Oxford Cambridge and RSA

Tuesday 13 May 2025 – Morning

AS Level Chemistry B (Salters)

H033/01 Foundations of chemistry

Time allowed: 1 hour 30 minutes

You must have:
- the Data Sheet for Chemistry B

You can use:
- a scientific or graphical calculator
- an HB pencil

Please write clearly in black ink. **Do not write in the barcodes.**

Centre number | | | | | | Candidate number | | | | |

First name(s) _____

Last name _____

INSTRUCTIONS
- Use black ink. You can use an HB pencil, but only for graphs and diagrams.
- Write your answer to each question in the space provided. If you need extra space use the lined page at the end of this booklet. The question numbers must be clearly shown.
- Answer **all** the questions.
- Where appropriate, your answer should be supported with working. Marks might be given for using a correct method, even if your answer is wrong.

INFORMATION
- The total mark for this paper is **70**.
- The marks for each question are shown in brackets **[ ]**.
- This document has **20** pages.

ADVICE
- Read each question carefully before you start your answer.

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SECTION A

You should spend a **maximum** of **25 minutes** on this section.

Write your answer to each question in the box provided.

1 What is correct about atomic number?

A It is half the mass number for most elements.

B It is the number of neutrons in the nucleus.

C It determines the position of an element in the periodic table.

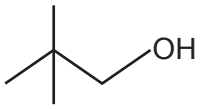
D It varies between isotopes of the same element.

Your answer ☐ **[1]**

2 Which of these is a tertiary alcohol?

A $CH_3CH(OH)CH_3$

B



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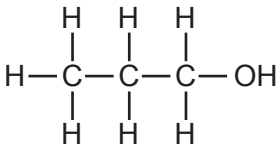

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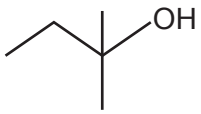

Your answer ☐ **[1]**

3 Which row has the homologous series named correctly?

	Compound	Homologous series
A	CH_3CHO	ketone
B	CH_3NH_2	amine
C	CH_3COOCH_3	carboxylic acid
D	CH_3COCH_3	aldehyde

Your answer ☐ **[1]**

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4 Ethanol can be dehydrated.

$C_2H_5OH \rightarrow C_2H_4 + H_2O$

What process describes this reaction?

A drying

B elimination

C oxidation

D reduction

Your answer ☐ **[1]**

5 A student is measuring the effect of temperature on the rate of reaction of hydrochloric acid with calcium carbonate.

What is a variable that must be controlled?

A mass of calcium carbonate

B size of reacting flask

C temperature

D volume of CO_2 produced

Your answer ☐ **[1]**

6 A substance has a high melting point and is soluble in water.

What is the structure type of the substance?

A covalent network

B ionic

C metallic

D simple molecular

Your answer ☐ **[1]**

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7 The Geiger and Marsden experiment was an important step in discovering the structure of the atom.

What could be deduced from this experiment?

A Atoms consist of balancing positive and negative charges.

B Atoms have a small dense nucleus.

C The electrons in an atom are in energy levels.

D The nucleus contains neutrons.

Your answer ☐ **[1]**

8 What is correct about the emissions from petrol-fuelled cars?

A CO comes from the complete combustion of petrol.

B NO_x is mainly made by the combustion of nitrogen compounds in petrol.

C SO_2 is made by the combustion of sulfur compounds in petrol.

D No unburnt hydrocarbons are emitted.

Your answer ☐ **[1]**

9 How can benzene be described?

A A cycloalkene

B An alkane

C An alkene

D An arene

Your answer ☐ **[1]**

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10 What is a **disadvantage** of using hydrogen rather than methane for burning in home gas boilers?

A Hydrogen can be made by electrolysis of water using alternative energy sources.

B Hydrogen gives no CO_2 when burned.

C Hydrogen is less dense and more likely to leak out of pipes.

D Hydrogen is renewable.

Your answer ☐ **[1]**

11 1-bromopropane reacts with hydroxide ions:

$C_3H_7Br + OH^- \rightarrow C_3H_7OH +$ .....

What is correct?

A 1-iodopropane undergoes a similar reaction but more slowly.

B The missing product is HBr.

C The OH^- ion is acting as a nucleophile.

D This is an addition reaction.

Your answer ☐ **[1]**

12 Sodium hydroxide reacts with sulfuric acid:

$2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$

What volume (in cm^3) of 0.1 mol dm^{-3} NaOH will neutralise 15 cm^3 of 0.2 mol dm^{-3} H_2SO_4?

A 7.5

B 15

C 30

D 60

Your answer ☐ **[1]**

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13 Ethene, C_2H_4, reacts with HBr:

$C_2H_4 + HBr \rightarrow C_2H_5Br$

What mass of HBr (in g) will react exactly with 120 cm^3 of ethene at RTP?

A 0.4

B 0.8

C 4

D 8

Your answer ☐ **[1]**

14 In which row does the compound have the correct systematic name?

	Compound	**Systematic name**
A	Cu_2O	Copper(II) oxide
B	$NaClO$	Sodium hypochlorite
C	$FeSO_4$	Iron(II) sulfate(VI)
D	$KMnO_4$	Potassium permanganate

Your answer ☐ **[1]**

15 Which molecule is most polar?

A BF_3

B CO_2

C CH_3Cl

D CH_3F

Your answer ☐ **[1]**

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16 What is a reaction of methanol, CH_3OH?

A It can be dehydrated to an alkene.

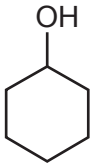
B It can be esterified using another alcohol.

C It can be oxidised to a ketone.

D It can be substituted using HBr.

Your answer ☐ **[1]**

17 A compound has the formula:



What is a reaction of this compound?

A It can be oxidised by acid dichromate(VI) to an aldehyde.

B It gives a purple colour with $FeCl_3$.

C It reacts with $(CH_3CO)_2O$.

D It reacts with Na_2CO_3.

Your answer ☐ **[1]**

18 The first ionisation enthalpies of atoms of the elements increase in general across a period.

Which trend across a period is a reason for this?

A The atoms get larger.

B The tendency to form negative ions increases.

C There are more protons in the nucleus.

D The trend is metals $\rightarrow$ non-metals.

Your answer ☐ **[1]**

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19 25 cm^3 of 0.10 mol dm^{-3} silver nitrate solution reacts with an excess of a sodium halide solution to form 0.59 g of silver halide precipitate.

Which halide is reacting?

A fluoride

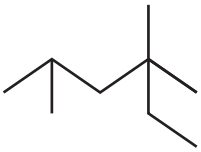
B chloride

C bromide

D iodide

Your answer ☐ **[1]**

20 A branched alkane has the formula:



What is the systematic name of the alkane?

A 2,4,4-trimethylhexane

B 2,4-dimethyl-2-ethylpentane

C 2-ethyl-2,4,4-trimethylbutane

D 3,3-dimethyl-5-methylhexane

Your answer ☐ **[1]**

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Turn over for Section B

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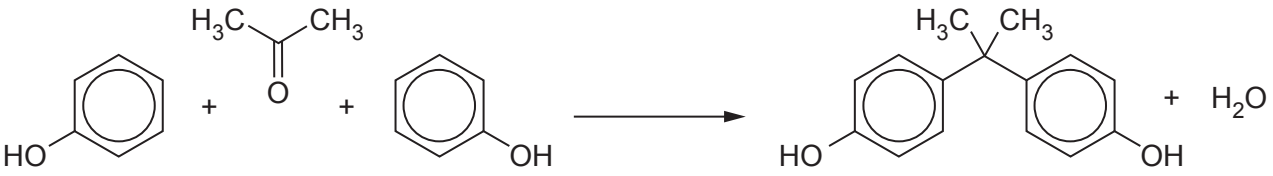
SECTION B

21 Bisphenol A is a starting material for manufacturing plastics, particularly polycarbonate.

Bisphenol A is made by reacting phenol with propanone.



phenol M_r 94 **propanone** M_r 58 **Bisphenol A**

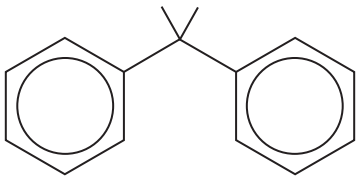
(a) This process is regarded as 'green' because water is the only co-product and the reaction has a high atom economy.

Calculate the atom economy of the process.

Atom economy = ... % **[2]**

(b) An aromatic product is formed when bisphenol A reacts with ethanoic anhydride, $(CH_3CO)_2O$.

Complete the **skeletal** formula of this aromatic product.



[2]

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(c) Bisphenol A can be purified by recrystallisation from dilute ethanoic acid.

Describe the steps in this procedure, stating where soluble and insoluble impurities are removed.

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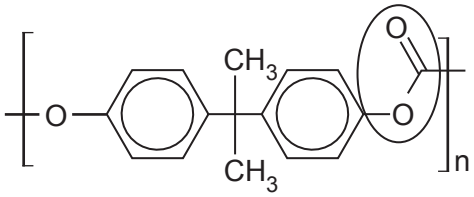
..... **[5]**

(d) Bisphenol A can be converted to polycarbonate.



Polycarbonate

Name the functional group inside the oval ring.

..... **[1]**

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22 Chloroethane, C_2H_5Cl, has a boiling point of 12 °C.

(a) C_2H_5Cl can be made by reacting ethane with chlorine.

Complete the stages for this process:

Stage 1: **Initiation**

Chlorine radicals are formed from chlorine molecules.

The radiation that splits the chlorine molecules is .....

Stage 2: **Propagation**

Give the equations for the two propagation steps:

Step 1

Step 2

Stage 3: **Termination**

One termination reaction is $Cl + Cl \rightarrow Cl_2$

Give the equation of another termination reaction that occurs:

[3]

(b) C_2H_5Cl was once used as an aerosol propellant in spray cans.

It is no longer used because it causes the breakdown of ozone in the stratosphere.

Describe how C_2H_5Cl causes the breakdown of ozone and give **one** effect this ozone breakdown has on life on Earth.

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..... **[4]**

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(c) The boiling point of bromoethane, C_2H_5Br, is higher than that of chloroethane, C_2H_5Cl.

This is because one type of intermolecular bonds are stronger for C_2H_5Br.

State which **type** of intermolecular bonds are stronger for C_2H_5Br.

Explain why they are stronger.

Type of Intermolecular bonds: .....

Explanation: .....

.....

.....
[2]

(d) A scientist has 10.0 g of C_2H_5Cl in a pressurised container.

What volume of gas (in dm^3) would this give at 293 K and 101 000 Pa?

Volume = ... dm^3 **[3]**

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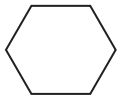
23 Some students are given the hydrocarbon shown.



C_6H_{12}

(a) Give the systematic name of the hydrocarbon.

..... **[1]**

(b) Write the equation for the complete combustion of C_6H_{12}.

[1]

(c) The students look up the enthalpy change of combustion, $\Delta_c H$, of C_6H_{12}.
They find it is negative.

(i) Which one-word term describes a reaction with a negative enthalpy change?

..... **[1]**

(ii) Explain, in terms of bonds broken and made, why some enthalpy changes are negative.

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..... **[1]**

Question 3(c) starts on Page 16

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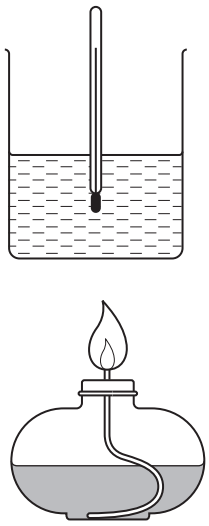
(d) The students set up the apparatus shown below to measure the enthalpy change of combustion of C_6H_{12}.

They burn C_6H_{12} in a spirit burner and measure the rise in temperature of water in a beaker.



(i) The students obtain the following results.

Mass of burner + C_6H_{12} at start	20.2 g
Mass of burner + C_6H_{12} at end	17.6 g
Mass of water in beaker	505 g
Temperature of water at start	20.0 °C
Temperature of water at end	65.5 °C

Use their results to calculate a value for the enthalpy change of combustion, $\Delta_c H$, of C_6H_{12}, in $kJ\,mol^{-1}$.

$\Delta_c H$ of C_6H_{12} = ... $kJ\,mol^{-1}$ **[3]**

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(ii) The value in **(i)** is less negative than the Data Book value.

A student makes two statements:

- One reason for this is that some C_6H_{12} vapour might have evaporated during the process.
- Putting a cap on the lamp at the beginning of the experiment is more important to avoid evaporation than putting it on at the end.

Comment on the student's statements, giving reasons.

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

(e) The mass spectrum of C_6H_{12} has an $(M+1)^+$ peak at 85.

What causes this peak?

.....

..... **[1]**

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24 A group of students are given some sodium iodide, NaI, to investigate.

(a) The students electrolyse a solution of sodium iodide and collect the gaseous product at the cathode (negative electrode).

(i) Draw a labelled diagram of an apparatus they could use.

[4]

(ii) Write the half-equation for the reaction occurring at the cathode (negative electrode).

[2]

(iii) Name the substance formed at the **anode**.

..... **[1]**

(b) The students react sodium iodide solution with chlorine solution.

(i) Write an **ionic** equation for the reaction that occurs.

[1]

(ii) Explain, in terms of electrons, why this reaction indicates that chlorine is more reactive than iodine.

.....

..... **[1]**

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(c) A student says that a pure sample of hydrogen iodide can be made by adding concentrated sulfuric acid to solid sodium iodide.

Comment on this statement, giving the correct chemistry where necessary.

.....

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

(d) This reaction occurs in the manufacture of iodine by reacting NaI with $NaIO_3$.

$5I^- + IO_3^- + 6H^+ \rightarrow 3I_2 + 3H_2O$ **Equation 24.1**

(i) Give the systematic name for the IO_3^- ion.

..... **[1]**

(ii) Identify the reducing agent in **Equation 24.1**.

Explain your answer in terms of the change in oxidation state of the reducing agent.

Reducing agent is: .....

Oxidation state of reducing agent changes from ..... to ..... **[2]**

(iii) Calculate the volume (in cm^3) of 0.24 mol dm^{-3} $NaIO_3$ solution that would react with 15 g of NaI in **Equation 24.1**.

Give your answer to an **appropriate** number of significant figures.

Volume of $NaIO_3$(aq) = ... cm^3 **[3]**

END OF QUESTION PAPER

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EXTRA ANSWER SPACE

If you need extra space use this lined page. You must write the question numbers clearly in the margin.

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