



Cambridge International Examinations

Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME					
CENTRE NUMBER			CANDIDATE NUMBER		

CHEMISTRY 9701/21

Paper 2 Structured Questions AS Core

May/June 2014

1 hour 15 minutes

Candidates answer on the Question Paper.

Additional Materials: Data Booklet

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use an HB pencil for any diagrams or graphs.

Do not use staples, paper clips, glue or correction fluid.

DO **NOT** WRITE IN ANY BARCODES.

Answer all questions.

Electronic calculators may be used.

You may lose marks if you do not show your working or if you do not use appropriate units.

A Data Booklet is provided.

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [] at the end of each question or part question.



International Examinations

Answer **all** the questions in the spaces provided.

1	(a)	Ехр	lain what is meant by the term ionisation energy.
			[3]
	(b)	The	first seven ionisation energies of an element, A , in kJ mol ⁻¹ , are
			1012 1903 2912 4957 6274 21269 25398.
		(i)	State the group of the Periodic Table to which ${\bf A}$ is most likely to belong. Explain your answer.
			[2]
		(ii)	Complete the electronic configuration of the element in Period 2 that is in the same group as A .
			1s ² [1]
	(c)	forn	other element, Z , in the same period of the Periodic Table as A , reacts with chlorine to a compound with empirical formula $\mathbf{ZC}l_2$. The percentage composition by mass of $\mathbf{ZC}l_2$, 31.13; $\mathbf{C}l$, 68.87.
		(i)	Define the term <i>relative atomic mass</i> .
			[2]
		(ii)	Calculate the relative atomic mass, A_r , of Z . Give your answer to three significant figures.

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(d)		chlorides of elements in Period 3 of the Periodic Table show different behaviours on lition to water, depending on their structure and bonding.
	(i)	Write equations to show the behaviour of sodium chloride, NaC l , and silicon chloride, SiC l_4 , when separately added to an excess of water.
		NaC1
		$\operatorname{SiC} l_4$ [2]
	(ii)	State and explain the differences in behaviour of these two chlorides when added to water, in terms of their structure and the bonding found in the compounds.
		[4]
(e)	Sulf	fur reacts with fluorine to form SF ₆ . State the shape and bond angle of SF ₆ .
	sha	pe of SF ₆
	bon	d angle of SF ₆
		[2]
		[Total: 18]

2		mmonest form of iron(II) sulfate is the heptahydrate, FeSO ₄ .7H ₂ O. On heating at 90 °C es some of its water of crystallisation to form a different hydrated form of iron(II) sulfate, xH_2O .
	3.40 g c	of FeSO ₄ .xH ₂ O was dissolved in water to form 250 cm ³ of solution.
		cm 3 sample of this solution was acidified and titrated with 0.0200moldm^{-3} potassium nate(VII).
		itration 20.0cm^3 of this potassium manganate(VII) solution was required to react fully with ions present in the sample.
	(a) The	$e MnO_4^-$ ions in the potassium manganate(VII) oxidise the Fe ²⁺ ions in the acidified solution.
	(i)	Explain, in terms of electron transfer, the meaning of the term <i>oxidise</i> in the sentence above.
		[1]
	(ii)	Complete and balance the ionic equation for the reaction between the manganate (VII) ions and the iron(II) ions.
		$\label{eq:mnO4} MnO_4^-(aq) \ + \ 5Fe^{2+}(aq) \ + \H^+(aq) \ \rightarrow \(aq) \ + \ 5Fe^{3+}(aq) \ + \H_2O(I) \ \ [3]$
	(b) (i)	Calculate the number of moles of manganate(VII) used in the titration.
		[1]
	(ii)	Use the equation in (a)(ii) and your answer to (b)(i) to calculate the number of moles of Fe ²⁺ present in the 25.0 cm ³ sample of solution used.
		[4]
	(iii)	[1] Calculate the number of moles of FeSO ₄ .xH ₂ O in 3.40 g of the compound.
		[1]
	(iv)	Calculate the relative formula mass of FeSO ₄ .xH ₂ O.
		7.41
		[1]

(v) The relative formula mass of anhydrous iron(II) sulfate, FeSO $_4$, is 151.8.

[1]

[Total: 9]

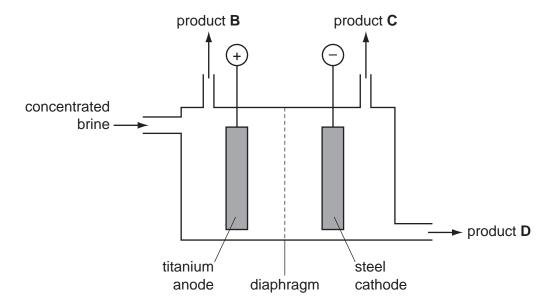
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Calculate the value of x in FeSO₄.xH₂O.

3

(a)		his question, K , L and M refer to a halogen atom or halide ion. each part question, read the information and complete the answer lines below.
	(i)	When concentrated sulfuric acid is added to solid Na K , white fumes are produced that turn damp blue litmus paper red. No other colour changes are observed.
		identity of K =
		equation for reaction
		explanation of observation
		[3]
	(ii)	When silver nitrate solution is added to an aqueous solution of NaL, a precipitate forms that remains after the addition of concentrated ammonia solution.
		identity of L =
		colour of precipitate
		equation for reaction
	(iii)	\mathbf{M}_{2} is a liquid at room temperature with a boiling point higher than that of chlorine but lower than that of iodine.
		identity of M =
		explanation
		[2]

(b) The diagram below is a simplified representation of a diaphragm cell.



(i) Identify each of the products.

В	
С	
D	
	[3]

(ii) Give the equations for the two electrode reactions.

anode	
cathode	
	[2]

[Total: 13]

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Alkanes and alkenes both react with bromine.

)	Explain how and why bromine can be used to distinguish between an alkene and an alkane.
	[2]
)	The reaction of ethane with bromine forms a mixture of products.

(b)

(i)	State the essential conditions for this reaction to occur.	
		[1]

(ii) Give the full name of the mechanism of this reaction.

(iii) Give the equation for a **termination** step that could occur, producing a **hydrocarbon**.

(iv)	Give the equation for one propagation step involved in the formation of dibromoethane
. ,	from bromoethane during this reaction.

......[2]

(c) The reaction of ethene with bromine forms a single product.

Include all relevant charges, partial charges, curly arrows and lone pairs.

[4]

(d)	Chloroethene can be polymerised to form a polymer commonly known as PVC.
	Draw a diagram of the structure of PVC including three repeat units.

[2]

(e) Chloroethane undergoes a series of reactions as shown in the diagram below.

product
$$\mathbf{Q}$$

NaCN

 $H \longrightarrow C \longrightarrow C \longrightarrow H$
 $C \longrightarrow$

(i)	Give the reagent and conditions necessary for reaction 1.
	[2]

1	'ii\	Give the	skeletal	formula	of	product	P
١		Olve the	Sheiclai	IUIIIIuia	OI	product	

[1]

(iii) Give the displayed formula and the name of product Q.

.....[2]

[Total: 20]

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