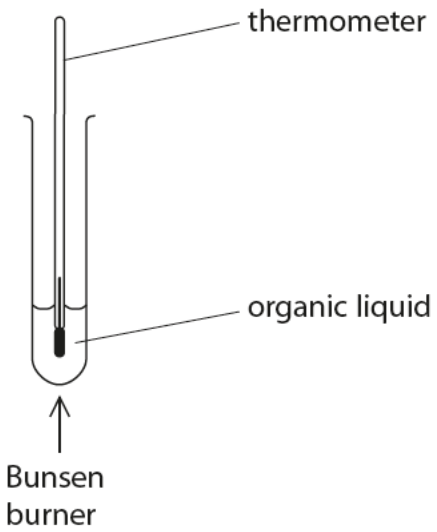
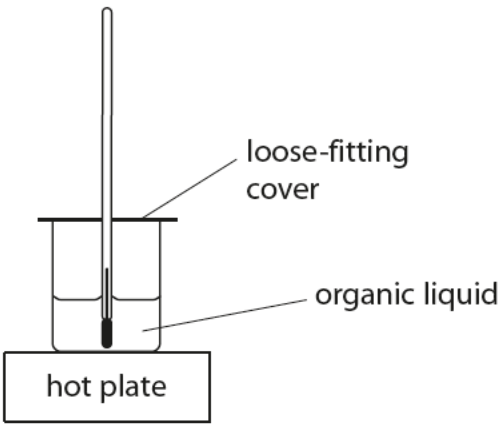
1 A teacher discussed with her students whether the boiling points of organic compounds are related to the size of their molecules.

The students suggested measuring the boiling points of some organic compounds using this apparatus.



(a) The teacher said that their suggested method was too dangerous.

She recommended using the apparatus shown below instead.



Suggest **one** reason why this apparatus is better than the students' suggestion.

(1)

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(b) The students used the apparatus recommended by the teacher to measure the boiling points of five alcohols.

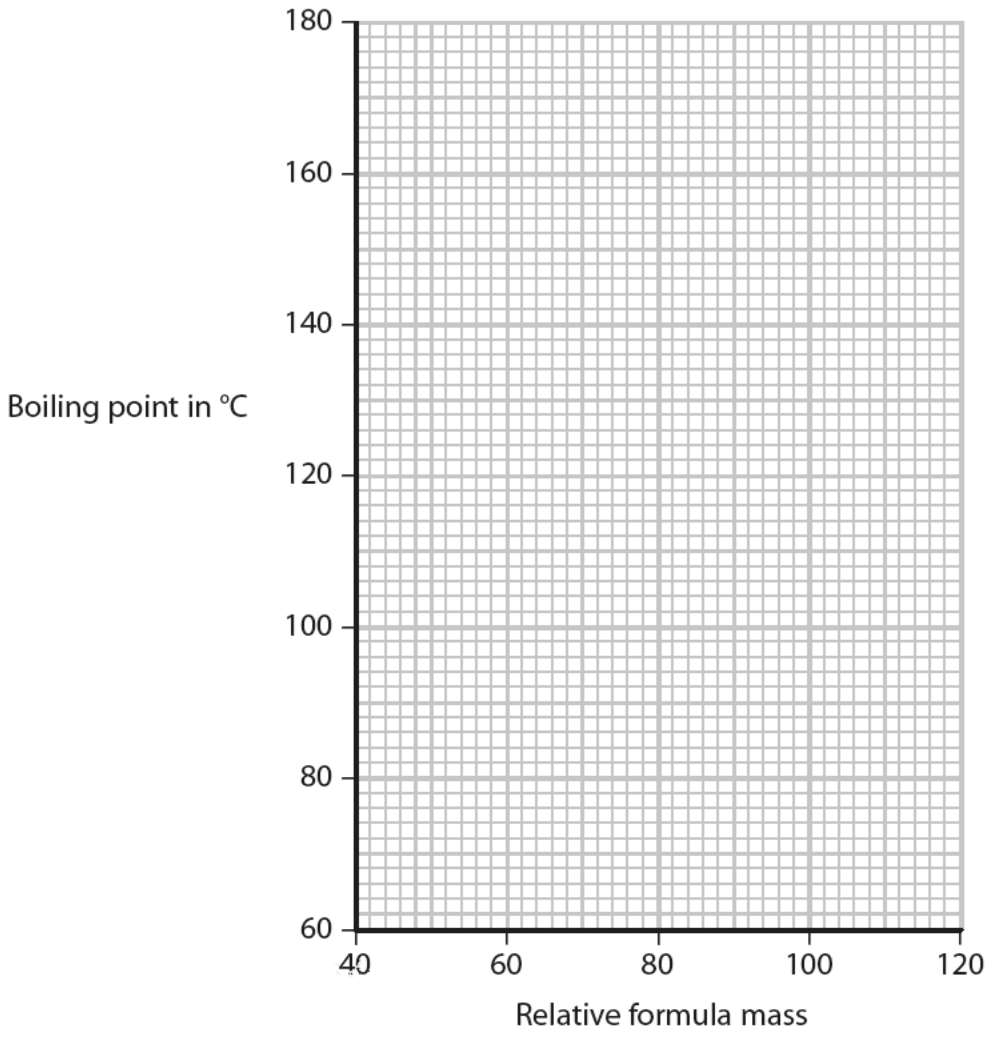
Their results are shown in the table.

	Alcohol				
	A	**B**	**C**	**D**	**E**
Boiling point in °C	78	96	138	157	176
Relative formula mass	46	60	88	102	116

(i) Plot a graph of the data in the table on the grid.

Draw a straight line of best fit through the points.

(3)



(ii) Describe the relationship shown by your graph.

(1)

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(iii) Use your graph to predict the boiling point of the alcohol that has a relative formula mass of 74.

(1)

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(iv) Which of the alcohols **A**, **B**, **C**, **D** or **E** is the least volatile?

(1)

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(Total for Question 1 = 7 marks)

2 Carbon monoxide and hydrogen are used in the manufacture of methanol (CH_3OH).

The reaction is reversible and can reach a position of dynamic equilibrium.

$$CO(g) + 2H_2(g) \rightleftharpoons CH_3OH(g) \qquad \Delta H = -91 \text{ kJ/mol}$$

The reaction is carried out at a pressure of about 100 atmospheres and a temperature of 250 °C.

(a) State two features of a reaction that is in dynamic equilibrium.

(2)

1 .....

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2 .....

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(b) (i) How would a decrease in temperature at constant pressure affect the amount of methanol in the equilibrium mixture?

Explain your answer.

(2)

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(ii) How would an increase in pressure at constant temperature affect the amount of methanol in the equilibrium mixture?

Explain your answer.

(2)

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(c) Methanol (CH_3OH) can be converted into methanal (H_2CO).

A mixture of methanol and oxygen is passed over an iron oxide catalyst at 250 °C.

Methanal and water are the only two products.

(i) Write a chemical equation for the conversion of methanol into methanal.

(2)

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(ii) What is meant by the term **catalyst**?

(2)

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(iii) Explain how a catalyst works.

(2)

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(d) Methanol can be used in racing cars as an alternative fuel to petrol.

Write the chemical equation for the complete combustion of methanol.

(2)

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(Total for Question 2 = 14 marks)