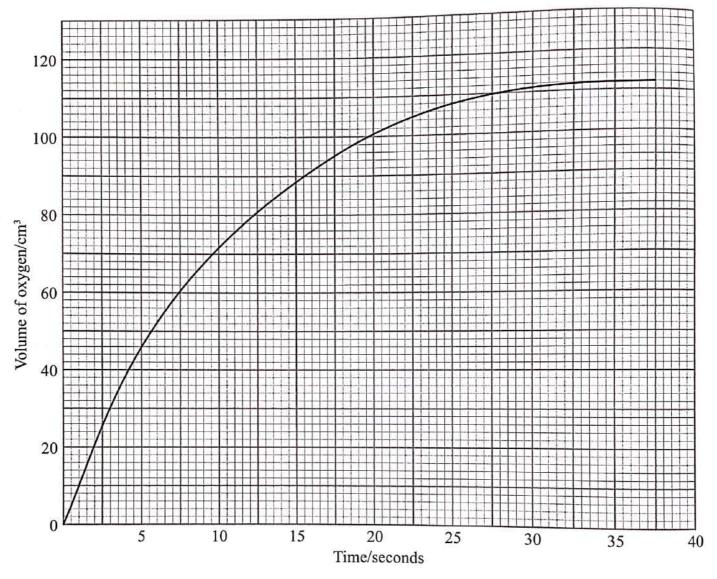


Figure 3

(i)	Write an equation for the reaction.	(1 mark)

(ii)	Using the graph, determine the maximum number of moles of oxygen					
	(Molar gas volume at room temperature and pressure $= 24 \mathrm{dm}^3$).	(2 marks)				
(iii)	Calculate the concentration in moles per litre of hydrogen peroxide.	(2 marks)				
(iv)	Determine the rate of decomposition at the 18th second.	(1 mark)				
		······				
(v)	State and explain one factor that would increase the rate of decomposition of the hydrogen peroxide.	tion of (1 mark)				
		5.932				

5.	(a)	Expla gas ar	in how id disti	concentrated sulphuric(VI) acid can be prepared from sulphur(VI) lled water.	I) oxide (2 marks)	
		•••••	•••••			
			••••••			
	(b)	Conc	entrated	d sulphuric(VI) acid acts as a dehydrating and as a drying agent.		
		(i)	Give	an example of a gas that can be dried using concentrated sulphuri-	(1 mark)	
			**********			65
		(ii)		plete the following equations to show how concentrated sulphurical as a dehydrating agent.	(VI) acid	
			I.	$C_{12}H_{22}O_{11} \longrightarrow$	(1 mark)	
			II.	$CoCl_2 \cdot 6H_2O \longrightarrow$	(1 mark)	
		(iii)	State	the observations made when concentrated sulphuric(VI) acid dehy	vdrates:	
		,		$C_{12}H_{22}O_{11}$	(1 mark)	
			1.	C12-22-11	(1 mark)	
			II.	CoCl ₂ · 6H ₂ O	(1 mark)	2053
					······································	
	(c)			operties of concentrated sulphuric(VI) acid which are illustrated by actions:	the	
		(i)	•	$+ 2H_2SO_4(1) \rightarrow 3SO_2(g) + 2H_2O(1)$	(1 mark)	
			••••••			



		(ii)	$NaNO_3(s) + H_2SO_4(l) \rightarrow HNO_3(aq) + NaHSO_4(s)$	(1 mark)
	(d)	When ethan	a a mixture of 5 cm ³ ethanol, 1 cm ³ concentrated sulphuric(VI) acid and 5 oic acid was heated in a beaker, a pleasant smelling compound was formed	cm ³ ed.
		(i)	state the role of the concentrated sulphuric(VI) acid.	(1 mark)
387				
		(ii)	write the formula of the pleasant smelling compound.	(1 mark)
				••••••
6.		us types ury cell.	s of cells are used to electrolyse concentrated sodium chloride. One of the	m is the
	(a)	Name	another type of cell used.	(1 mark)
· S	(b)	The m	nercury cell uses titanium or graphite as anode and mercury as cathode. So not used for the anode.	tate why (1 mark)
205				
	(c)	At the	anode, chloride ions and not hydroxide ions are oxidised. Give a reason.	(1 mark)



(d)	Descri	be using equations, how sodium hydroxide and hydrogen are produced i	n the cell. (3 marks)
			••••••
			••••••
			••••••
	•••••		•••••
	•••••		
	•••••		
(e)	Give t	wo reasons why it is necessary to recycle the mercury used in the cell.	(2 marks)
	•••••		
			•••••
(f)		roducts of electrolysis of concentrated sodium chloride find extensive use ries. State the role of chlorine and sodium hydroxide in the paper industry	
	(i)	Chlorine	(1 mark)
	(ii)	Sodium hydroxide	(1 mark)

of two ionic compounds that can be used to prepare lead(II) (1 mark)	(i)	(a)	7.
eous ammonia reacted with one mole of phosphoric(V) acid. for the reaction that took place. (1 mark)	(ii)		

(b) Solid copper(II) sulphate is available either as anhydrous or hydrated salt. Figure 4 shows enthalpy changes involved when water is added to each solid.

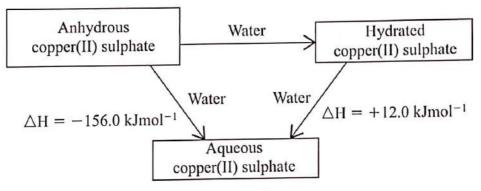


Figure 4

(i) Calculate the enthalpy change for the process:

C	uSO ₄ (s) –	$\xrightarrow{\text{Water}}$ CuSO ₄	• 5H ₂ O(s)	(1 mark)

		(ii)	Describe how each of the following can be prepared starting with aqueous copper(II) sulphate.		
			1.	hydrated copper(II) sulphate.	(2 marks
387					
			II.	anhydrous copper(II) sulphate.	(1 mark
	(c)	Alum	inium h	ydroxide is used as an antacid.	
		(i)	Name	another compound that is used as an antacid.	(1 mark)
2053					
		(ii)	The concentration of hydrochloric acid in the stomach is 0.01 M. If an antacid containing aluminium hydroxide is used, calculate the mass of the antacid required to neutralise 100.0 cm ³ of the stomach acid		
			(Al =	27.0; $O = 16.0$; $H = 1.0$).	(3 marks)
			•••••		
			•••••		
			•••••		
			••••••		
		50	•••••		
	60		•••••		
			•••••		•••••••
			•••••		



THIS IS THE LAST PRINTED PAGE.