FORM TP 2014150



MAY/JUNE 2014

CARIBBEAN EXAMINATIONS COUNCIL

CARIBBEAN ADVANCED PROFICIENCY EXAMINATION®

CHEMISTRY

UNIT 1 - Paper 02

2 hours 30 minutes

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

- 1. This paper consists of SIX questions in TWO sections. Answer ALL questions.
- 2. For Section A, write your answers in the spaces provided in this booklet.
- 3. For Section B, write your answers in the spaces provided at the end of each question in this booklet.
- 4. ALL working MUST be shown.
- 5. You may use a silent, non-programmable calculator to answer questions.
- 6. A data booklet is provided.

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.

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SECTION A

Answer ALL questions.

Write your answers in the spaces provided in this booklet.

MODULE 1

FUNDAMENTALS IN CHEMISTRY

1.	(a)	Defin	the terms
		(i)	mole
			[2 marks]
		(ii)	molar mass (include the units).
			[2 marks]
	(b)	A carb with h	onate of a metal, M, has the formula M_2CO_3 . The equation for the reaction of M_2CO_3 ydrochloric acid is given below.
			$M_2CO_3(aq) + 2HCl(aq) \rightarrow 2MCl(aq) + CO_2(g) + H_2O(l)$
		6.125 require	g of $\rm M_2CO_3$ was used to prepare 1 dm³ of solution. 40 cm³ of the solution was ed to neutralize exactly 23.6 cm³ of 0.150 mol dm⁻³ hydrochloric acid.
		(i)	Calculate
			a) the number of moles of M ₂ CO ₃
			<u> </u>
	A A	O_{i}	
	X	V	
			[2 marks]

	b)	the relative molecular mass of M_2CO_3 .	
			f2 mark
(ii)	Dedu	ice the identity of M.	
Outline page 2.		experimental steps required to carry out the rea	[2 mark
	•		

KINETICS AND EQUILIBRIA

2.	(a)	(i)	State the Bronsted–Lowry theory of acids and bases.
		(ii)	Distinguish between a 'strong acid' and a 'weak acid'.
			[2 marks]
	(b)	25 cm	³ of 0.1 mol dm ⁻³ hydrochloric acid is titrated with 0.1 mol dm ⁻³ of aqueous ammonia
		(i)	In the space below, sketch the curve which is expected to illustrate the changes that take place during titration.

[2 marks]

(ii)	Suggest an indicator, giving a reason for your choice.		Y	
		V		
		V	2 mar	ks]

(c) A solution of a halic acid, HOX, readily decomposes at room temperature with oxygen as the only gaseous product. The data in the table below applies to the decomposition of aqueous HOX at room temperature.

Experiment	Initial Concentration of HOX (mol dm ⁻³)	Initial Rate (mol dm ⁻³ s ⁻¹)
I	1.6×10^{-3}	0.12
II	2.4 × 10♣	0.18
III	3.2 × 10.3	0.24

(i) Deduce the order of the reaction.

[1 mark]

(ii) Calculate the rate constant for the decomposition.

[2 marks]

(d)	(i)	Magnesium filings were added to the remaining solution at 2 (c). What observation is expected?
	(ii)	Outline an alternative experimental method to determine the rate of decomposition of HOX at room temperature.
		[4 marks]
		Total 15 marks
X	0	
	4	

CHEMISTRY OF THE ELEMENTS

3.	(a)	Defin the term 'transition element'.	, (
	(b)	Cignletin [Dt(NH) Cl 1 is a drug used in concer treatment	[2 marks]		
	(b)	Cisplatin, [Pt(NH ₃) ₂ Cl ₂], is a drug used in cancer treatment. (i) Deduce the oxidation number of the platinum atom.			
		(ii) Suggest the shape of the cisplatin molecule.	[1 mark]		
		- X	[1 mark]		
	(c)	(i) Complete the diagrams below by inserting arrows to show configuratio of EACH ion.	the electronic		
		a) Fe ²⁺ : [Ar]	4s		
		b) Mn ²⁺ . [Ar]			
		(ii) Use the information in (c) (i) b) to explain why Mn ²⁺ ions resist or ions.	[2 marks] xidation to Mn ³⁺		
	X				
			[2 marks]		

	пО	В	C	D CI-
[Co(OI	$[O]_4^{1/2}$ $[O]_4^{1/2}$ $[O]_4^{1/2}$ $[O]_4^{1/2}$ $[O]_4^{1/2}$	$Co(H_2O)_6]^{2+}(aq) =$	$\operatorname{IH}_3 = [\operatorname{Co(NH}_3)_6]^{2+}(\operatorname{aq})$	$\stackrel{\text{C1}}{\Longrightarrow} [\text{Co}(\text{Cl}_4)]^{2-(4)}$
(i)	List the colour o	of the following io	ons:	
	B:)
	C:			
	D:			[3
(ii)	Sketch the arran	gement of bonds	in the ion labelled C.	
		3		
		10		
		10.		[2

[2 marks]

SECTION B

Answer ALL questions.

Write your answers in the spaces provided at the end of each question.

MODULE 1

MODULE 1

FUNDAMENTALS IN CHEMISTRY

4.	(a)	Carbon	combines with hydrogen covalently to form a gas, ethane.
		(i)	State the electronic configuratio of carbon in its ground state using sp notation. [1 mark]
			Account for the number and type of orbitals around EACH carbon atom in a molecule of ethane. [3 marks]
		(iii)	Use the VSEPR theory to deduce the arrangement of the orbitals and the bond angles around EACH carbon atom in a molecule of dichloroethane, CH ₂ ClCH ₂ Cl. [3 marks]
	(b)	(i)	State THREE assumptions of the kinetic theory as it pertains to ideal gases. [3 marks]
		(ii)	Under what conditions of temperature and pressure will a real gas deviate from ideal gas behaviour? [1 mark]
	(c)		with a mass of 0.299 g was collected in a 400 cm ³ container at a pressure of 0.4 Pa and a temperature of 25 °C.
		Calcula	te the relative molecular mass (M _r) of the gas.
			$[R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}]$ [4 marks]
			Total 15 marks
Write	the an	swer to Q	Question 4 here.
(a)	(i)		
	(ii)		
	X	V	
		•	

Write the answer	to Question 4 here.
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(a) (iii)

(b)	(i)	
	×	

Write th	ıe	answer	to	Question	4	here.
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(b)	(ii)	1

(c)

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KINETICS AND EQUILIBRIA

5.	(a)	Defin	the terms	
		(i)	solubility	[2 marks]
		(ii)	solubility product.	[2 marks]
	(b)		°C, a saturated solution of lead(II) azide, $Pb(N_4)_2$, is prepared by g in water to make 100.0 cm ³ of solution.	y dissolving
		(i)	Calculate the solubility, in mol dm ⁻³ , of the lead(II) azide.	[2 marks]
		(ii)	Lead(II) azide dissociates in a saturated solution according to the follow	ing equation:
			$Pb(N_3)_2(s) \Longrightarrow Pb^{2+}(aq) + 2N_3^-(aq)$	
			Write the expression for the solubility product of lead(II) azide.	[2 marks]
		(iii)	Calculate the solubility product of lead(II) azide.	[2 marks]
	(c)	(i)	Sketch a diagram showing the distribution of energies in a gas temperature, T_1 .	s at a given [2 marks]
		(ii)	On the same diagram as in 5 (c) (i), insert another curve showing the of energies of the molecules at a higher temperature, T_2 .	e distribution [1 mark]
		(iii)	Using your sketch, explain the difference in the rates of reaction at T_1 and T_2 .	temperatures [2 marks]
			Tot	al 15 marks
Write	e the ans	swer to	Question 5 here.	
(a)	(i)			
()	(-)			
		4	<i></i>	

Write the answer to Question 5	here.	5 here.
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(a) (ii) _____

(b) (i)

(ii)

(iii)

Write the answer to Quest	tion 5	here.
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 $(c) \qquad (i) - (ii)$

(iii)			
	7		
X	U		
	· 	 	

CHEMISTRY OF THE ELEMENTS

6.	(a)	Defin	the term 'polarization'.	[2 marks]
	(b)	(i)	State the trend in ionic size of the elements from Na to Al.	[1 mark]
		(ii)	Explain the following observation. (Include relevant equations answer.)	s to support your
			The pH of an aqueous solution of sodium chloride corresponding value for aluminium chloride is 3.	is 7, while the [7 marks]
	(c)	A, of tetrach	a stream of chlorine gas is passed through an aqueous solution of molecular mass 212.5, a reddish-brown solution, B, is formed. sloromethane in a separatory funnel produces C, a purple organilless aqueous layer.	Shaking B with
		(i)	State the name of the halide ion in A.	[1 mark]
		(ii)	Write the formula equation for the reaction of A with chlorine.	[2 marks]
		(iii)	Describe an additional simple test to confir the identity of the	halide ion in A. [2 marks]
Write (a)	e the an	swer to	Question 6 here.	Total 15 marks
		0.		
	X			

te tne a	answer to Question 6 here.
(i)	
(ii)	
X	
· ·	

Writ	te the ansv	ver to Question 6 here.	
(c)	(i)		
	(··)		
	(ii)		
	(iii)		
	X(
	X	END OF TEST	
	S.		
.0	IF YOU	END OF TEST FINISH BEFORE TIME IS CALLED, CHECK YOUR WO	ORK ON THIS TEST. 02112020/CAPE