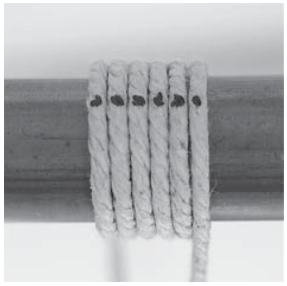
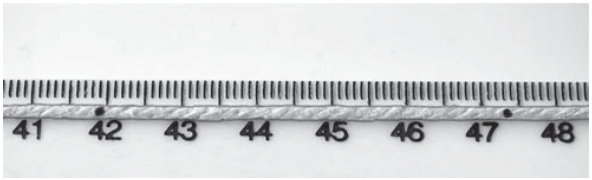
1 A student measures the circumference of a circular pipe.

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)

47.3 - 41.9 = 5.4cm

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)

25.6 / 5 = 5.12cm

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

circumference = diameter × π

(2)

3.14 * 15.10 = 47.44 = 4.74cm

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)

the string is likely to stretch and overestimate the circumference, also the string method includes the string's diameter and so will overestimate for that reason too. Using callipers might squash the pipe slightly, underestimating the circumference.

(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)

183 + 273 = 90K

Temperature = ... K

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

(3)

when a liquid boils the particles move fast enough to escape their mutual attraction to each other and separate from each other forming a gas this causes gas bubbles to form in the boiling liquid. The bubbles rise to the surface and escape.

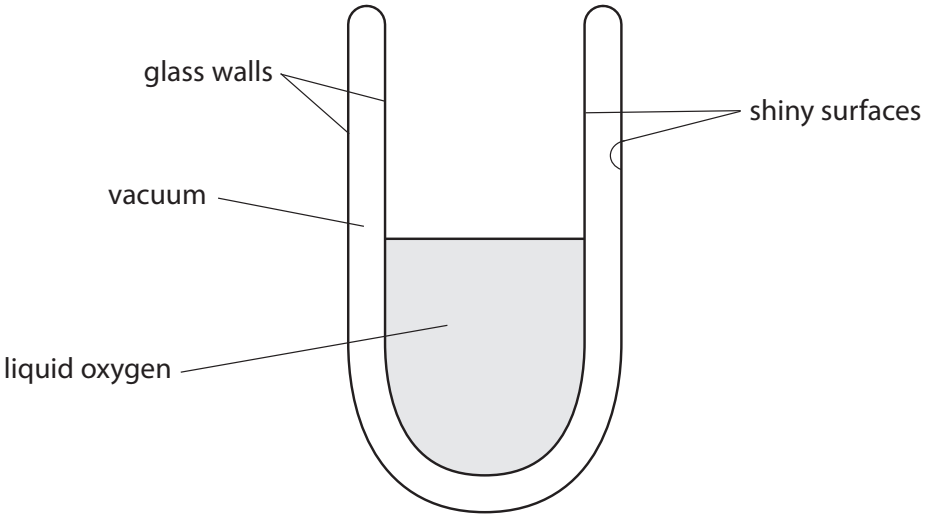
(b) Dewar invented a special flask for storing liquid oxygen in the laboratory.

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)

shiny surfaces are poor emmitters and good reflectors of radiated heat. The outer shiny surface will emit less radiation inwards and the shiny inner surface will reflect more of what radiated heat is emitted towards it.

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

(2)

a vacuum contains no air particles and so cannot conduct heat inwards from the air to the liquid oxygen.

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

Suggest why a lid was not needed.

(2)

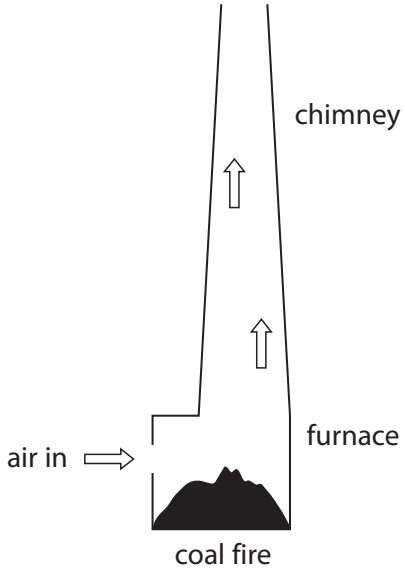
heat cannot rapidly enter through the top because warm air rises by convection and so cannot fall into the flask.

(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)

the coal fire heats air at the bottom of the chimney, the heated air expands, becomes less dense and rises up the chimney by convection. The rising air lowers the pressure at the bottom of the chimney and causes the outside air to rush into the bottom of the chimney

(Total for Question 2 = 5 marks)