Name of the Student:_____
Max. Marks : 26 Marks **Time : 26 Minutes**

Q1.

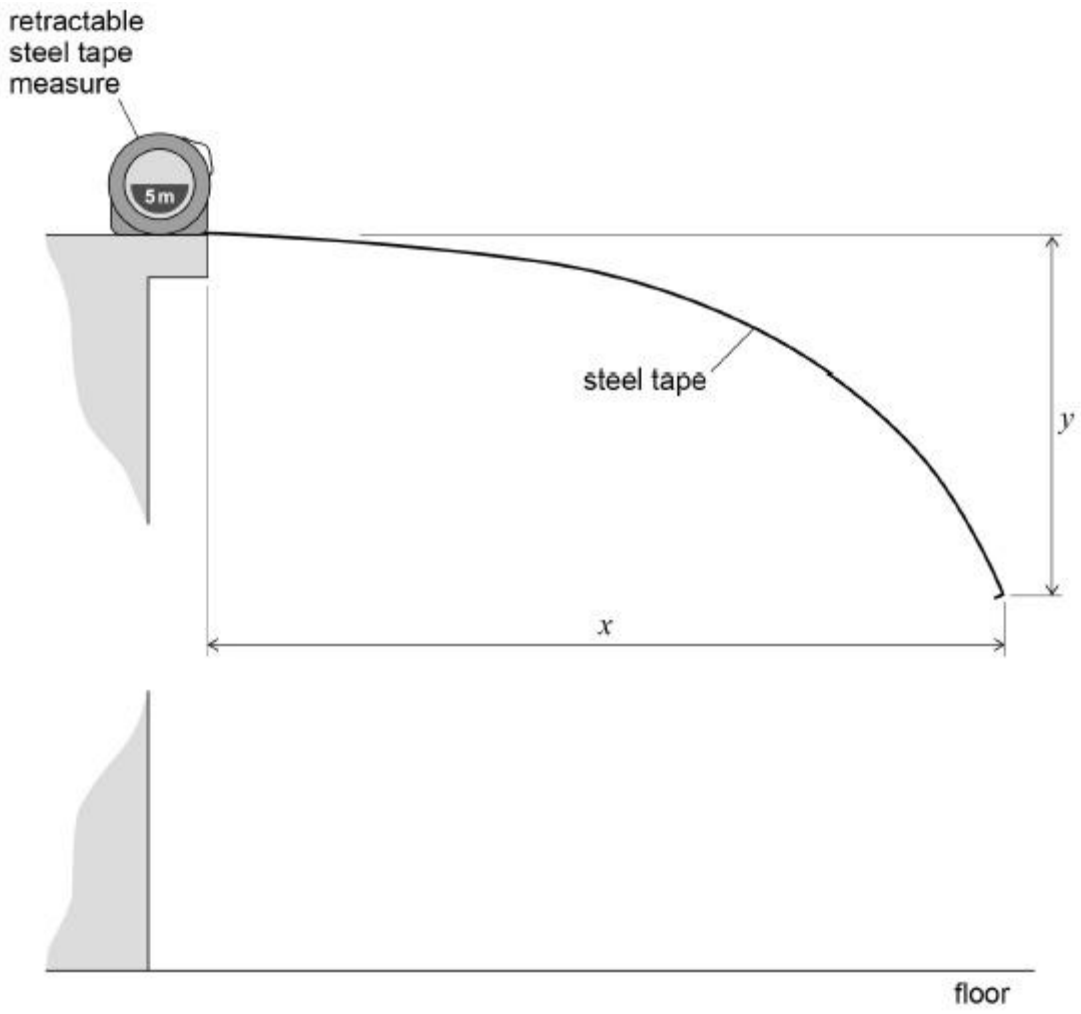
This question is about an experiment with a retractable steel tape measure.

The tape measure is placed at the edge of the bench and about 1 m of the steel tape is extended so that it overhangs the bench.

The tape is then locked in this position to stop it from retracting.

A student measures the dimensions x and y, the horizontal and vertical displacements of the free end of the tape, as shown in **Figure 1**.

Figure 1



(a) Describe a suitable procedure the student could use to measure y.
You may add detail to **Figure 1** to illustrate your answer.

(2)

(b) By changing the extension of the tape, the student obtains further values of x and y.

These data are shown in the table.

x / cm	y / cm
132.4	61.2
116.8	33.7
105.1	24.3
94.5	15.6
84.3	11.0
73.2	5.7

Suggest why the student chose to make **all** measurements of x greater than 70 cm

(1)

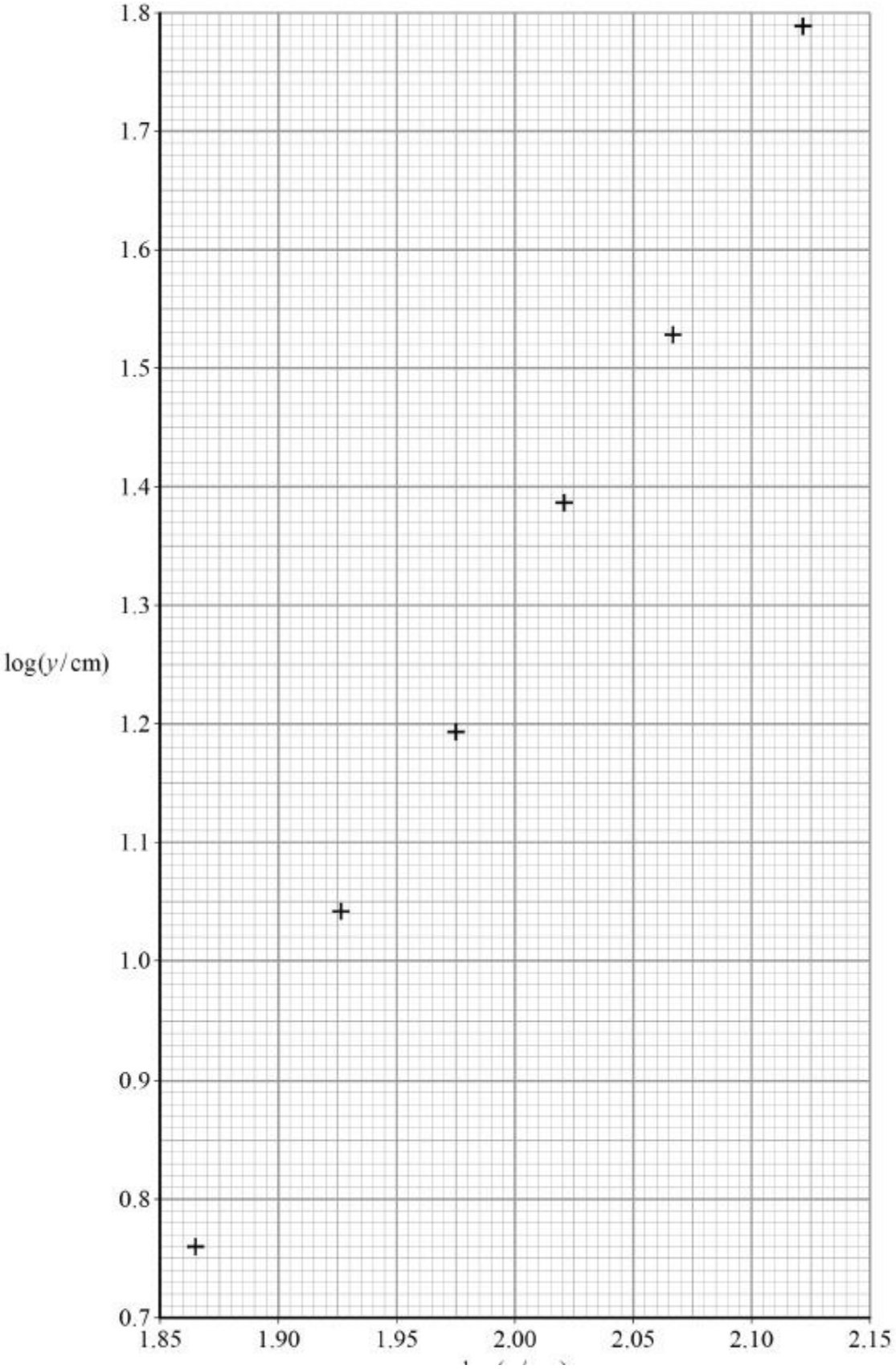
(c) The data from the experiment suggest that $y = Ax^n$ where n is an integer and A is a constant.

These data are used to plot the graph in **Figure 2**.

Determine n using **Figure 2**.

$n =$ _____

Figure 2



(3)

(d) Explain how the numerical value of A can be obtained from **Figure 2**.

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(e) Estimate the order of magnitude of A.
You should use data for x and y from any **one** row in the table above.
Give your answer with an appropriate unit.

order of magnitude of A = _____ unit _____

(3)

(Total 12 marks)

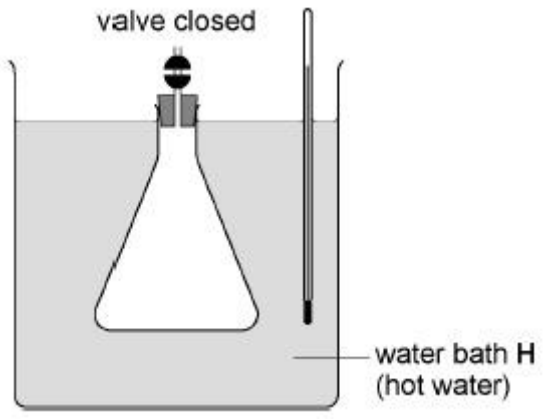
Q2.

This question is about an experiment to estimate absolute zero.

Figures 1a to 1d show the stages in the procedure carried out by a student.

An empty flask fitted with a tube and an open valve is placed in water bath **H** containing hot water.
The air inside the flask is allowed to come into thermal equilibrium with the water.
The valve is then closed, trapping a certain volume of air, as shown in **Figure 1a**.

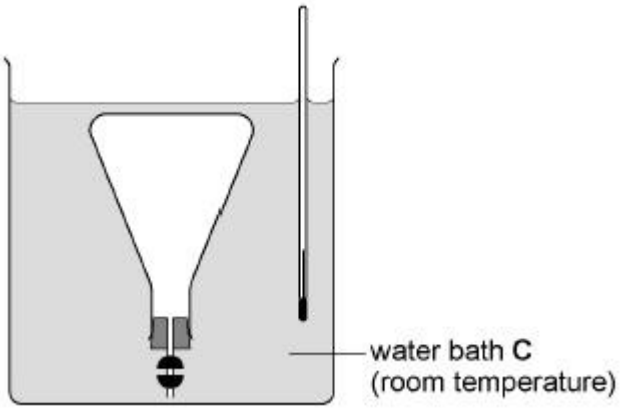
Figure 1a



The flask is inverted and placed in water bath **C** in which the water is at room temperature.
The air inside the flask is again allowed to come into thermal equilibrium with the water, as shown in

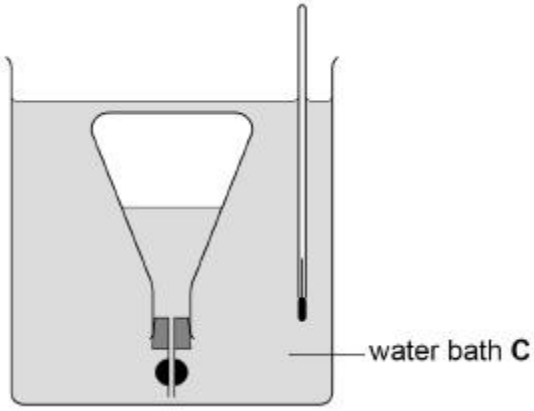
Figure 1b.

Figure 1b



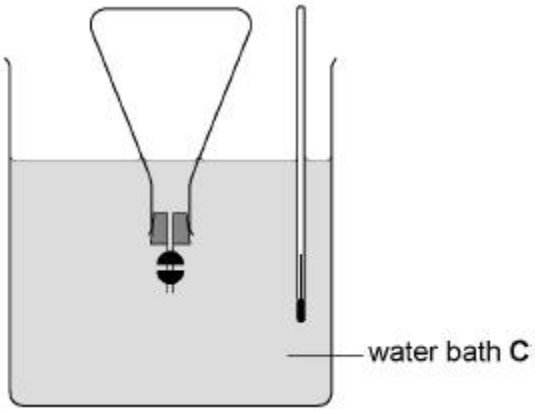
The valve is opened and some water enters the flask, as shown in **Figure 1c**.

Figure 1c



The depth of the inverted flask is adjusted until the level of water inside the flask is the same as the level in the water bath.
The valve is then closed, trapping the air and the water inside the flask, as shown in **Figure 1d**.

Figure 1d



(a) Explain why the volume of the air in the flask in **Figure 1c** is less than the volume of the air in the flask in **Figure 1d**.

_____

(2)

(b) Explain why Charles's Law can be applied to compare the air in the flask in **Figure 1a** with the air in the flask in **Figure 1d**.

(2)

(c) The flask is removed from water bath **C** and the valve and stopper are removed.

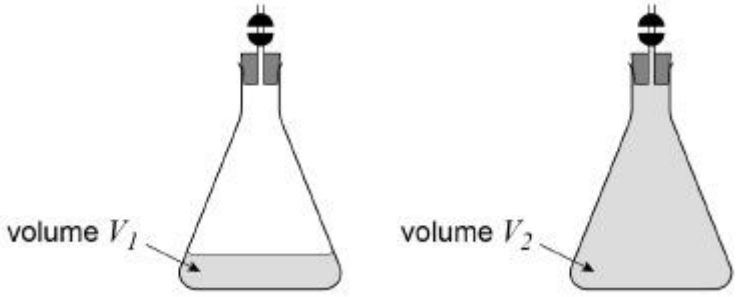
The volume of the water in the flask is V_1

The flask is then completely refilled with water and the valve and stopper replaced.

The volume of the water now in the flask is V_2

The volumes V_1 and V_2 are shown by the shaded parts in **Figure 2**.

Figure 2



Explain how V_1 and V_2 can be determined.

In your answer you should

- identify a suitable measuring instrument
- explain a suitable procedure to eliminate possible systematic error.

(3)

(d) Plot on **Figure 3** points to show the volume V and the temperature θ of the air in the flask when
- the flask is as shown in **Figure 1a**
- the flask is as shown in **Figure 1d**.

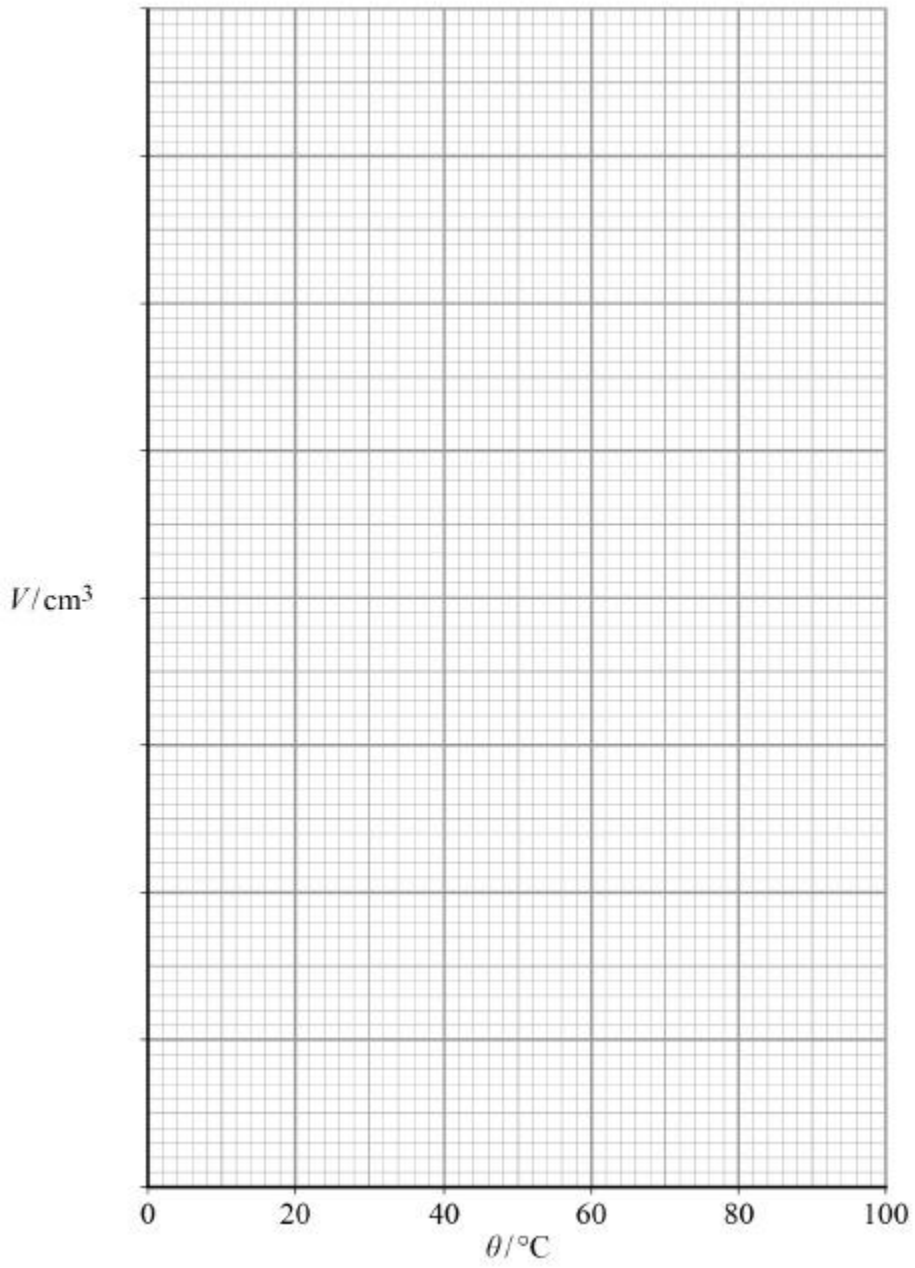
The temperature of the hot water bath is 86 °C

Room temperature is 19 °C

V_1 = 48 cm^3

V_2 = 255 cm^3

Figure 3



(3)

(e) Add a best fit line to your graph in **Figure 3** to show how V should vary with θ according to Charles's Law.

(1)

(f) Determine the value of absolute zero in °C using your graph in **Figure 3**.

value of absolute zero = _____ °C

(3)

(Total 14 marks)