

CANDIDATE
NAME

--

CENTRE
NUMBER

--	--	--	--	--

CANDIDATE
NUMBER

--	--	--	--

CHEMISTRY

9701/21

Paper 2 AS Level Structured Questions

May/June 2018

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.

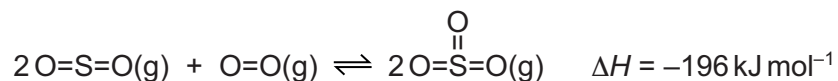
This document consists of **11** printed pages and **1** blank page.



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

- 1 Sulfuric acid is manufactured by the Contact process.

One stage in this process is the conversion of sulfur dioxide into sulfur trioxide in the presence of a heterogeneous catalyst of vanadium(V) oxide, V_2O_5 .



- (a) (i) State the effect of a catalyst on a reaction.
Explain how a catalyst causes this effect.

.....

 [2]

- (ii) State the meaning of the term *heterogeneous* as applied to catalysts.

.....

 [1]

- (b) Some bond energies are given.

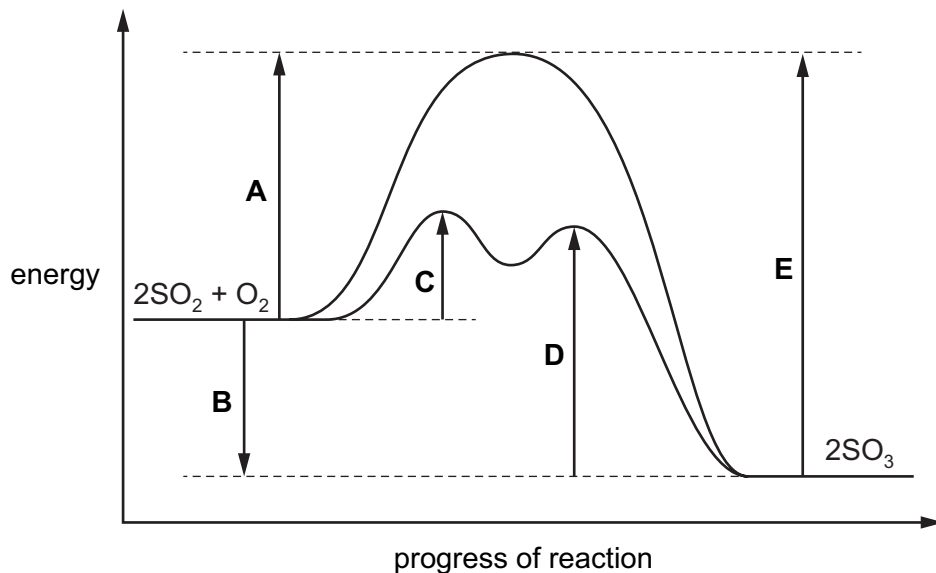
bond	bond energy / kJ mol^{-1}
S=O (in SO_2)	534
O=O	496

Use the data, and the enthalpy change for the conversion of sulfur dioxide into sulfur trioxide, to calculate a value for the S=O bond energy in SO_3 .

S=O bond energy in SO_3 = ... kJ mol^{-1} [2]

The Contact process is usually carried out at a temperature of about 400 °C and a pressure just above atmospheric pressure. Using a higher or lower temperature and pressure would affect both the rate of production of sulfur trioxide and the yield of sulfur trioxide.

- (c) A reaction pathway diagram for both the catalysed and uncatalysed reactions between SO_2 and O_2 is shown.



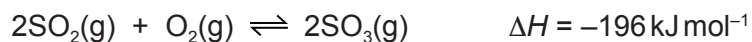
The letters **A–E** represent energy changes.

Complete the table by stating which letter, **A–E**, represents the energy change described.

energy change	letter
the energy change for the production of SO_3	
the activation energy for the production of SO_3 in the absence of a catalyst	
the activation energy for the first step in the decomposition of SO_3 in the presence of a catalyst	

[3]

The equation for this stage of the Contact Process is shown.



- (d) (i) State and explain the effect of increasing temperature on the rate of production of SO_3 .

.....
.....
.....
..... [3]

- (ii) State and explain the effect of increasing temperature on the yield of SO_3 .

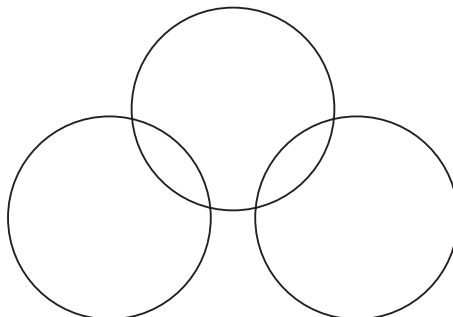
.....
.....
.....
..... [3]

- (e) The SO_3 produced is converted to sulfuric acid in two stages. In the first stage the SO_3 is reacted with concentrated sulfuric acid to produce oleum, $\text{H}_2\text{S}_2\text{O}_7$.
The oleum is then reacted with water to form sulfuric acid.

Suggest an equation for the reaction of oleum, $\text{H}_2\text{S}_2\text{O}_7$, with water to form sulfuric acid.

..... [1]

- (f) SO_2 reacts with water to form sulfurous acid. Sulfurous acid is a weak Brønsted-Lowry acid, while sulfuric acid is a strong Brønsted-Lowry acid.
- (i) Complete the 'dot-and-cross' diagram to show the bonding in a molecule of SO_2 . Show outer electrons only.



[1]

- (ii) State the meaning of the term *strong Brønsted-Lowry acid*.

.....
.....
..... [2]

- (iii) Write an equation to show the acid-base behaviour of sulfuric acid with water. Include state symbols.

..... [2]

[Total: 20]

2 Crude oil is a complex mixture of hydrocarbon molecules.

The hydrocarbon molecules in crude oil are separated by fractional distillation. Fractional distillation is used because the different hydrocarbon molecules in crude oil have different boiling points.

(a) Explain why the hydrocarbon molecules in crude oil have different boiling points.

.....

.....

.....

.....

.....

.....

..... [2]

(b) Some of the hydrocarbon molecules obtained from crude oil are processed further by cracking.

Suggest why some hydrocarbon molecules are processed further by cracking.

.....

.....

..... [1]

(c) Cracking one mole of dodecane, $C_{12}H_{26}$, produces two moles of ethene and one mole of another hydrocarbon molecule.

(i) Write the equation for this cracking reaction.

..... [1]

The ethene can be used in the production of poly(ethene).

(ii) Give the full name of the process used to produce poly(ethene) from ethene.

..... [1]

- (iii) Give **two** reasons why poly(ethene) should be reused or recycled rather than just thrown away.

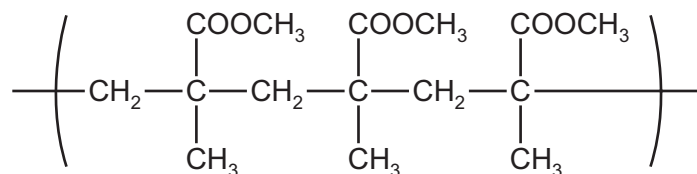
.....

.....

.....

..... [2]

- (iv) Part of a polymer chain, produced by the same type of process as poly(ethene), is shown.



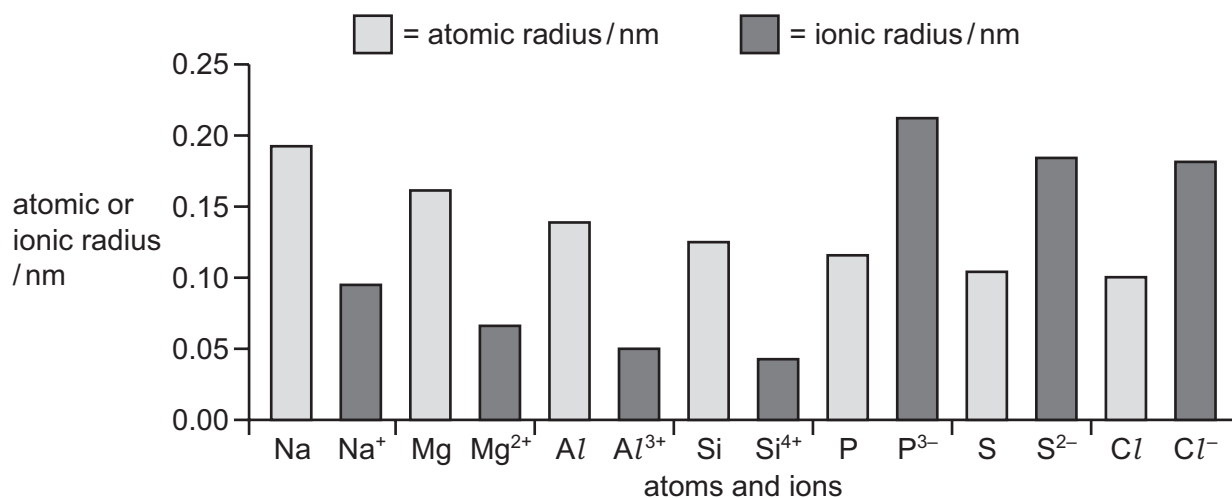
Give the **displayed** formula of the monomer used to produce this polymer.

[2]

[Total: 9]

- 3 The elements in the third period exhibit periodicity in both their chemical and physical properties.

(a) A graph of the atomic and ionic radii across the third period is shown.



- (i) Explain the decrease in atomic radius across the third period.

.....

 [2]

- (ii) Explain why, for sodium to silicon, the ionic radii are less than the atomic radii.

..... [1]

- (iii) Explain why, for phosphorus to chlorine, the ionic radii are greater than the atomic radii.

..... [2]

- (b) The first ionisation energies of the elements across the third period show a general increase.

Aluminium and sulfur do **not** follow this general trend.

- (i) Explain why aluminium has a lower first ionisation energy than magnesium.

..... [2]

- (ii) Explain why sulfur has a lower first ionisation energy than phosphorus.

.....

.....

..... [2]

- (c) The elements in the third period, from sodium to silicon, can react with chlorine to form chlorides.

- (i) State and explain the pattern of change of oxidation number which occurs to both chlorine and the different Period 3 elements when they react together.

.....

.....

.....

..... [3]

- (ii) Give the equations to show the reactions of sodium chloride and silicon(IV) chloride when separately added to water.

sodium chloride

silicon(IV) chloride [2]

- (iii) Complete the table to describe the structure and bonding in sodium chloride and silicon(IV) chloride.

	structure	bonding
sodium chloride		
silicon(IV) chloride		

[2]

[Total: 16]

4 **X** is $\text{CH}_3\text{CH}(\text{OH})\text{CH}_2\text{CH}_3$.

(a) The reaction between **X** and alkaline aqueous iodine produces a yellow precipitate.

(i) Give the name of the compound formed as a yellow precipitate in this reaction.

..... [1]

(ii) Give the name of **X**.

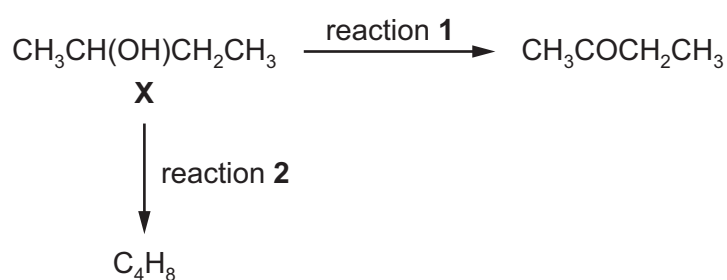
..... [1]

(b) There are three structural isomers of **X** that are alcohols.

Draw the structures of these three isomers of **X**.

[2]

(c) Two reactions of **X** are shown.



(i) Identify the type of reaction involved in reaction 1.

..... [1]

(ii) Identify the reagents for reaction 1.

..... [1]

- (iii) Reaction 2 can be carried out by passing the vapour of **X** over hot aluminium oxide.

The product of reaction 2, C_4H_8 , is actually a mixture of three isomers.

Give the full names of the three isomers formed by reaction 2.

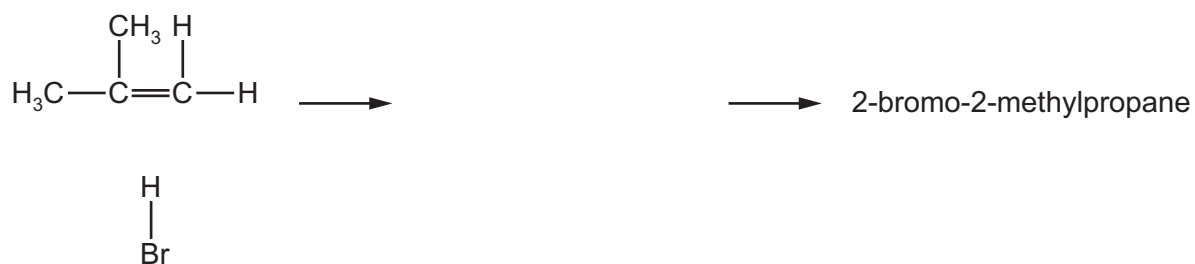
- 1
- 2
- 3 [3]

- (d) The reaction of methylpropene, $(CH_3)_2CCH_2$, with hydrogen bromide, HBr, produces a mixture of two halogenoalkanes.

One of the halogenoalkanes, 2-bromo-2-methylpropane, is formed as the major product while 1-bromo-2-methylpropane is formed in small quantities.

- (i) Complete the mechanism to show the reaction of methylpropene with HBr to form the **major** product.

Include the structure of the intermediate and all necessary charges, dipoles, lone pairs and curly arrows. The structure of 2-bromo-2-methylpropane is not required.



[4]

- (ii) Explain why 2-bromo-2-methylpropane is the major product of this reaction.

.....

.....

.....

..... [2]

[Total: 15]

BLANK PAGE

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge International Examinations Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at www.cie.org.uk after the live examination series.

Cambridge International Examinations is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.

CANDIDATE
NAME

--

CENTRE
NUMBER

--	--	--	--	--

CANDIDATE
NUMBER

--	--	--	--



CHEMISTRY

9701/22

Paper 2 AS Level Structured Questions

May/June 2018

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.

This document consists of **10** printed pages and **2** blank pages.

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

1 Sodium and magnesium are the first two elements in the third period.

(a) Sodium and magnesium both react with cold water to produce the same type of product in solution. With sodium the solution is clear but with magnesium it appears cloudy.

(i) Write an equation for the reaction of magnesium with cold water.

..... [1]

(ii) Suggest why the solution is cloudy after the reaction of magnesium with cold water.

.....
 [1]

(b) Group 2 elements, including magnesium, react with oxygen and with dilute acids. There are trends in both the physical and chemical properties of the elements and their compounds down the group. Reactivity generally increases from Mg to Ba.

(i) Explain why there is a general increase in reactivity from Mg to Ba.

.....

 [2]

(ii) Give **two** observations for the reaction of magnesium with oxygen. Write an equation for this reaction. Include state symbols.

.....

 equation [3]

(iii) Write an equation for the reaction of magnesium with sulfuric acid.

..... [1]

(iv) Suggest why there is a general **decrease** in the melting points of the elements down Group 2.

.....

 [3]

[Total: 11]

2 Ammonium iron(II) sulfate, $(\text{NH}_4)_2\text{Fe}(\text{SO}_4)_2$, has a relative formula mass, M_r , of 284.

(a) Define the term *relative formula mass*.

.....

.....

.....

..... [2]

(b) One of the cations in ammonium iron(II) sulfate is the ammonium ion, NH_4^+ .

(i) Draw a 'dot-and-cross' diagram of an ammonium ion. Show outer shell electrons only.

Use $\times$ to show electrons from nitrogen.
Use $\bullet$ to show electrons from hydrogen.

[2]

(ii) Suggest the shape of an ammonium ion and predict the bond angle.

shape

bond angle [2]

(c) In aqueous solution the ammonium ion acts as a weak Brønsted-Lowry acid.

(i) Explain the meaning of the term *weak Brønsted-Lowry acid*.

.....

.....

.....

..... [2]

(ii) Write an equation to show this behaviour of the ammonium ion in water. Include state symbols.

..... [2]

(d) Mohr's salt, $(\text{NH}_4)_2\text{Fe}(\text{SO}_4)_2 \cdot x\text{H}_2\text{O}$, is the hydrated form of ammonium iron(II) sulfate.

x represents the number of moles of water in 1 mole of the salt.

A student wanted to determine the value of x. 0.784 g of the hydrated salt was dissolved in water and this solution was acidified.

All of the solution was titrated with $0.0200 \text{ mol dm}^{-3}$ potassium manganate(VII). 20.0 cm^3 of this potassium manganate(VII) solution was required for complete reaction with the Fe^{2+} ions.

(i) Use changes in oxidation numbers to balance the equation for the reaction taking place.



(ii) State the role of the Fe^{2+} ions in this reaction.

Explain your answer.

.....
 [2]

(iii) Calculate the amount, in moles, of manganate(VII) ions that reacted.

amount = ... mol [1]

(iv) Calculate the amount, in moles, of Fe^{2+} ions in the sample of the salt.

amount = ... mol [1]

(v) Calculate the relative formula mass of $(\text{NH}_4)_2\text{Fe}(\text{SO}_4)_2 \cdot x\text{H}_2\text{O}$.

relative formula mass = ... [1]

(vi) Calculate the value of x .

x = ... [1]

[Total: 17]

3 Most vehicle fuels contain hydrocarbons obtained from crude oil.

- (a) (i) State the name of the type of reaction that hydrocarbons undergo when being used as fuels.

..... [1]

- (ii) Write an equation for the reaction of octane, C_8H_{18} , as a fuel, as in (a)(i).

..... [2]

- (b) The supply of material suitable for use as fuels directly from crude oil is **not** sufficient to meet demand. A process is carried out to make some of the larger hydrocarbon molecules more useful.

- (i) Name this process.

..... [1]

As well as producing fuels, this process produces compounds suitable for use in the production of polymers. An example of such a compound is but-2-ene, $CH_3CH=CHCH_3$.

- (ii) Draw the repeat unit of the polymer that is produced from but-2-ene.

[2]

- (iii) Name the type of polymerisation that occurs during the production of the polymer in (ii).

..... [1]

- (c) Gases produced in internal combustion engines include carbon monoxide, oxides of nitrogen such as NO_2 , and unburnt hydrocarbons.

These gases are removed from the exhaust before they can enter the atmosphere.

- (i) State what is used to remove these gases from the exhaust.

..... [1]

- (ii) Write **one** equation to show how both carbon monoxide, CO , and nitrogen dioxide, NO_2 , are removed from the exhaust.

..... [1]

- (iii) State the environmental consequence of allowing unburnt hydrocarbons to enter the atmosphere.

..... [1]

- (d) Vehicle fuels are treated to remove sulfur. If sulfur is present in a fuel when it is burned, SO_2 is produced and may be released into the atmosphere where it can form acid rain.

- (i) Acid rain can contribute to breathing difficulties.

Identify **two** other consequences of acid rain in the atmosphere.

.....

 [2]

- (ii) NO_2 is involved in the production of acid rain from SO_2 .

Give **two** equations which describe how acid rain is formed by the action of NO_2 with SO_2 .

.....
 [2]

- (iii) NO_2 is described as a catalyst during this process.

Explain, with the use of an appropriate equation, why NO_2 is described as a catalyst.

.....
 [2]

[Total: 16]

4 **W** is $\text{CH}_3\text{COCH}_2\text{CH}_3$.

(a) The reaction between **W** and alkaline aqueous iodine produces a yellow precipitate.

(i) Give the name of the compound formed as a yellow precipitate in this reaction.

..... [1]

(ii) Give the name of **W**.

..... [1]

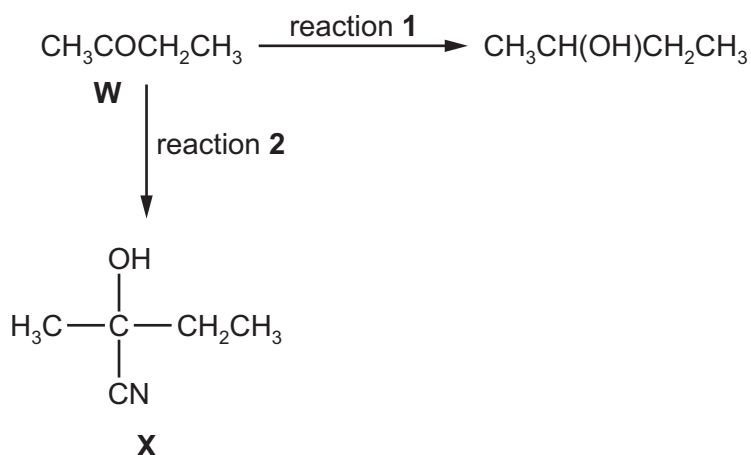
(b) There are two structural isomers of **W** that are also carbonyl compounds.

Draw the structures of these two isomers of **W**.

--	--

[2]

Two reactions of **W** are shown.



(c) (i) Identify the type of reaction occurring in reaction 1.

..... [1]

(ii) Identify the reagent for reaction 1.

..... [1]

- (d) Reaction 2 is carried out by adding a mixture of HCN and NaCN to **W**.
The product, **X**, is formed as a mixture of two isomers.

- (i) Complete the mechanism for this reaction.

Include the structure of the intermediate formed and all necessary charges, dipoles, lone pairs and curly arrows.



- (ii) State the name of the type of isomerism shown by **X**.

..... [1]

- (iii) Explain fully why **X** shows this type of isomerism.

.....

 [2]

Question 4 continues on page 10.

- (e) If **X** is treated with ammonia and the product hydrolysed, a compound, **Y**, is obtained that contains 51.3% C, 9.40% H, 12.0% N and 27.3% O by mass.
- (i) Show that the empirical formula of **Y** is $\text{C}_5\text{H}_{11}\text{NO}_2$.

[2]

- (ii) The empirical formula of **Y** is $\text{C}_5\text{H}_{11}\text{NO}_2$ and the M_r of **Y** is 117.

Deduce the molecular formula of **Y**. You **must** explain your reasoning.

molecular formula = ...

.....

.....

[1]

[Total: 16]

BLANK PAGE

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge International Examinations Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at www.cie.org.uk after the live examination series.

Cambridge International Examinations is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.

CANDIDATE
NAME

--

CENTRE
NUMBER

--	--	--	--	--

CANDIDATE
NUMBER

--	--	--	--

CHEMISTRY

9701/23

Paper 2 AS Level Structured Questions

May/June 2018

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.

This document consists of **11** printed pages and **1** blank page.

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

1 The elements sodium to chlorine, in the third period, all form oxides.

(a) Draw a diagram to show the shape of the molecule of each of the oxides, SO_3 and Cl_2O . Name each shape.

In SO_3 each oxygen atom forms a double bond with the sulfur atom.

SO_3	Cl_2O

[4]

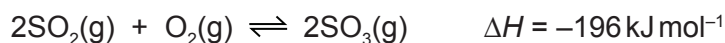
(b) (i) Explain why the melting point of MgO is higher than that of Na_2O .

[2]

(ii) Explain why the melting point of SiO_2 is much higher than that of SO_3 .

[2]

- (c) SO_3 is produced by the reaction between SO_2 and O_2 in the Contact process. A dynamic equilibrium is established.



- (i) Explain why increasing the total pressure, at constant temperature, increases the rate of production of SO_3 and increases the yield of SO_3 .

rate

.....

.....

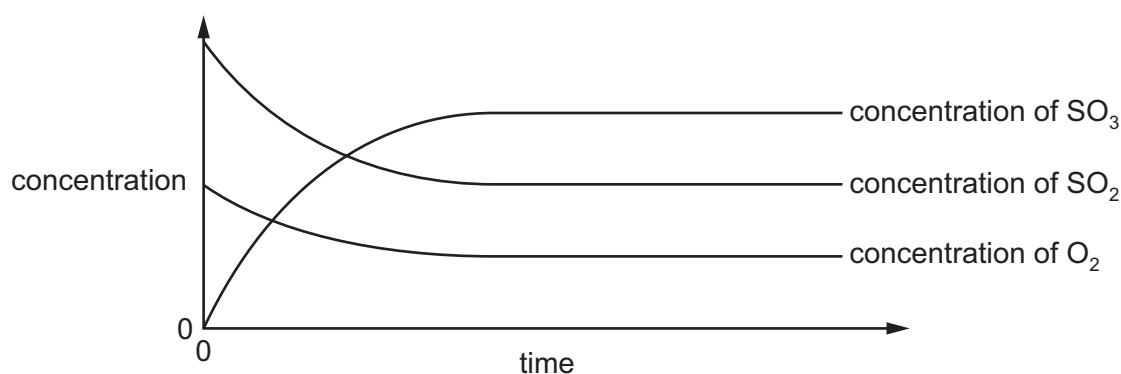
yield

.....

.....

[4]

The graph shows how the concentrations of all three species in the system change with time for a typical reaction mixture. The gradients of all three lines decrease with time and then level off in this dynamic equilibrium.



- (ii) Explain why the gradients of the SO_2 and O_2 lines decrease with time.

.....

..... [2]

- (iii) Explain why all three lines become horizontal.

.....

..... [1]

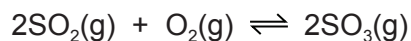
- (iv) Suggest a reason why the initial gradient of the SO_2 line is steeper than that of the O_2 line.

.....

.....

..... [1]

- (d) 2.00 moles of $\text{SO}_2(\text{g})$ and 2.00 moles of $\text{O}_2(\text{g})$ are sealed in a container with a suitable catalyst, at constant temperature and pressure. The resulting equilibrium mixture contains 1.98 moles of $\text{SO}_3(\text{g})$.
The total volume of the equilibrium mixture is 40.0 dm^3 .



- (i) Write the expression for the equilibrium constant, K_c , for the reaction between $\text{SO}_2(\text{g})$ and $\text{O}_2(\text{g})$ to produce $\text{SO}_3(\text{g})$.

$$K_c =$$

[1]

- (ii) Calculate the amount, in moles, of $\text{SO}_2(\text{g})$ and $\text{O}_2(\text{g})$ in the equilibrium mixture.

$$\text{SO}_2(\text{g}) = \dots\dots\dots \text{ mol}$$

$$\text{O}_2(\text{g}) = \dots\dots\dots \text{ mol}$$

[2]

- (iii) Use your answers to (d)(i) and (d)(ii) to calculate the value of K_c for this equilibrium mixture. Give the units of K_c .

$$K_c = \dots\dots\dots$$

$$\text{units} = \dots\dots\dots$$

[3]

[Total: 22]

- 2 One reason for the wide variety of organic compounds is isomerism, either structural isomerism or stereoisomerism.

(a) (i) Explain the meaning of the term *structural isomerism*.

.....
.....
..... [2]

(ii) Explain the meaning of the term *stereoisomerism*.

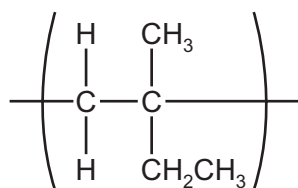
.....
.....
..... [2]

(b) Pent-1-ene, $\text{CH}_2=\text{CH}(\text{CH}_2)_2\text{CH}_3$, does not show stereoisomerism.

(i) Give **two** reasons why pent-1-ene does **not** show stereoisomerism.

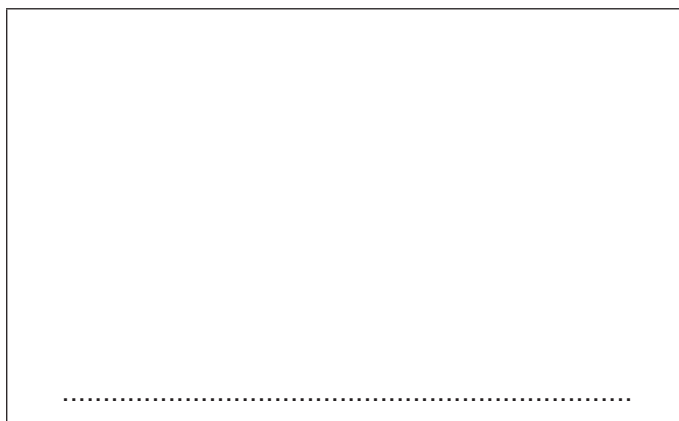
reason 1
.....
reason 2
..... [2]

- (ii) A structural isomer of pent-1-ene is used as the monomer to form a polymer. The repeat unit of this polymer is shown.



Draw the **displayed** formula of the monomer used to make this polymer.

Give the name of the monomer.

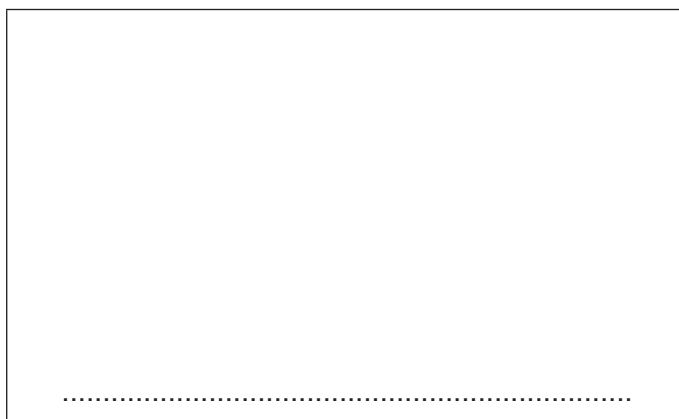


[2]

- (iii) A different structural isomer of pent-1-ene shows geometrical isomerism.

Draw the structure of **one** of the two geometrical isomers with the formula C_5H_{10} .

Give the full name of this isomer.



[2]

[Total: 10]

- 3** The elements in Group 17, the halogens, show trends in both their chemical and physical properties. The elements and their compounds have a wide variety of uses.

(a) At room temperature fluorine and chlorine are gases, bromine is a liquid and iodine is a solid.

(i) State the trend in the volatility of the Group 17 elements down the group.

..... [1]

(ii) Explain this trend.

.....

.....

..... [2]

(b) Iodine, I_2 , can be displaced from $NaI(aq)$, by chlorine, Cl_2 .

Write an equation for this reaction.

..... [1]

(c) Silver nitrate solution, $AgNO_3(aq)$, is added to separate solutions of NaI and $NaCl$. Precipitates form. An excess of aqueous ammonia is then added to both precipitates.

(i) Complete the table to give the colour and name of the precipitate formed in each reaction and the effect of the addition of an excess of aqueous ammonia to each of the precipitates formed.

	$NaI(aq) + AgNO_3(aq)$	$NaCl(aq) + AgNO_3(aq)$
colour of precipitate		
name of precipitate		
effect of addition of an excess of aqueous ammonia to the precipitate		

[3]

(ii) Write an ionic equation, including state symbols, to show the reaction occurring when $AgNO_3(aq)$ is added to $NaI(aq)$.

..... [1]

- (d) Solid NaI reacts with concentrated sulfuric acid to form purple fumes of $I_2(g)$ and hydrogen sulfide gas, $H_2S(g)$.
However, when solid NaCl reacts with concentrated sulfuric acid the only gas produced is $HCl(g)$.

Explain the difference in the reactions of concentrated sulfuric acid with NaI and with NaCl. Your answer should refer to the role of the sulfuric acid in each reaction.

.....

.....

.....

.....

.....

..... [3]

- (e) Chlorine is commonly used in water purification. When chlorine is added to water it reacts to produce a mixture of acids, one of which is chloric(I) acid, $HClO$, a powerful oxidising agent.

(i) Explain the meaning of the term *oxidising agent*, in terms of electron transfer.

.....

.....

..... [1]

(ii) Suggest an equation for this reaction of chlorine with water.

..... [1]

(iii) Write an equation for the reaction of chlorine with **hot** aqueous sodium hydroxide.

Use oxidation numbers to explain why this is a redox reaction.

equation

.....

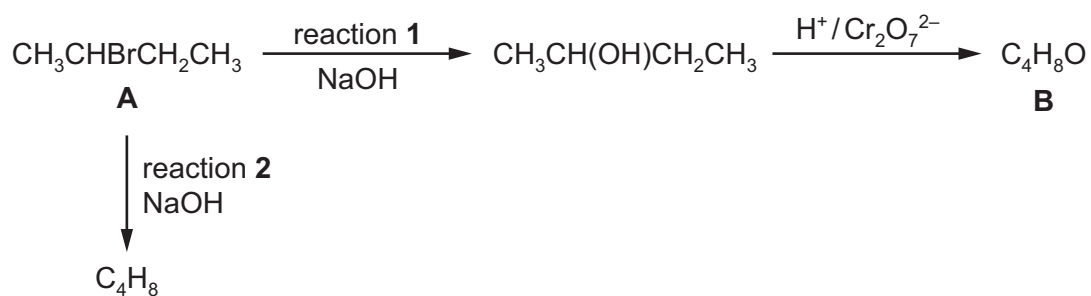
..... [2]

[Total: 15]

Question 4 starts on the next page.

4 **A** is $\text{CH}_3\text{CHBrCH}_2\text{CH}_3$.

(a) Some reactions of **A** are shown.



(i) Name **A**.

..... [1]

(ii) Name the class of compound to which **B** belongs.

..... [1]

(b) There are three structural isomers of **A**.

Draw the structures of these three isomers of **A**.

--	--	--

[2]

(c) Reaction 1 occurs by two different mechanisms at the same time.

These mechanisms are referred to as S_N1 and S_N2 .

(i) State what the letters 'S' and 'N' represent in the abbreviation S_N1 .

S

N

[1]

(ii) Complete the S_N1 mechanism for reaction 1.

Include the structure of the intermediate and all necessary charges, dipoles, lone pairs and curly arrows.



[3]

(d) The S_N1 mechanism for reaction 1 is repeated using $\text{CH}_3\text{CHClCH}_2\text{CH}_3$ or $\text{CH}_3\text{CHICH}_2\text{CH}_3$ in place of the $\text{CH}_3\text{CHBrCH}_2\text{CH}_3$.

State and explain how the rates of these two reactions will compare with the rate of the original reaction using $\text{CH}_3\text{CHBrCH}_2\text{CH}_3$.

.....

.....

.....

.....

..... [3]

(e) Reaction 2 uses the same reagent as reaction 1, but under different conditions.

State **two** differences in the conditions needed to ensure that reaction 2 is more likely to take place than reaction 1 when this reagent is added.

.....

.....

..... [2]

[Total: 13]

BLANK PAGE

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge International Examinations Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at www.cie.org.uk after the live examination series.

Cambridge International Examinations is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.