

Please check the examination details below before entering your candidate information

Candidate surname					Other names				
Centre Number					Candidate Number				

Pearson Edexcel International GCSE (9–1)

Friday 13 June 2025

Morning (Time: 1 hour 40 minutes)

Paper reference **4WCH2/1C**

Chemistry (Modular)

UNIT 2: 4WCH2

PAPER: 1C

You must have:
Calculator, ruler

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
– *there may be more space than you need.*
- Show all the steps in the calculations and state the units where required.

Information

- The total mark for this paper is 90.
- The marks for **each** question are shown in brackets
– *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Write your answers neatly and in good English.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ►

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Answer ALL questions.

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 This question is about elements in Group 1 of the Periodic table.

(a) The box gives some of the elements in Group 1.

caesium

francium

lithium

potassium

sodium

Select an element from the box to answer these questions.

(i) Give the element that is in Period 6.

(1)

(ii) State which element has ions that give a yellow colour in a flame test.

(1)

(b) Describe an experiment to provide evidence that the element rubidium could be in Group 1.

(2)



(c) The table shows the densities of some of the elements from this group.

The density of potassium is not shown.

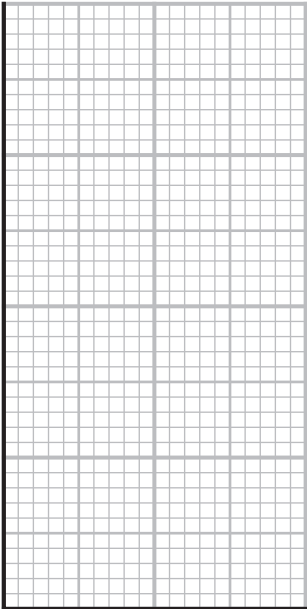
Element	Symbol	Density in g per cm ³
caesium	Cs	1.9
lithium	Li	0.5
potassium	K	

(i) Plot a bar chart to show the densities of caesium and lithium.

Include an appropriate scale for the y-axis.

(2)

Density
in g per cm³



Cs Li
Symbol

(ii) Estimate a value for the density of potassium.

(1)

density = g per cm³

(Total for Question 1 = 7 marks)

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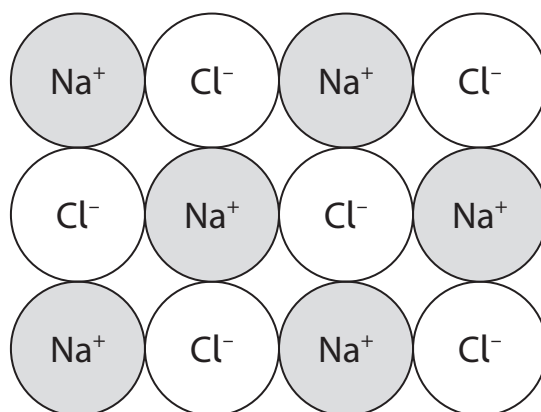
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2 Sodium chloride, NaCl, is an ionic compound.

(a) (i) The diagram represents the structure of sodium chloride.



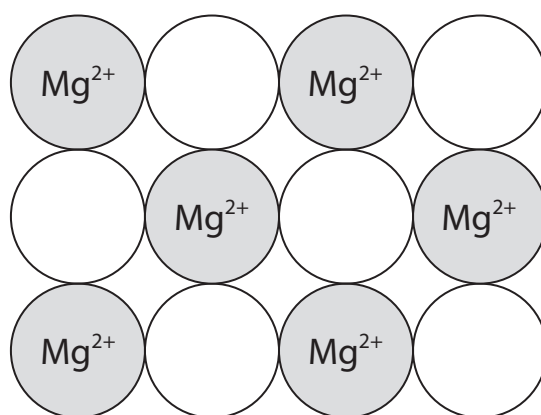
State why this structure prevents sodium chloride from conducting electricity.

(1)

(ii) Magnesium sulfide, MgS, is a different ionic compound.

Complete the diagram to show the structure of magnesium sulfide.

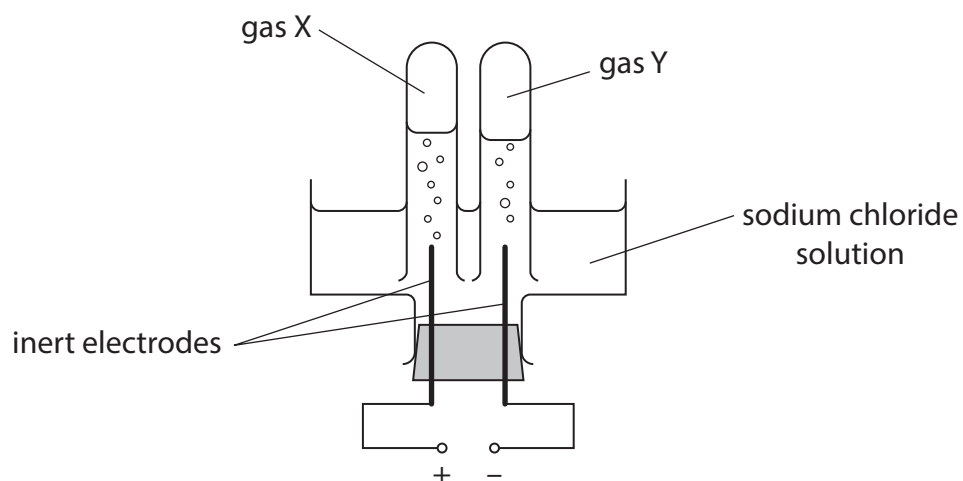
(1)



(iii) Explain why magnesium sulfide has a higher melting point than sodium chloride.

(2)

- (b) The diagram shows the apparatus used for the electrolysis of a concentrated aqueous solution of sodium chloride.



- (i) Name gases X and Y.

(2)

gas X

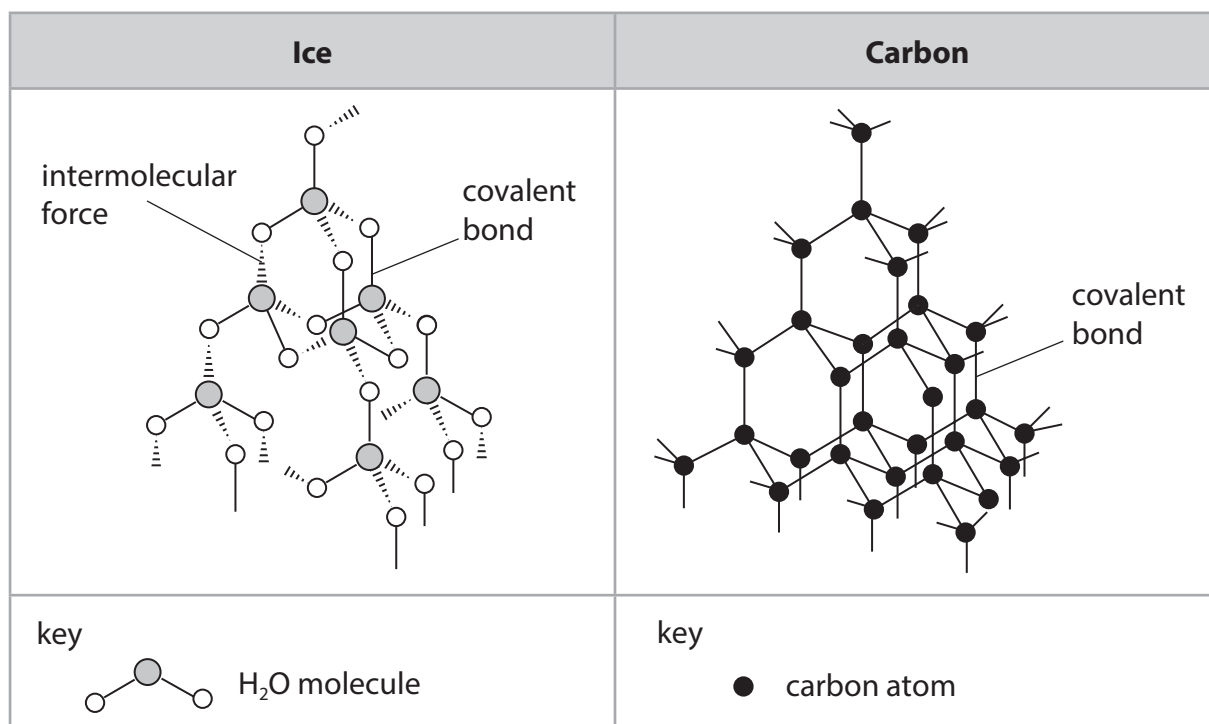
gas Y

- (ii) Give the half-equation for the reaction at the negative electrode.

(2)

(Total for Question 2 = 8 marks)

3 The diagram shows the structure of ice and the structure of a type of carbon.



(a) Which type of carbon is shown in the diagram?

(1)

- ☐ **A** diamond
- ☐ **B** fullerene
- ☐ **C** graphite
- ☐ **D** methane

(b) Both structures in the diagram have covalent bonds.

Describe covalent bonding between two atoms.

Refer to electrons and nuclei in your answer.

(2)

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.....

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(c) Give one physical property that would be similar for ice and for this type of carbon.

(1)

(d) Explain why ice has a much lower melting point than this type of carbon.

(5)



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(e) State a physical test to show that a sample of ice is pure water.

(2)

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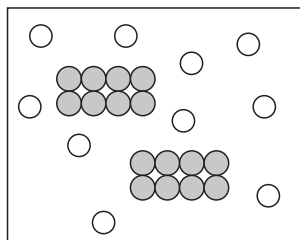
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(Total for Question 3 = 11 marks)



4 This question is about rates of reaction.

- (a) The diagram shows a container with particles of a gas and particles of a solid reacting together.

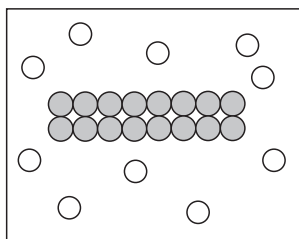


- (i) Which diagram shows a change that **increases** the rate of this reaction?

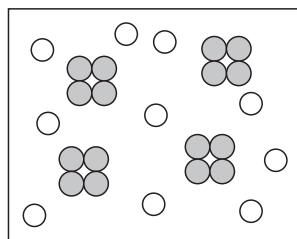
(1)



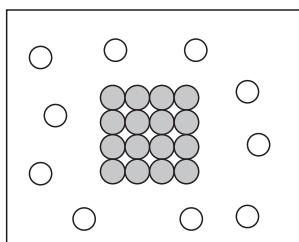
A



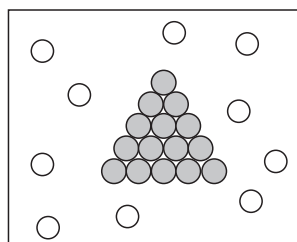
B



C



D

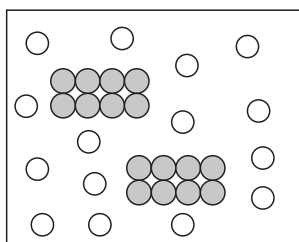


- (ii) Which diagram shows a change that **decreases** the rate of this reaction?

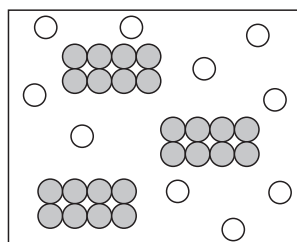
(1)



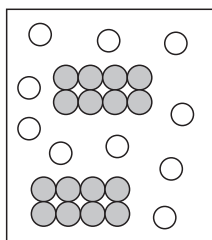
A



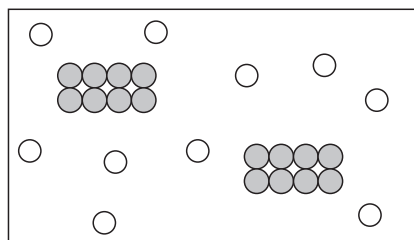
B



C



D



- (b) A teacher investigates the effect of temperature on the rate of reaction between a dilute acid and a metal.

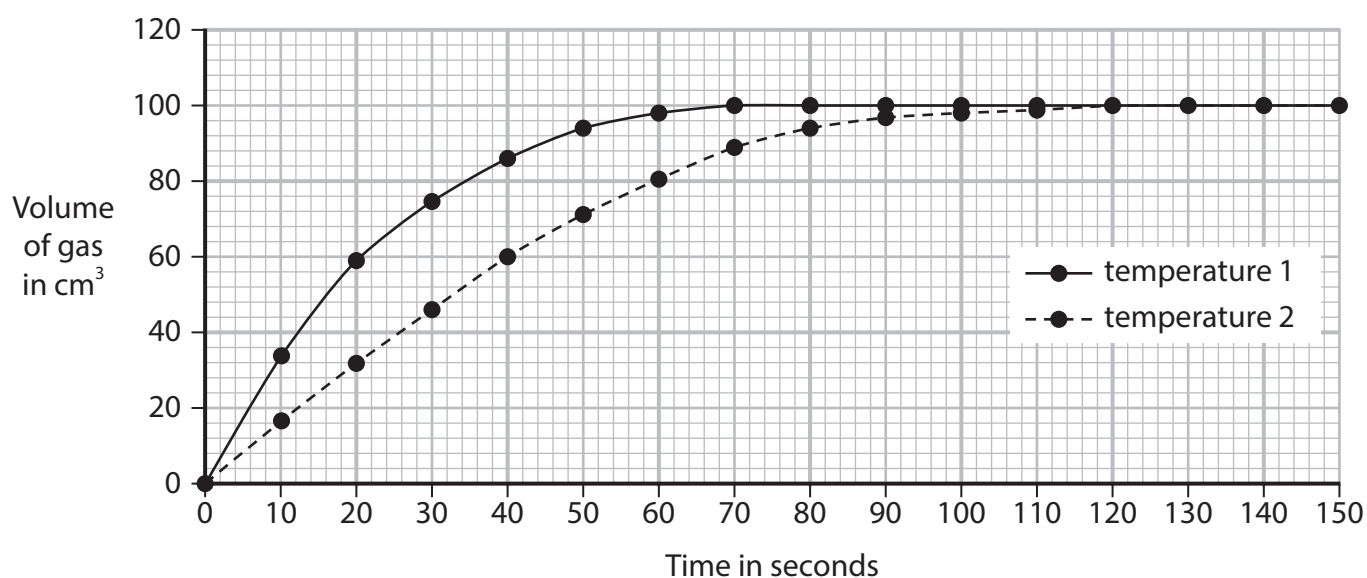
The teacher warms the acid and adds the metal.

The reaction between the acid and the metal produces a gas which is collected.

The teacher records the volume of gas every 10 seconds until there is no further change in volume.

The teacher uses these temperatures, 25 °C, 35 °C and 45 °C.

The graph shows the teacher's results for two of the temperatures.



- (i) Temperature 1 is 35 °C.

Using information from the graph, explain whether temperature 2 is 25 °C or 45 °C.

(2)

- (ii) For temperature 1, draw a tangent on the graph at 30 seconds.

(1)

- (iii) Use the tangent to show that the rate of reaction at 30 seconds is approximately 1.3 cm³ per second.

(2)



5 Propene (C_3H_6) is used to produce polymers.

(a) C_3H_6 can be made from the thermal decomposition of C_3H_8



Calculate the maximum mass, in g, of C_3H_6 that can be produced from 6 600 000 g of C_3H_8

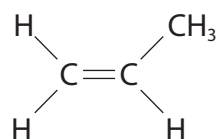
Give your answer in standard form.

[for C, $A_r = 12$ for H, $A_r = 1$]

(3)

mass of $C_3H_6 = \dots\dots\dots$ g

(b) The diagram shows the structure of C_3H_6



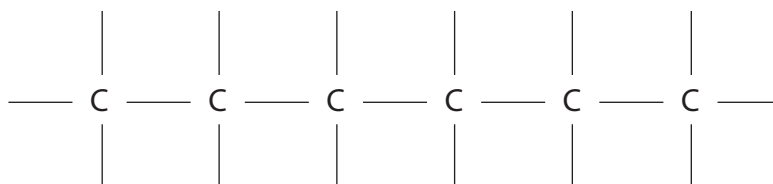
C_3H_6 can undergo polymerisation.

(i) Name this type of polymerisation.

(1)

(ii) Complete the diagram to show **three** repeat units of the polymer.

(2)



(iii) Burning is one method that could be used to dispose of this polymer.

Burning produces carbon dioxide.

Explain one problem this causes.

(2)

(iv) Another method of disposal of the polymer is burial in a landfill site.

State one problem with this method of disposal.

(1)

(Total for Question 5 = 9 marks)

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6 This question is about the reactions of ethanol and ethanoic acid.

(a) (i) Ethanol reacts with potassium dichromate(VI) to form ethanoic acid.

Name the other reagent needed in this reaction.

(1)

(ii) State the colour change that occurs when ethanol reacts with potassium dichromate(VI).

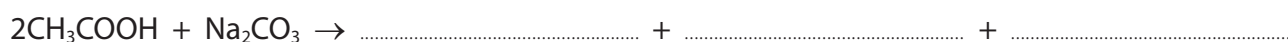
(2)

from to

(b) Ethanoic acid reacts with solid sodium carbonate.

(i) Complete the chemical equation for this reaction.

(2)



(ii) State two observations seen in this reaction.

(2)

1

2



- (c) A student prepares the ester, ethyl ethanoate, by reacting ethanol with ethanoic acid.

This is the student's method.

- mix equal amounts of ethanol and ethanoic acid in a boiling tube
- add a few drops of concentrated sulfuric acid
- place the boiling tube in a hot water bath for several minutes

- (i) State the role of sulfuric acid in this reaction.

(1)

- (ii) State why the student heats the mixture in a water bath instead of directly with a Bunsen burner flame.

(1)

- (iii) State how the student would know that ethyl ethanoate has formed.

(1)

(Total for Question 6 = 10 marks)

7 Oxygen (O_2) is one of the gases in the Earth's atmosphere.

(a) Describe the test for oxygen gas.

(1)

(b) Draw a dot-and-cross diagram for a molecule of oxygen.

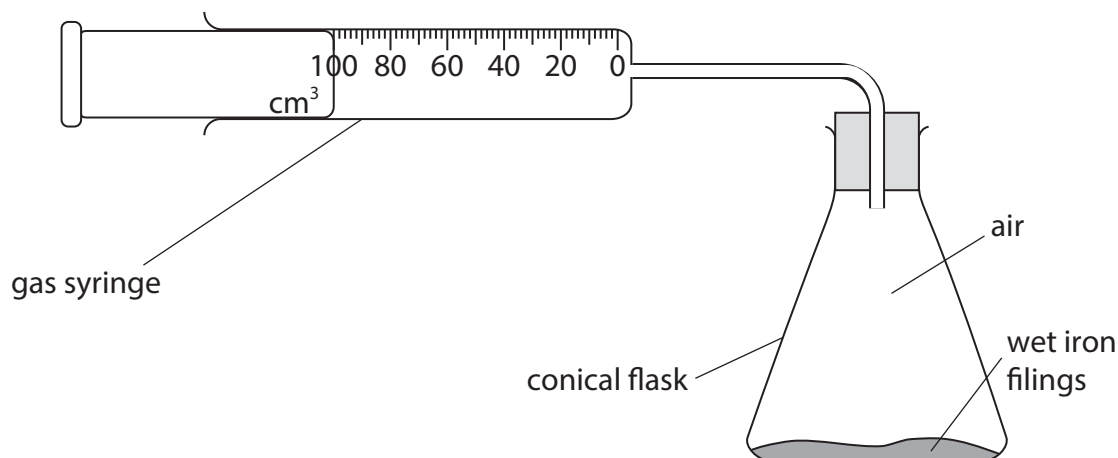
Show outer shell electrons only.

(2)



(c) Oxygen makes up about 21% of dry air.

A student uses this apparatus in an experiment to determine the percentage of oxygen in a sample of dry air.



At the start of the experiment, the air in the apparatus has a total volume of 230 cm^3 .

At the start of the experiment, the reading on the gas syringe is 100 cm^3 , but decreases as all of the oxygen reacts with the iron.

- (i) Determine the final reading on the gas syringe if the dry air contains 21% oxygen.

Give your answer to 2 significant figures.

(3)

final reading on gas syringe = cm^3

(ii) Iron filings react with oxygen to form the iron oxide, Fe_2O_3

Give a balanced chemical equation for this reaction.

State symbols are not required.

(2)

(iii) Fe_3O_4 is the formula of a different iron oxide.

Fe_3O_4 contains the **two** most common ions of iron.

Complete the table by writing how many of each type of ion are found in Fe_3O_4

The first row has been done for you.

(2)

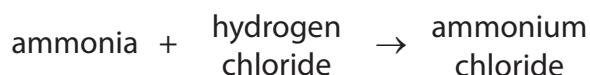
Ion	Number of these ions in Fe_3O_4
Fe^+	0
Fe^{2+}	
Fe^{3+}	
Fe^{4+}	
Fe^{5+}	

(Total for Question 7 = 10 marks)

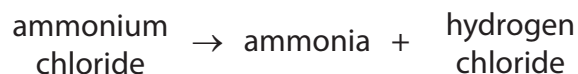


8 This question is about the compound ammonium chloride, NH_4Cl

(a) The reaction of ammonia and hydrogen chloride produces ammonium chloride.



When ammonium chloride is warmed in a test tube, a mixture of ammonia and hydrogen chloride is produced.



(i) State how the mixture of ammonia and hydrogen chloride can be changed back into ammonium chloride.

(1)

(ii) Give a chemical equation, including state symbols, to show that this reaction is reversible.

(2)

(b) A student tests an unknown compound Z to see if it may be ammonium chloride.

The table shows the results of the tests on ammonium chloride and compound Z.

Test	Ammonium chloride	Compound Z
• carry out a flame test	no flame colour	orange-red flame
• dissolve the compound in water • add a few drops of sodium hydroxide solution • warm the mixture • carry out a test for ammonia gas		no gas produced
• dissolve the compound in water • add a few drops of acidified silver nitrate solution		yellow precipitate

(i) Complete the table to show the test results for ammonium chloride.

(2)

(ii) Use the results from the table to deduce the formula of compound Z.

(1)



(iii) The student carried out a further test on each compound.

This is the student's method.

- dissolve the compound in water
- add a few drops of bromine water
- observe any colour change

Explain the observations that the student would make for ammonium chloride and compound Z during this test.

(4)

ammonium chloride

compound Z

(Total for Question 8 = 10 marks)

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- 9 In industry, ethanol, $\text{C}_2\text{H}_5\text{OH}$, is produced using the reaction of ethene gas, C_2H_4 , with steam.

The reaction is normally carried out in the presence of a phosphoric acid catalyst, using a specific temperature and pressure.

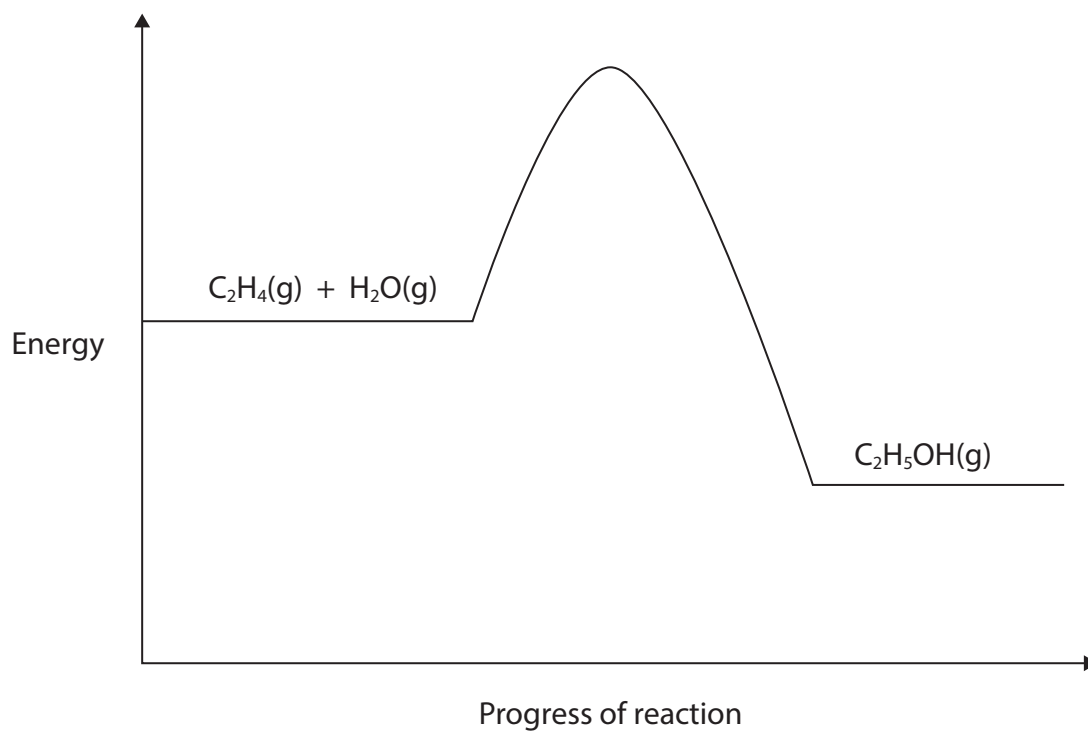
- (a) The boxes give two conditions and possible values for these conditions.

Draw one straight line from each condition to a suitable value.

(2)

Condition	Value
	• 60
pressure in atmospheres •	• 120
	• 180
temperature in °C •	• 240
	• 300

(b) The reaction profile diagram for the uncatalysed reaction is shown.



- (i) Explain how the reaction profile diagram would change when phosphoric acid is added to the reaction mixture.

(2)

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- (ii) A chemist investigates what happens when the reaction occurs in a sealed container.

When the temperature is increased, the yield of ethanol decreases.

Explain why this happens.

Use information from the reaction profile diagram in your answer.

(3)

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Question 9 continues on the next page.



(c) In an experiment, the percentage yield of ethanol, $\text{C}_2\text{H}_5\text{OH}$, is 5%.

Calculate the volume, in cm^3 , of ethene gas at rtp needed to produce 1.84 g of ethanol.

[for H, $A_r = 1$ for C, $A_r = 12$ for O, $A_r = 16$]

[gas molar volume = 24 dm^3 at rtp]

(5)

volume of ethene = cm^3

(Total for Question 9 = 12 marks)

TOTAL FOR PAPER = 90 MARKS

