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S6 Mock Examination (2021-2022) Chemistry Paper 1 (2 hours 30 minutes)

## **SECTION B : Question-Answer Book B**

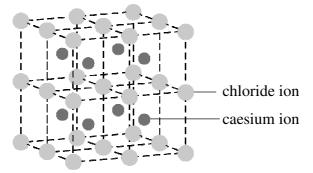
## INSTRUCTIONS FOR SECTION B

- 1. Write your name, class and class number in the spaces provided on this page.
- 2. Refer to the general instructions on the cover of the Question Book for Section A.
- 3. This section consists of TWO parts.
- 4. Answer ALL questions in each part. Write your answers in the spaces provided in this Question-Answer Book.
- 5. A Periodic Table is printed on the back of this Question-Answer Book. Atomic numbers and relative atomic masses of elements can be obtained from the Periodic Table.
- 6. An asterisk (\*) has been put next to the questions where one mark will be awarded for effective communication.

## **PART I**

Answer ALL questions. Write your answers in the spaces provided.

1. The diagram below shows the structure of caesium chloride.



(a) Draw the electron diagram for caesium chloride, showing ELECTRONS IN THE OUTERMOST SHELLS only.

(1 mark)

(b) Given that the density of caesium chloride crystal is 3.99 g cm<sup>-3</sup> under room conditions. Calculate the volume (in cm<sup>3</sup>) of one mole of caesium chloride crystals.

(Relative atomic masses: Cl = 35.5, Cs = 132.9)

(2 marks)

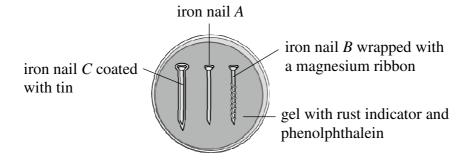
(c) How many chloride ions are surrounding one caesium ion?

(1 mark)

(d) Explain why caesium chloride is hard.

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2. The following diagram shows a set-up for investigating the factors that influence rusting. The set-up is allowed to stand under room conditions for two days.



(4 marks)

(b) Explain why iron nail C does NOT rust.

(1 mark)

(c) For iron nail *B*, there are some white solids formed on the surface of magnesium ribbon. Explain, with the aid of an ionic equation, such observation.

3. Consider the following reaction:

$$6OF_2 + 4N_2 + O_2 \rightarrow 4NF_3 + 4NO_2$$

(a) Identify the reducing agent in the above reaction. Explain briefly.

(1 mark)

(b) Select a molecule from the above equation which does NOT obey the octet rule.

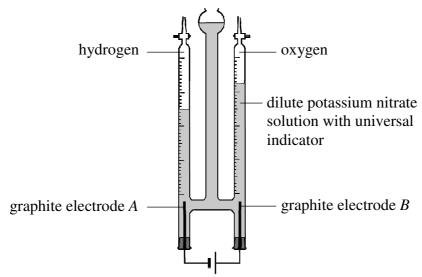
(1 mark)

(c) (i) Draw the three-dimensional structure of a nitrogen trifluoride molecule.

(ii) State and explain whether nitrogen trifluoride molecules are polar.

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4. The diagram below shows a Hofmann voltameter. It is used for measuring the volume of gaseous products during electrolysis. In the following set-up, dilute potassium nitrate solution with a few drops of universal indicator is electrolysed to give hydrogen and oxygen.



(a) With reference to the Electrochemical Series, explain why hydrogen formed at electrode A.

(2 marks)

- (b) After some time,  $60 \text{ cm}^3$  of hydrogen is collected above electrode A.
  - (i) Determine the theoretical volume of oxygen collected above electrode B at the same time.

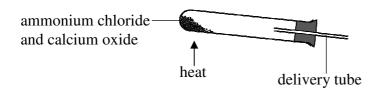
(ii) However, the actual volume of oxygen collected is less than the theoretical one. Suggest a reason for this.

4.	(c)	With the aid of a half equation, state and explain the colour change of the solution around electrode <i>A</i> during the electrolysis.
		(3 marks)

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5. To prepare ammonia gas, a solid mixture of ammonium chloride and calcium oxide is heated in a boiling tube. An incomplete set-up for the experiment is shown below:



(a) Write a chemical equation for the reaction of ammonium chloride with calcium oxide.

(1 mark)

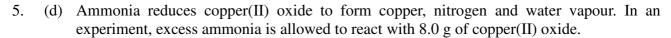
(b) Explain why the boiling tube is clamped in a slant position.

(1 mark)

(c) Add suitable drawing and label(s) to the diagram to show how ammonia can be collected.

(2 marks)

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(i) Write a chemical equation for the reaction involved.

(ii) Calculate the theoretical mass of copper obtained.

(Relative atomic masses: O = 16.0, Cu = 63.5)

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6.	The following ed	quation rea	presents the	hvdration o	f anhvd	rous copp	er(II	sulphat	e:
· ·	The folio wing o	9 4 4 4 5 11 1 5 1	or obolito tile	il j di di ci ci c	i cuilly con	coas copp		, saipiiae	,

$$CuSO_4(s) + 5H_2O(1) \rightarrow CuSO_4 \cdot 5H_2O(s)$$

(a) State the expected observation when a drop of water is added to anhydrous copper(II) sulphate.

(1 mark)

- (b) The enthalpy change of hydration of anhydrous copper(II) sulphate can be determined by applying Hess's Law.
  - (i) State the Hess's Law.

(ii) Given the following thermochemical equations:

$$CuSO_4(s) \rightarrow CuSO_4(aq)$$

$$\Delta H_1 = -156 \text{ kJ mol}^{-1}$$

$$CuSO_4 \cdot 5H_2O(s) \rightarrow CuSO_4(aq) + 5H_2O(l)$$

$$\Delta H_2 = +12 \text{ kJ mol}^{-1}$$

Calculate the enthalpy change of hydration of anhydrous copper(II) sulphate.

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6. (c) A student performed an experiment to determine the enthalpy change of dissolution of anhydrous copper(II) sulphate ( $\Delta H_1$ ). The student added 0.042 mol of anhydrous copper(II) sulphate to 50.0 cm<sup>3</sup> of distilled water in a beaker. The maximum temperature rise of the solution was 9.0°C.

(	i)	State	with	explanation.	an im	provement	for	the:	above	exp	erimen	t
١	1,	Diace,	** 1 (11	CAPIUIIUII	, աու ուու		101	uic i	above	CAP	CITITICI	

(ii) Calculate the enthalpy change of dissolution of anhydrous copper(II) sulphate.

(Assume that the density and specific heat capacity of the solution were the same as those of water, i.e.  $1.0~{\rm g~cm^{-3}}$  and  $4.2~{\rm J~K^{-1}~g^{-1}}$  respectively.)

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7. After an electroplating experiment, the electrolytic solution contains chromium(III) ions. To determine the concentration of chromium(III) ions in the solution, 25.0 cm³ of 0.20 M aqueous ammonia is added to 25.0 cm³ of the electrolytic solution to form insoluble chromium(III) hydroxide. The resultant mixture is filtered and the precipitate is washed thoroughly with distilled water. After that, the filtrate (containing the unreacted aqueous ammonia) is titrated against 0.22 M hydrochloric acid. 16.50 cm³ of the acid is required to reach the end point.

dist	lled water. A	resultant mixtu after that, the f ydrochloric acid	iltrate (conta	ining the u	nreacted aqu	ieous amn	nonia) is titra	
(a)	Suggest an electrolytic s	apparatus that solution.	is used to a	dd 25.0 cm	<sup>3</sup> of 0.20 M	aqueous	ammonia to	the
(b)	What is the	colour of chron	nium(III) hyd	lroxide?			(1 m	ark)
` /			\					

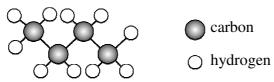
- (c) Based on the titration result, calculate
  - (i) the number of moles of unreacted aqueous ammonia in the filtrate, and

7.	(c)	(ii)	the concentration of chromium(III) ions in the electrolytic solution.	
				marks)
	(d)	Wh in tl	nat assumption has been made for determining the concentration of chromium(I he electrolytic solution?	II) ions
			(1	1 mark)

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8. Compound K is a saturated carbon compound. The structure of K is shown below:



(a) What is meant by the term 'saturated' when describing carbon compounds?

(1 mark)

(b) Write the empirical formula of K.

(1 mark)

- (c) Compound L has the same molecular formula as K.
  - (i) Write a possible structural formula of L.

(ii) Which compound, K or L, has a higher boiling point? Explain your answer.

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*9.	9. Four unlabelled gas jars each contains one of the following color	urless gases:
	oxygen ethane ethene argon	
	Suggest some tests to distinguish the four gases.	
		(5 marks)

## **PART II**

10. Consider the following equilibrium:

$$2NOCl(g) \rightleftharpoons 2NO(g) + Cl_2(g)$$

In an experiment, 2.00 mol dm<sup>-3</sup> of NOCl(g) was introduced into a closed container and allowed to reach equilibrium at a certain temperature. At equilibrium, 0.66 mol dm<sup>-3</sup> of NO(g) was found in the reaction mixture.

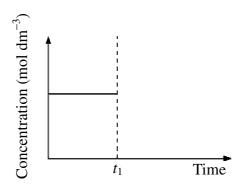
(a) Calculate the equilibrium concentrations of NOCl(g) and Cl<sub>2</sub>(g) respectively.

(2 marks)

(b) Write the expression for the equilibrium constant for the reaction and calculate its value at that temperature.

(2 marks)

(c) The following graph shows the equilibrium concentration of NO(g).



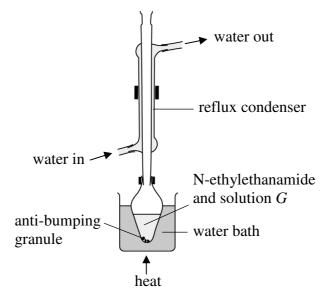
The volume of the container is reduced at time  $t_1$ . On the above graph, sketch the change in concentration of NO(g) with time from time  $t_1$  until a new equilibrium is reached.

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11.	Con (a)	which oxide has a giant covalent structure?	
	(b)	(1 mar Briefly describe the trend of acid-base nature of the oxides of elements from Na to Cl.	rk)
	(c)	(i) Name the oxide that shows the strongest basic properties.	rk)
		(ii) State what would be observed when the oxide mentioned in (i) is added to red littre solution.	nus
	(d)	(3 mark Write a chemical equation for the reaction occurred when phosphorus pentoxide is add to distilled water.	
		(1 mai	rk)

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12. In an experiment, a mixture of N-ethylethanamide and solution *G* is heated under reflux. Ethanoic acid is one of the products of the reaction. The set-up for the experiment is shown below:



(a) Write the structural formula of N-ethylethanamide.

(1 mark)

(b) Suggest what solution G is.

(1 mark)

(c) What is the function of reflux condenser in the set-up?

12.	(d)	Ethanoic acid can be separated from the reaction mixture by distillation. Draw a label diagram of the set-up for distilling the reaction mixture.	led
	(e)	Besides ethanoic acid, name another product formed in the reaction.	ks)
		(1 ma	rk)

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13. The structure of compound P is shown below:

P reacts with concentrated sulphuric acid at high temperatures to form two isomeric compounds Q and R. Q is the cis-isomer while R is the trans-isomer.

(a) In the above diagram, label the chiral carbon(s) of the compound by using an asterisk '\*'.

(1 mark)

(b) Name the type of reaction between *P* and concentrated sulphuric acid.

(1 mark)

(c) Draw the structures of Q and R respectively.

(2 marks)

- (d) Q undergoes addition polymerization to give a polymer.
  - (i) What is meant by the term 'addition polymerization'?

(ii) Draw a segment of the polymer, showing TWO repeating units.

(2 marks)

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*14.	. Describe how you would perform an experiment to follow the progress of the alka hydrolysis of methyl methanoate by titrimetric method.	aline
	$HCOOCH_3(l) + NaOH(aq) \rightarrow HCOONa(aq) + CH_3OH(aq)$	
	(5 ma	arks)

END OF SECTION B

END OF PAPER

PERIODIC TABLE 周期表

GROI	GROUP 族				ato	atomic number 原子序	lber 原	子序									
				\	\												0
				1													2
				Н													He
Н		,		1.0								III	IV	Λ	VI	VII	4.0
3												5	9	7	8		10
r Li					/							В	ပ	Z	0		Ne
6.9					/							10.8	12.0	14.0	16.0		20.2
	12				rel	lative ato	mic mas	55 相對	lative atomic mass 相對原子質量			13	14	15	16	17	18
Na												A	Si	Ь	S		Ar
23.0												27.0	28.1	31.0	32.1		40.0
19		_		23	24	25	26	27	28	29	30	31	32	33	34		36
×				>	Ċ	Mn	Fe	ပိ	Z	Cu	Zn	Сa	Ge	As	Se		Kr
39.1				6.05	52.0	54.9	55.8	58.9	58.7	63.5	65.4	69.7	72.6	74.9	79.0		83.8
37				41	42	43	44	45	46	47	48	49	50	51	52		54
Rb				$^{\mathbf{q}}$	$M_0$	Tc	Ru	Rh	Pd	$\mathbf{Ag}$	Cd	In	$\mathbf{Sn}$	$\mathbf{S}\mathbf{p}$	Te		Xe
85.5		$\overline{}$		92.9	95.9	(86)	101.1	102.9	106.4	107.9	112.4	114.8	118.7	121.8	127.6		131.3
55				73	74	75	9/	77	78	62	80	81	82	82	84		98
C				Тa	*	Re	Os	Ir	Pt	Αu	$_{ m Hg}$	I	Pb	Bi	$P_0$	At	Rn
132.9		_		180.9	183.9	186.2	190.2	192.2	195.1	197.0	200.6	204.4	207.2	209.0	(209)	$\overline{}$	(222)
87		** 68	104	105													
F																	
(223)	_	_															

*	28	29	09	61	62	63	64	65	99	29	89	69	70	71	
	Ce	Pr	PN	Pm	Sm	Eu	РS	$\mathbf{T}\mathbf{b}$	Dy	Ho	Er	Tm	$\mathbf{A}\mathbf{P}$	Lu	
	140.1	140.9	144.2	(145)	150.4	152.0	157.3	158.9	162.5	164.9	167.3	168.9	173.0	175.0	
* *	06	91	92	93	94	95	96	26	86	66	100	100	102	103	
	Th	Pa	n	dN	Pu	Am	Cm	Bk	Ct	Es	Fm	Md	No	L	
	232.0	(231)	238.0	(237)	(244)	(243)	(247)	(247)	(251)	(252)	(257)	(258)	(259)	(260)	