1 A student is investigating the boiling and freezing points of a liquid.

Fig. 5.1 shows the apparatus he uses to find the boiling point.

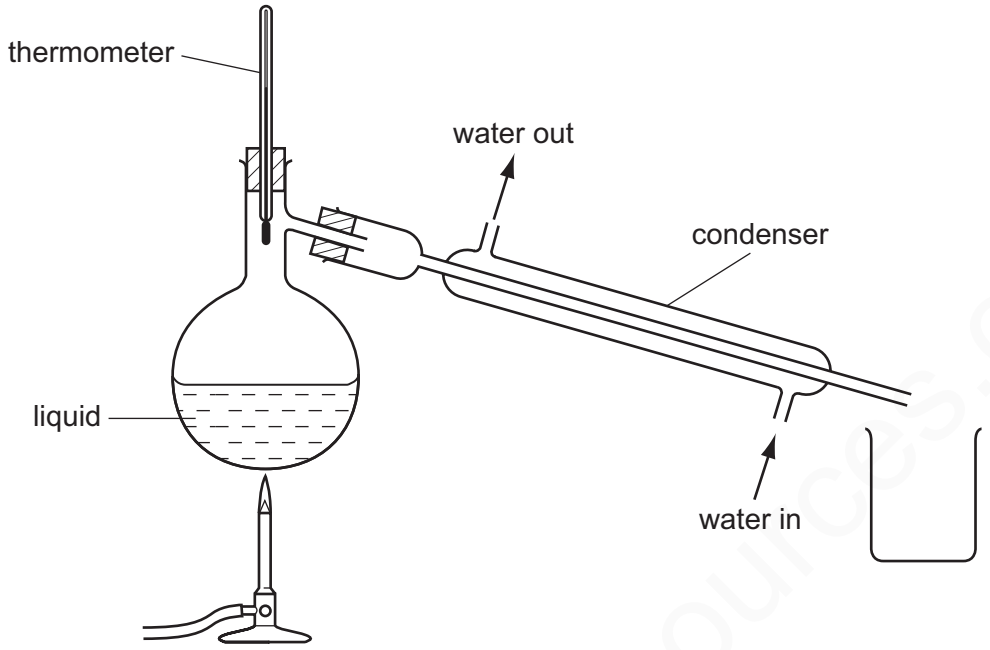

Fig. 5.1

(a) (i) He observes the liquid in the apparatus while he gently heats the flask with a Bunsen burner flame. The liquid and its vapour are colourless and transparent.

Suggest **one** observation that will tell the student when the reading on the thermometer shows the boiling point of the liquid.

.....

..... [1]

(ii) Explain why the temperature of the liquid does not rise above its boiling point even though the flask is still being heated. Use the words *thermal energy* in your answer.

.....

.....

..... [2]

(iii) Fig. 5.2 shows the thermometer scale at the point when the liquid boils.

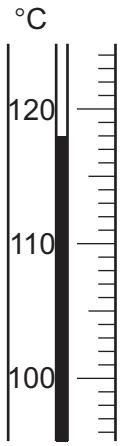

Fig. 5.2

Complete the sentence.

The boiling point of the liquid is ..... °C [1]

(iv) Explain what happens to the molecules of vapour when they enter the condenser. Use the word *energy* in your answer.

.....

..... [2]

Fig. 5.3 shows the apparatus the student uses to find the freezing point of the liquid.

He places some of the liquid in a large test-tube surrounded by ice. He measures the temperature of the liquid every 30 seconds and plots the graph shown in Fig. 5.4.

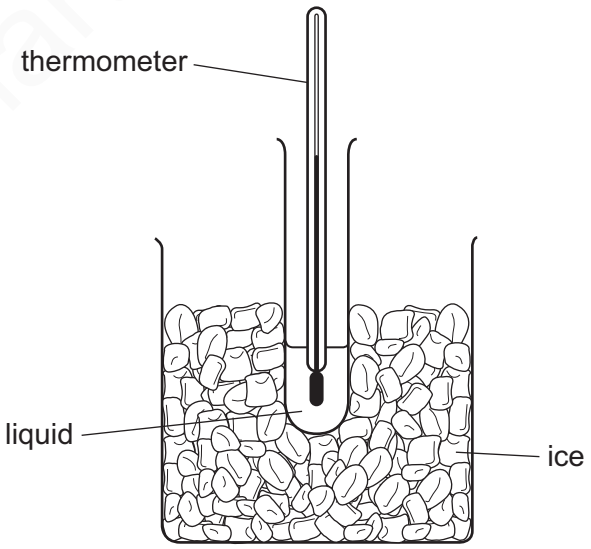

Fig. 5.3

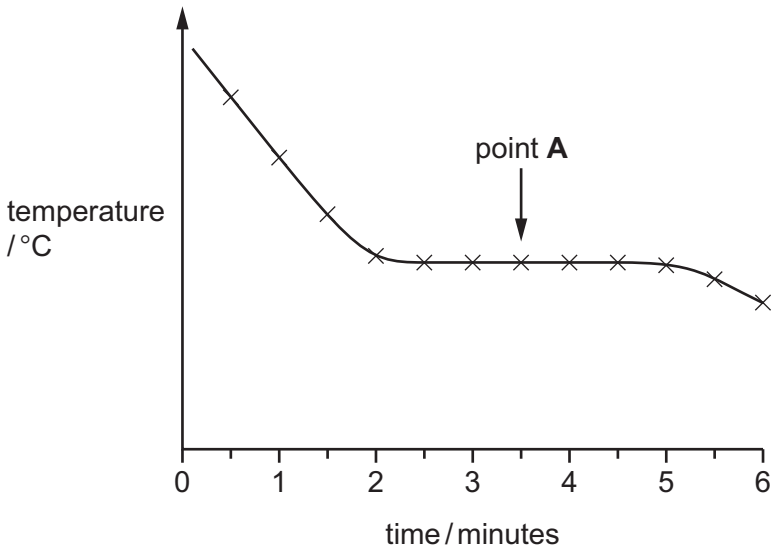

Fig. 5.4

(b) (i) The student also watches the liquid in the tube while it cools.

State what he observes in the test-tube when the liquid reaches the freezing point.

..... [1]

(ii) Fig. 5.5 shows the thermometer corresponding to point **A** on the graph. This is the temperature at which the liquid freezes.

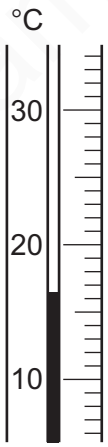

Fig. 5.5

Read the scale and record the temperature of point **A** to the nearest 0.5 °C.

freezing point of the liquid = ... °C [1]

(iii) Explain why the temperature stays constant at the temperature of point **A** on the graph for several minutes even though the contents of the test-tube have not yet cooled to 0 °C, the temperature of the ice.

Your answer must include a reference to the thermal energy of the molecules of the liquid.

.....

.....

..... [2]

MARKING SCHEME

(a) (i) temperature is constant / stops increasing ; [1]

(ii) (all) intermolecular forces broken / change from liquid to gas ;
caused by thermal energy / as thermal energy absorbed ; [2]

(iii) 118 °C ; [1]

(iv) molecules lose energy ;
AND *any 1 from:*
intermolecular forces form ;
get stronger ;
molecules get closer together ;
turn to a liquid ; [max 2]

(b) (i) solid / crystals appear ; [1]

(ii) 16.5 ; [1]

(iii) (thermal) energy is given out ;
AND *any 1 from:*
stops the temperature falling ;
strengthens / more intermolecular forces ; [max 2]

[Total: 10]