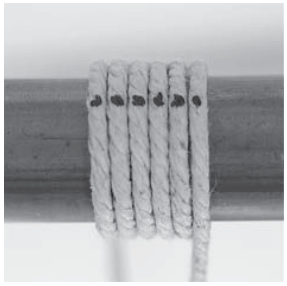
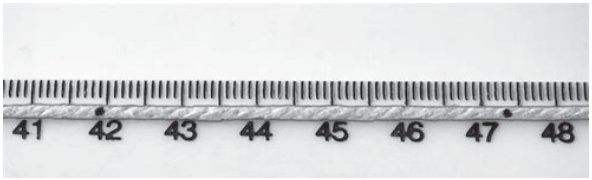
1 A student measures the circumference of a circular pipe.

He wraps a length of string around the pipe five times and marks it with ink, as shown in the photograph.



(a) The student unwraps the string and holds it against a ruler with a centimetre scale. The next photograph shows the first two ink marks on the string.



(i) Estimate the circumference of the pipe, using the photograph of the string and the centimetre scale.

Give your answer to two significant figures.

(2)

estimated circumference = ... cm

(ii) The student finds that the total length of string for 5 turns is 25.6 cm.

Calculate the average (mean) circumference of the pipe using this value.

(1)

average circumference = ... cm

(iii) The student measures the **diameter** of the pipe using a digital calliper.

The calliper shows that the diameter is 15.10 mm.

Calculate the circumference of the pipe using the formula

$$\text{circumference} = \text{diameter} \times \pi$$

(2)

calculated circumference = ... cm

(b) The student uses two methods to find the circumference

- averaging, using a measured length of string
- calculating, using the digital calliper reading

Explain why the two methods are likely to give different results.

(4)

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(Total for Question 1 = 9 marks)

2 James Dewar was a scientist who investigated liquid oxygen.

(a) He discovered that the boiling point of liquid oxygen is –183 °C.

(i) Convert –183 °C to a temperature on the Kelvin scale.

(1)

Temperature = ... K

(ii) Use ideas about particles to describe the changes that happen when a liquid boils to form a gas.

(3)

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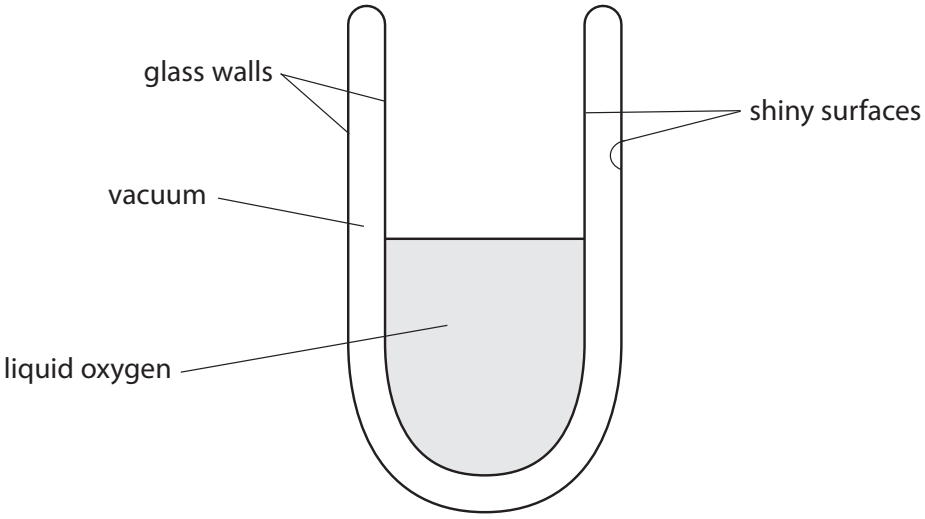
(b) Dewar invented a special flask for storing liquid oxygen in the laboratory.

It was designed to reduce heat flow from the air outside to the liquid oxygen inside.

The flask had two glass walls with a vacuum between them.

The inside glass surfaces were each covered with a thin layer of shiny metal.

The diagram shows a cross section of the flask.



(i) Explain how the **shiny surfaces** reduce the thermal energy transferred to the liquid oxygen from the laboratory.

(2)

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(ii) Explain how the **vacuum** reduces the thermal energy transferred to the liquid oxygen from the laboratory.

(2)

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(c) Dewar's flask did not have a lid when it was holding liquid oxygen.

Suggest why a lid was not needed.

(2)

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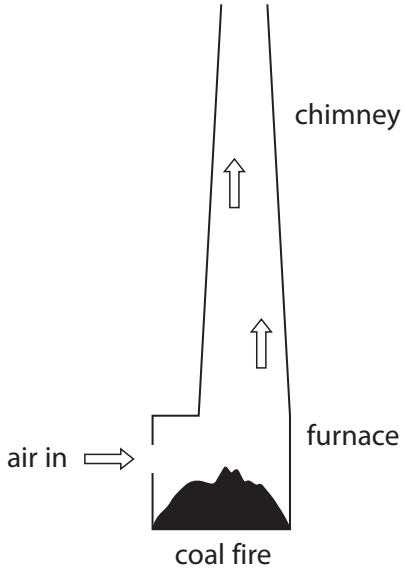
(Total for Question 2 = 10 marks)

2 The diagram shows a chimney over a furnace.

A coal fire is burning in the furnace.

Air moves into the furnace and up the chimney.



Describe how the process of convection causes this air movement.

(5)

(Total for Question 2 = 5 marks)