



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

SECTION A

You should aim to spend no more than 55 minutes on this section.

1. A halogenoalkane, **P**, has the molecular formula  $C_4H_9X$ , where X represents chlorine, bromine or iodine. **P** reacts with a hot aqueous solution of silver nitrate to form a yellow precipitate very quickly.

(a) (i) Give the **formula** of the yellow precipitate.

.....  
(1)

(ii) Write the ionic equation, including state symbols, for the formation of this yellow precipitate.

(1)

(b) (i) Write a balanced equation for the reaction of the halogenoalkane, **P**, with water.

(1)

(ii) State the type of reaction which has occurred in (b)(i).

.....  
(1)

(iii) What type of reagent is water in this reaction?

Explain why water can act in this way.

.....  
.....  
.....  
(2)



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(c) The halogenoalkane, **P**, reacts with a hot concentrated solution of potassium hydroxide in ethanol very quickly, to form methylpropene.

(i) Draw a fully labelled diagram of the apparatus you would use to carry out this reaction and collect the methylpropene gas formed.

(3)

(ii) Deduce the displayed formula and the name of the halogenoalkane, **P**.

Name .....

(2)

(d) Explain why the halogenoalkane, **P**, reacts very quickly with water.

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(2)



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- (e) (i) At high temperature and high pressure, in the presence of a suitable catalyst, methylpropene polymerises.

Draw a section showing **two** units of the polymer chain.

(1)

- (ii) Explain why working at high pressure increases the yield of this equilibrium reaction.

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(1)

- (iii) In general, how does a catalyst increase the rate of a chemical reaction?

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(2)

(Total 17 marks)

Q1



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N 3 1 0 2 6 A 0 5 1 6

2. This question is about three organic compounds with the following physical properties:

Compound	Formula	Boiling Point /K	$\Delta H_{\text{vap}}^{\ominus}$ /kJ mol <sup>-1</sup>
Butane	CH <sub>3</sub> CH <sub>2</sub> CH <sub>2</sub> CH <sub>3</sub>	273	6.9
Propan-1-ol	CH <sub>3</sub> CH <sub>2</sub> CH <sub>2</sub> OH	371	14.8
Propanone	CH <sub>3</sub> COCH <sub>3</sub>	330	9.0

(a) (i) Name the intermolecular force present in all three compounds.

.....  
(1)

(ii) Explain why this intermolecular force is likely to have a similar strength in butane and propan-1-ol.

.....  
.....  
(1)

(b) (i) Draw a 'dot and cross' diagram for the propan-1-ol molecule, showing outer electrons only.

(1)

(ii) Name the strong additional intermolecular force between propan-1-ol molecules **not** present in the other two compounds.

.....  
(1)



(iii) Using displayed formulae, draw a diagram to show this intermolecular force between two propan-1-ol molecules.

State the values of the following bond angles:

COH .....

The bond angle between the molecules .....

**(3)**

(iv) Suggest the apparatus you would use, and the measurements you would make, to determine the enthalpy change of vaporisation,  $\Delta H_{\text{vap}}$ , of a liquid such as propan-1-ol.

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.....  
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**(3)**

(v) Use the values of the standard enthalpy changes of vaporisation to calculate the strength of the additional intermolecular forces between propan-1-ol molecules, which are not present between butane molecules.

**(1)**



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- (c) (i) Name the intermolecular force between propanone molecules that is **not** present in butane.

.....  
(1)

- (ii) Explain why you would expect propanone to mix with propan-1-ol.

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(2)

- (d) (i) Name the process which could be used in industry to obtain ethene from butane.

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(1)

- (ii) State the type of reaction which occurs when butane reacts with chlorine to form 1-chlorobutane.

Name the mechanism involved.

Type of reaction .....

Name of mechanism .....

(2)

Q2

(Total 17 marks)



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N 3 1 0 2 6 A 0 9 1 6

3. (a) (i) What condition is necessary to make a solution containing a mixture of potassium iodate,  $\text{KIO}_3$ , and potassium iodide from iodine and  $4.0 \text{ mol dm}^{-3}$  potassium hydroxide solution?

.....  
(1)

(ii) State the oxidation number of iodine in

iodine .....

potassium iodate,  $\text{KIO}_3$  .....

potassium iodide .....

(2)

(iii) Write a balanced equation, with state symbols, for the reaction between iodine and potassium hydroxide solution.

(2)

(iv) Explain why this is classified as a disproportionation reaction.

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.....  
(1)



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(b) The purity of a sample of potassium iodate,  $\text{KIO}_3$ , can be found by reacting it in aqueous solution with two chemicals to form iodine. The quantity of iodine formed can then be found by titration.

(i) Name these **two** chemicals.

.....

.....

(2)

(ii) Name the solution used to determine the iodine concentration by titration.

.....

(1)

(iii) Name the indicator used in this titration and state the colour change.

Indicator .....

From ..... to .....

(2)

Q3

(Total 11 marks)

**TOTAL FOR SECTION A: 45 MARKS**



**SECTION B**

**You should aim to spend no more than 35 minutes on this section. The passage needed for this section is provided on a separate sheet.**

4. Read the passage on **ETHYNE** straight through and then more carefully. Answer the following questions.

(a) Draw the displayed formula for ethyne and give the CCH bond angle.

Bond angle .....

**(1)**

(b) Why may ethyne need to be purified in the industrial process when it is made from calcium carbide?

.....  
.....

**(1)**

(c) Suggest why many other countries are considering changing to the calcium carbide process for the industrial production of ethyne.

.....  
.....  
.....

**(1)**

(d) How do the reactions between ethyne and ethene with bromine water differ?

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.....  
.....

**(1)**



(e) Give TWO reactions of ethyne which have no corresponding reactions in ethene chemistry?

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.....  
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**(1)**

(f) (i) Name the TWO chemicals you would use to make 1,2-dibromoethane, for use in the preparation of ethyne.

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**(1)**

(ii) Draw a labelled diagram of the apparatus you would use to prepare ethyne from 1,2-dibromoethane. You do **not** need to show how the gas is collected.

**(1)**

**QUESTION 4 CONTINUES ON THE NEXT PAGE**







