

Please write clearly in block capitals.

Centre number

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Candidate number

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Surname

Forename(s)

Candidate signature

I declare this is my own work.

INTERNATIONAL AS CHEMISTRY (9620)

Unit 2: Organic 1 and Physical 1

Thursday 15 January 2026

07:00 UK Time

Time allowed: 1 hour 30 minutes

Materials

For this paper you must have:

- the Periodic Table/Data Sheet, provided as an insert
- a ruler with millimetre measurements
- a scientific calculator, which you are expected to use where appropriate.

Instructions

- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- All working must be shown.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 70.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
TOTAL	



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

0 1

This question is about the hydrocarbons in crude oil and their uses.

0 1 . 1

Name the process used to separate crude oil into hydrocarbons with similar boiling points.

[1 mark]

0 1 . 2

Petrol is a fuel that is obtained from crude oil.

Explain why sulfur-containing compounds are removed from petrol before it is used as a fuel.

[2 marks]

0 1 . 3

Long chain hydrocarbons can be cracked using thermal cracking or catalytic cracking.

Which row in **Table 1** is correct for thermal cracking?

Tick (✓) **one** box.

[1 mark]

Table 1

Pressure	Main products	Tick (✓) one box
slight	alkenes	
slight	aromatic hydrocarbons	
high	alkenes	
high	aromatic hydrocarbons	



0 1 . 4

One mole of hydrocarbon $C_{18}H_{38}$ can be cracked to form one mole of octane (C_8H_{18}), some ethene and some propene.

Write an equation for this reaction.

[1 mark]

0 1 . 5

Propene can be used to make poly(propene).

Draw the displayed formula of the repeating unit of poly(propene).

[1 mark]

0 1 . 6

Explain why propene melts at a lower temperature than poly(propene).

[2 marks]

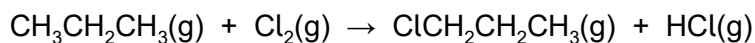
8

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0 2

Propane reacts with chlorine under certain conditions to form 1-chloropropane.



0 2 . 1

Write an equation for the initiation step of this reaction.

State the condition needed for this reaction.

[2 marks]

Initiation step _____

Condition _____

0 2 . 2

Write equations for the **two** propagation steps in the formation of 1-chloropropane.

[2 marks]

Step 1 _____

Step 2 _____

75.0 g of propane react with an excess of chlorine.

The percentage yield of 1-chloropropane is 9.7%

0 2 . 3

Calculate the mass of 1-chloropropane formed in this reaction.

[3 marks]

_____ g

0 2 . 4

Suggest **one** reason why the percentage yield for this reaction is low.

[1 mark]

8



0 3

One mole of oxygen is added to two moles of nitrogen monoxide at a given temperature and pressure.
The gases react to form nitrogen dioxide as shown.

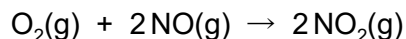
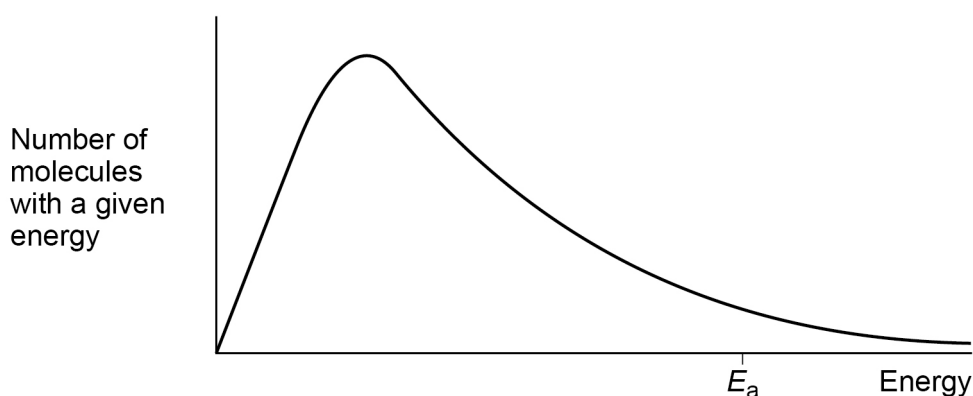


Figure 1 shows the Maxwell–Boltzmann distribution of molecular energies in one mole of this gaseous reaction mixture at this temperature.

E_a is the activation energy for the reaction of oxygen with nitrogen monoxide.

Figure 1



0 3 . 1

Sketch a curve on **Figure 1** to show the distribution of molecular energies of one mole of this gaseous reaction mixture at a higher temperature.

Some molecules can react at the higher temperature but cannot react at the lower temperature.

Show on **Figure 1** the area which represents these molecules.

[3 marks]

0 3 . 2

State the effect, if any, on the value of E_a of increasing the temperature.

[1 mark]

0 3 . 3

State why most collisions between oxygen and nitrogen monoxide molecules do **not** result in a reaction.

[1 mark]



0 4

This question is about compounds with the molecular formula C_6H_{12}

0 4 . 1

Hex-1-ene reacts with concentrated sulfuric acid to form compound **X**,
 $CH_3CH(OSO_3H)CH_2CH_2CH_2CH_3$

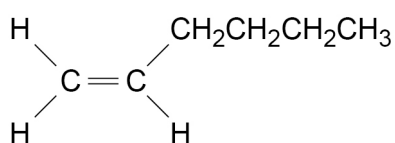
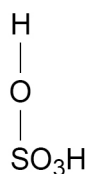
Name the mechanism for this reaction.

Complete the mechanism for the formation of compound **X**.

[5 marks]

Name of mechanism _____

Mechanism



The reaction of hex-1-ene and concentrated sulfuric acid also forms
 $CH_2(OSO_3H)CH_2CH_2CH_2CH_2CH_3$ in smaller amounts than **X**.

0 4 . 2

Draw a compound with molecular formula C_6H_{12} that forms only one product when it reacts with concentrated sulfuric acid.

[1 mark]



0 4 . 3

3-methylpent-2-ene also has the molecular formula C_6H_{12}

Draw *E*-3-methylpent-2-ene.

[1 mark]

0 4 . 4

Give the structure of a compound with molecular formula C_6H_{12} that does **not** have an absorption between 1620 and 1680 cm^{-1} in its infrared spectrum.

Use **Table A** on the Chemistry Data Sheet.

[1 mark]

8

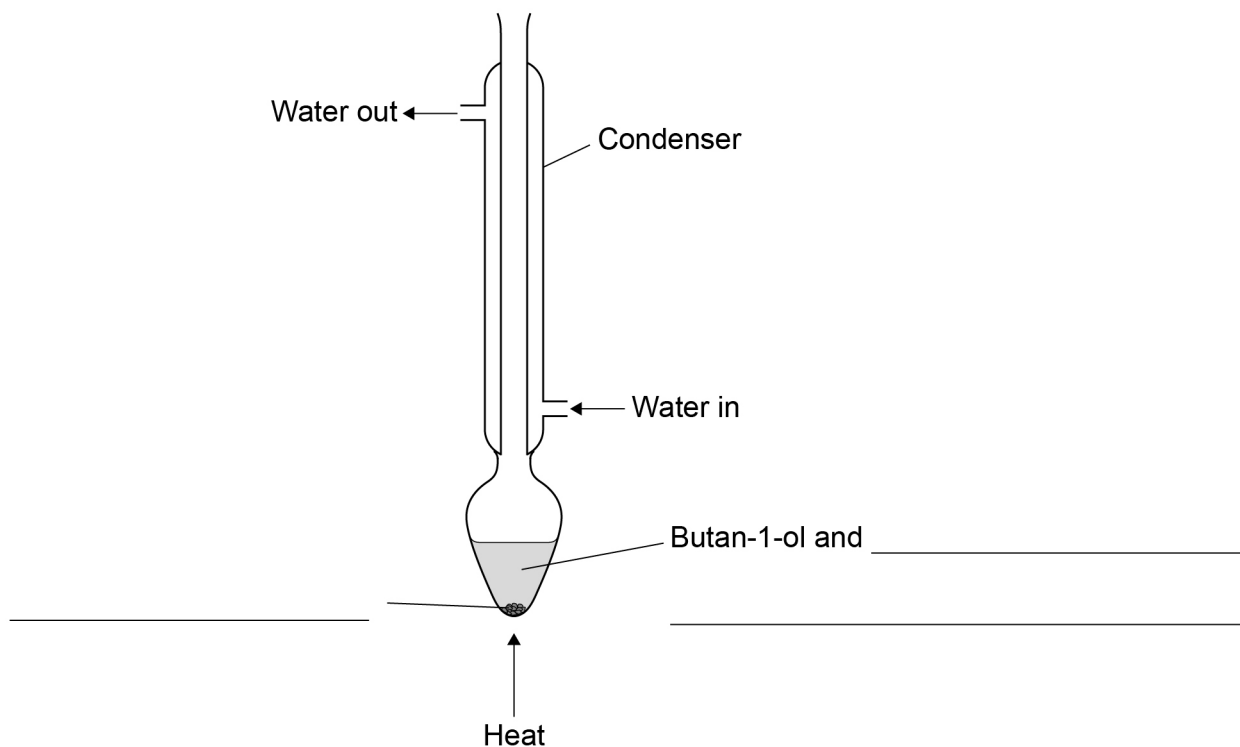
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0 5

This question is about the oxidation of butan-1-ol.

0 5 . 1

Butan-1-ol can be oxidised to butanoic acid using the equipment shown in **Figure 2**.**Figure 2**Complete the labels in **Figure 2**.**[2 marks]**

0 5 . 2

Write an equation for the oxidation of butan-1-ol to butanoic acid.

Use [O] to represent the oxidising agent.

[1 mark]

0 5 . 3

Give a reagent that can be used to confirm the presence of the functional group in butanoic acid.

State the observation with butanoic acid.

[2 marks]

Reagent _____

Observation _____



0 5 . 4 Butan-1-ol can also be oxidised to butanal.

Complete the diagram in **Figure 3** to show how butanal can be collected from the oxidation of butan-1-ol.

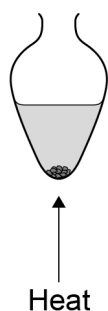
You should include:

- a condenser
- a thermometer
- a test-tube.

You do **not** need to include labels.

[2 marks]

Figure 3



0 5 . 5 Give a reagent, or combination of reagents, that can be used to distinguish between butan-1-ol and butanal.

State the observation with butanal.

[2 marks]

Reagent _____

Observation _____

Question 5 continues on the next page

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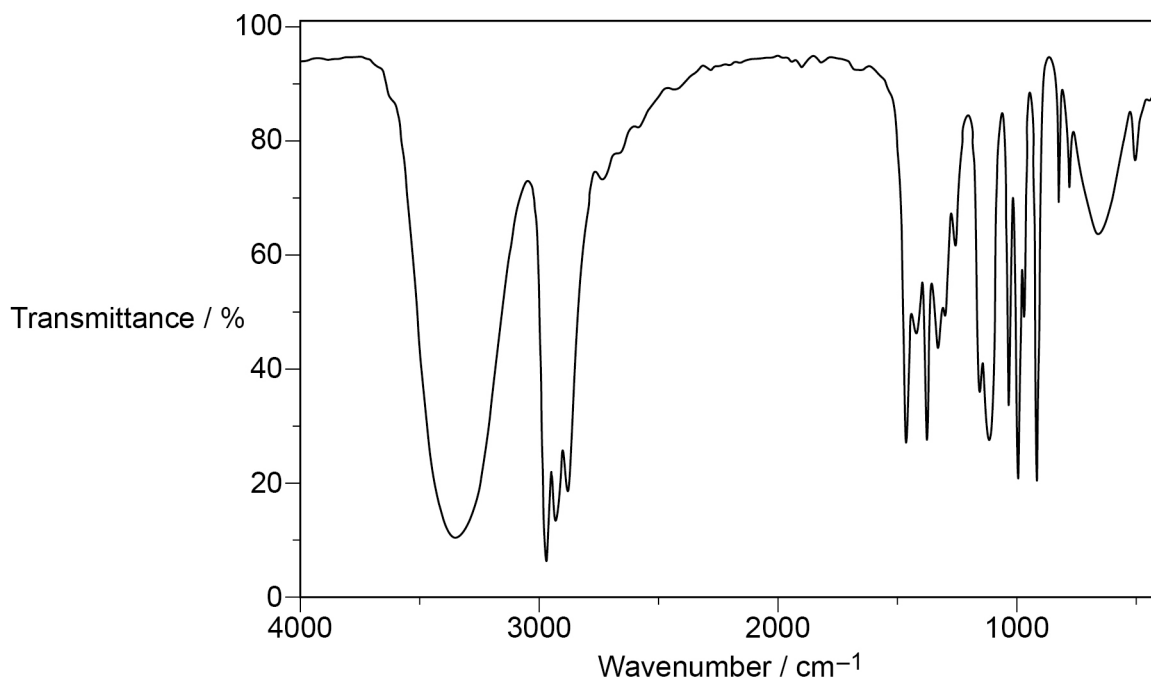


0 5 . 6

Figure 4 shows the infrared spectrum of one of the compounds:

- Butan-1-ol
- Butanal
- Butanoic acid.

Figure 4



Which compound produces this spectrum?

Use **Table A** on the Chemistry Data Sheet.

Tick (✓) **one** box.

[1 mark]

Butan-1-ol

☐

Butanal

☐

Butanoic acid

☐

10



0 6

This question is about epoxyethane.

0 6 . 1

Epoxyethane is formed by the partial oxidation of ethene in the presence of a catalyst.

Write an equation for the formation of epoxyethane from ethene.

[1 mark]

Epoxyethane reacts with methanol to form compound **A** and compound **B** as shown.

Both steps involve one mole of each reactant.

Step 1: methanol + epoxyethane $\rightarrow$ **A**

Step 2: **A** + epoxyethane $\rightarrow$ **B**

0 6 . 2

Give the structures of **A** and **B**.

[2 marks]

A	
B	

0 6 . 3

In **Step 1** and **Step 2**, methanol and **A** both act as nucleophiles.

Explain why methanol and **A** act as nucleophiles.

[1 mark]

4

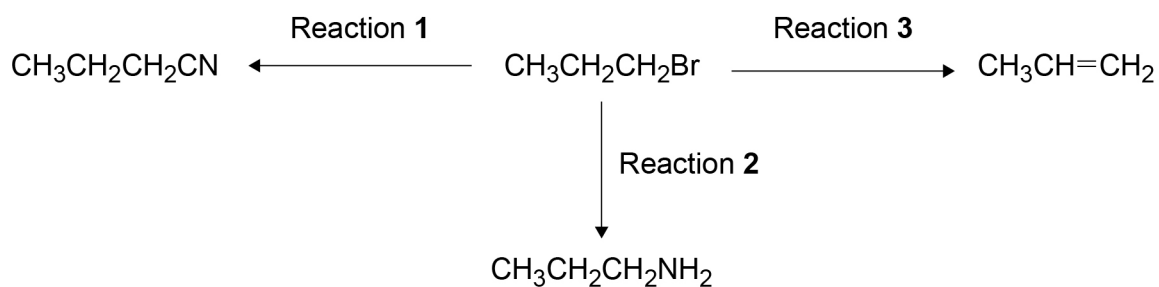
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07

Figure 5 shows some reactions of $\text{CH}_3\text{CH}_2\text{CH}_2\text{Br}$

Figure 5



07.1

Name the mechanism in **Reaction 1**.

[1 mark]

07.2

Use IUPAC rules to name the product of **Reaction 1**.

[1 mark]

07.3

Identify the reagent for **Reaction 2**.

Write an equation for this reaction.

[2 marks]

Reagent _____

Equation _____



0 7 . 4 Sodium hydroxide dissolved in ethanol can be used as the reagent in **Reaction 3**.

Outline the mechanism for this reaction.

State the role of the OH^- ions in this reaction.

[4 marks]

Mechanism

Role of OH^- ions _____

0 7 . 5 Identify a reagent that can be used to show that $\text{CH}_3\text{CH}=\text{CH}_2$ has been formed in **Reaction 3**.

State the observation with $\text{CH}_3\text{CH}=\text{CH}_2$

[2 marks]

Reagent _____

Observation _____

0 7 . 6 A different reaction from **Reaction 3** takes place when $\text{CH}_3\text{CH}_2\text{CH}_2\text{Br}$ reacts with warm aqueous sodium hydroxide.

Identify the organic product of this reaction.

[1 mark]



0	8
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This question is about alkanes.

0	8	.	1
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Alkanes are a homologous series of compounds.

One feature of the compounds in a homologous series is that they have the same general formula.

Give **two** other properties of a homologous series.

[2 marks]

1 _____

2 _____

0	8	.	2
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Complete combustion of alkane **Z** forms water and carbon dioxide.
Water is found to be 32.3% by mass of the products.

Calculate the empirical formula of **Z**.

Deduce the molecular formula of **Z**.

[5 marks]

Empirical formula _____

Molecular formula _____

7

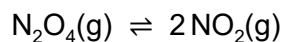


0 9

This question is about chemical equilibria.

1.10 mol of N_2O_4 are put in a sealed container of volume 2.25 dm^3 at a given temperature.

The equilibrium shown is established.



0 9 . 1

The equilibrium concentration of NO_2 is $0.204 \text{ mol dm}^{-3}$

Calculate the percentage of the original N_2O_4 present at equilibrium.

[3 marks]

Percentage N_2O_4 _____

0 9 . 2

The student repeats the experiment using the same starting amount of N_2O_4 at the same temperature but in a smaller container.

State the effect, if any, on the equilibrium concentration of N_2O_4

State the effect, if any, on the value of the equilibrium constant, K_c

[2 marks]

Effect on the equilibrium concentration of N_2O_4 _____

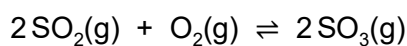
Effect on K_c _____

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The production of sulfur trioxide (SO_3) is an important equilibrium reaction in industry.



0 9 . 3

Some sulfur dioxide and oxygen are placed in a sealed container and are left to reach equilibrium at a given temperature.

At this temperature, the equilibrium constant, $K_c = \frac{[\text{SO}_3]^2}{[\text{SO}_2]^2[\text{O}_2]} = 11.2 \text{ mol}^{-1} \text{ dm}^3$

Table 2 shows the equilibrium concentrations of sulfur dioxide and oxygen.

Table 2

	Equilibrium concentration / mol dm^{-3}
SO_2	0.245
O_2	1.25

Calculate the equilibrium concentration of sulfur trioxide.

[2 marks]

Equilibrium concentration of sulfur trioxide _____ mol dm^{-3}



Table 3 shows the percentage conversion of sulfur dioxide into sulfur trioxide at different temperatures.

Table 3

Temperature / K	Conversion of SO ₂ into SO ₃ / %
600	90
800	65
1000	24

0 9 . 4

The forward reaction is exothermic.

Use the data in **Table 3** to justify this statement.

[2 marks]

9

END OF QUESTIONS



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