Rewarding Learning

Centre Number

71	

Candidate Number

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2014

Physics

Assessment Unit AS 3

assessing

Practical Techniques
Session 1

[AY131]

TUESDAY 13 MAY, MORNING

MV18

TIME

1 hour 30 minutes, plus your additional time allowance.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.

Turn to page 2 for further Instructions and Information.

INSTRUCTIONS TO CANDIDATES

Answer **all** the questions in this booklet. Rough work and calculations must also be done in this booklet. Except where instructed, do **not** describe the apparatus or experimental procedures. The Teacher/Supervisor will tell you the order in which you are to answer the questions.

One hour is to be spent on Section A and 30 minutes on Section B. This may be longer if you have an additional time allowance.

Section A consists of four short experimental tests. **You will have access to the apparatus for 13 minutes for each of the tests.** At the end of this 13-minute experimental period there is a 2-minute changeover to the area set aside for the next test. Any spare time before the start of the next test may be used to write up anything you have not yet completed.

At the end of your Section A work you will be told to move to the area set aside for Section B. Section B consists of one question in which you will analyse a set of experimental results.

INFORMATION FOR CANDIDATES

The total mark for this paper is 40.

Section A and Section B carry 20 marks each.

Figures in brackets printed at the end of each question indicate the marks awarded to each part question.

You may use an electronic calculator.

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(Questions start overleaf)

Section A

1 In this experiment you are to investigate the refraction of a ray of light as it travels from air into a transparent block and emerges from the other side.
You are provided with a transparent rectangular block, a ray box, a protractor and a ruler.

(a) Place the transparent block on **Fig. 1.2** on page 6 and mark its outline. The block should be as indicated in **Fig. 1.1** opposite. Remove the block and draw a normal near the middle of one of the long sides of the block.

Draw a line to represent an incident ray at an angle of incidence of 20° to the normal. Replace the block on its outline. Place the ray box on the page and direct a ray of light along the line. Mark the path of the emergent ray.
Remove the block and construct the path of the ray through the block.
Repeat the above procedure for an angle of incidence of 40°, on **Fig. 1.3** on page 7. [3 marks]

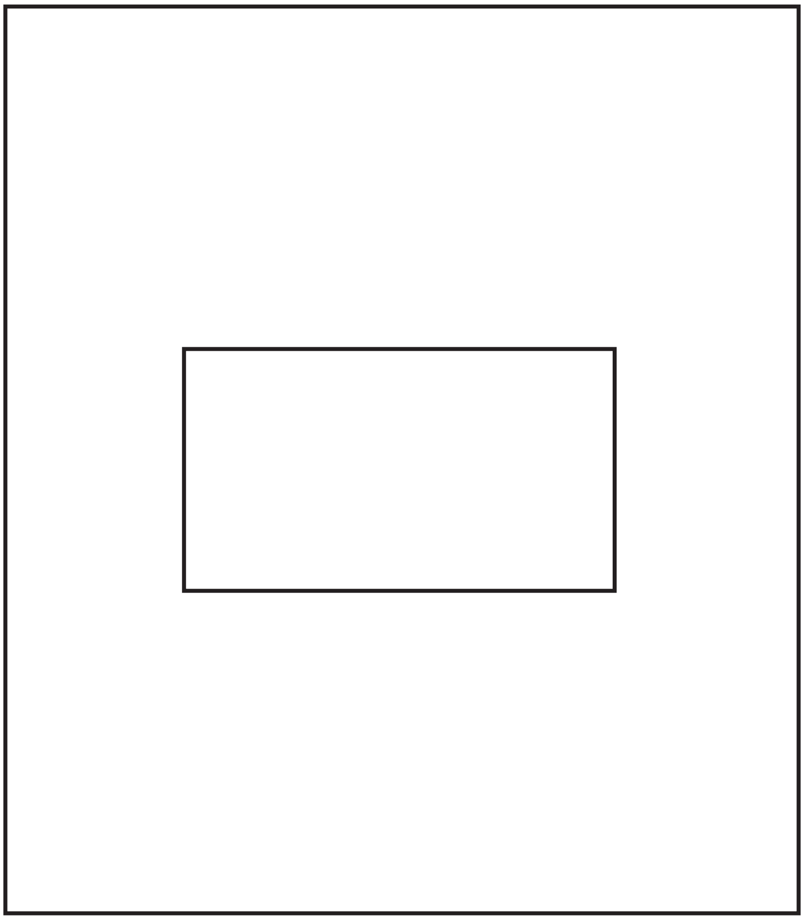


Fig. 1.1

Fig. 1.2

Fig. 1.3

(b) The lateral displacement of a ray of light which has travelled through a transparent block is measured as the perpendicular distance between the emergent ray and the original path of the incident ray, see **Fig. 1.4**.

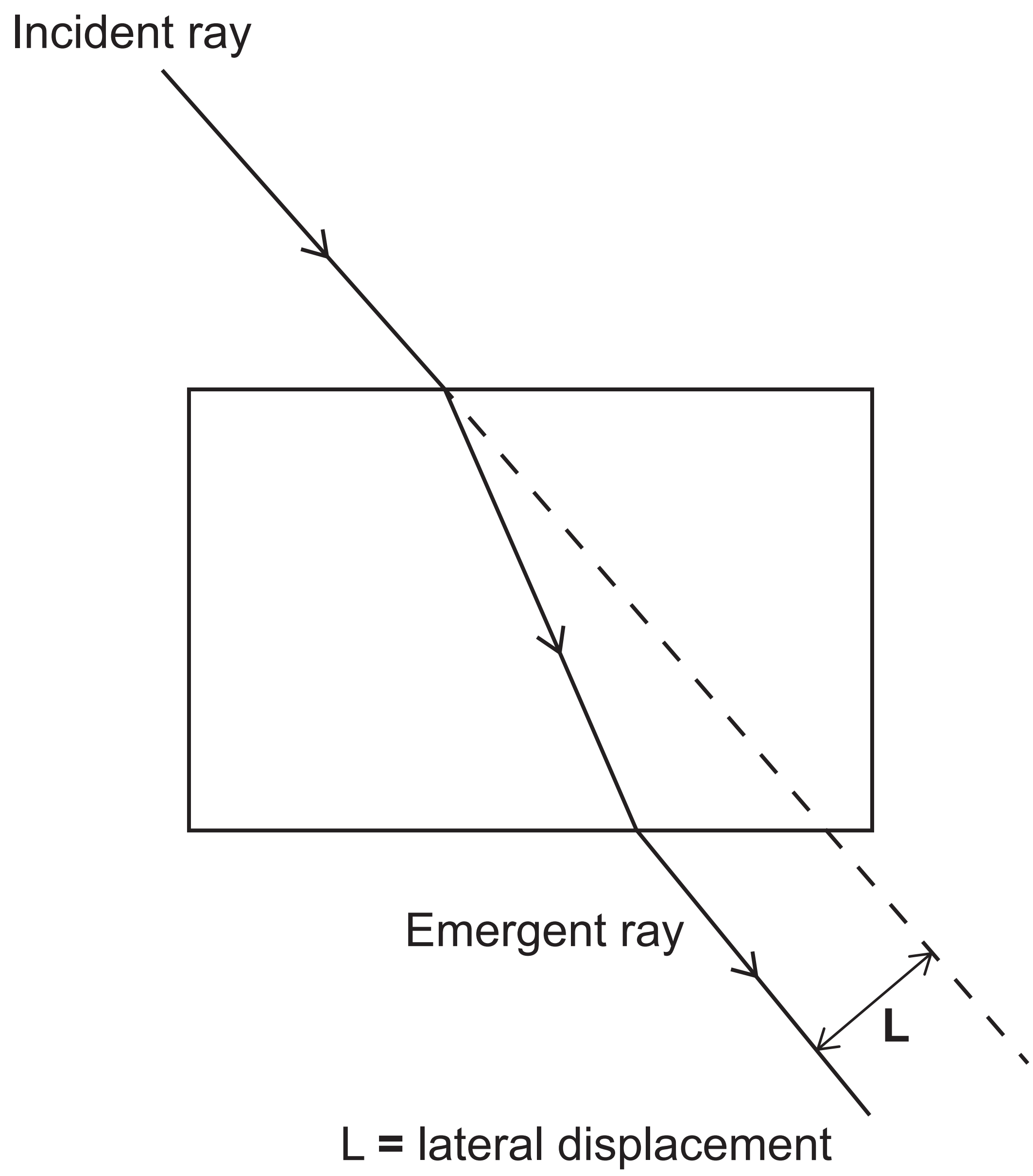


Fig. 1.4

(i) Use your diagrams in **Fig. 1.2** and **Fig. 1.3** to take measurements to find the lateral displacement for each incident ray. [1 mark]

Lateral displacement of ray with

angle of incidence 20° = ______________ mm

Lateral displacement of ray with

angle of incidence 40° = ______________ mm

(ii) Other than incident angle, suggest one factor which will affect the value of the lateral displacement of a ray of light as it travels through a transparent block. [1 mark]

____

2 In this experiment you are to obtain **reliable** values for some of the physical dimensions of a uniform wooden metre rule.

(a)

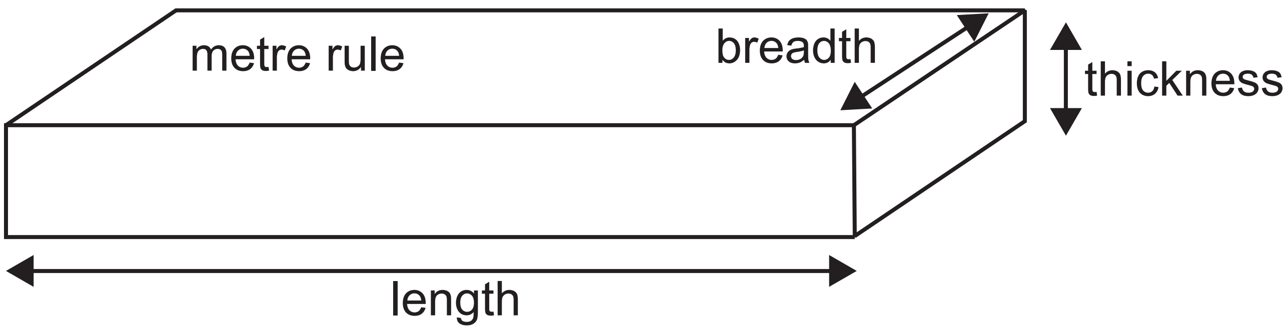


Fig. 2.1

Use the vernier callipers to measure the breadth of the suspended metre rule and the micrometer screw gauge to measure the thickness of the suspended metre rule. Enter all values in the **Table 2.1.** [2 marks]

Table 2.1

Physical dimension	**Instrument**	**Measurement/mm**
length	metre rule	1000
breadth	vernier calliper	
thickness	micrometer screw gauge	

(b) The metre rule is suspended from a retort stand at a point away from its centre of mass. Attach the mass hanger to the loop of string and move the loop until the metre rule is balanced horizontally, as shown in **Fig. 2.2.**

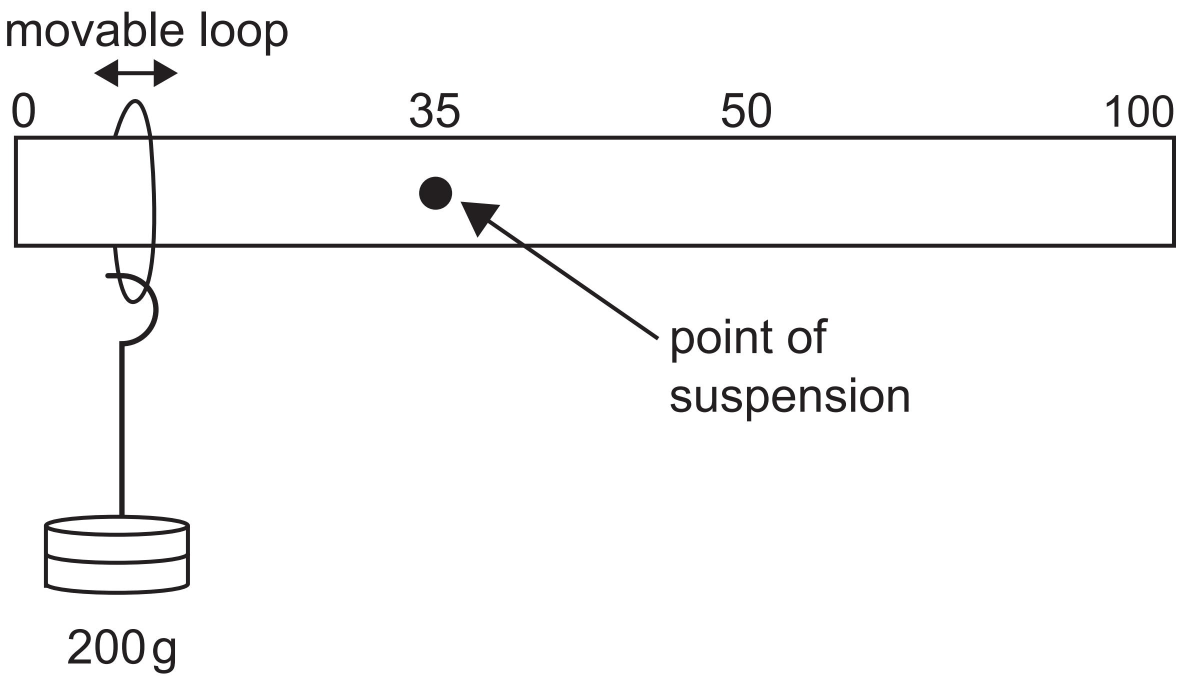


Fig. 2.2

Take suitable measurements to enable you to determine the mass of the metre rule.
Record these measurements and use them to determine the mass of the metre rule. Show clearly your working out. [3 marks]

Mass of metre rule **=** ________________ g

3 In this experiment you are to determine a value for the acceleration of free fall by investigating the period of oscillation of a loaded spring.

Fig. 3.1 shows the arrangement of the apparatus.

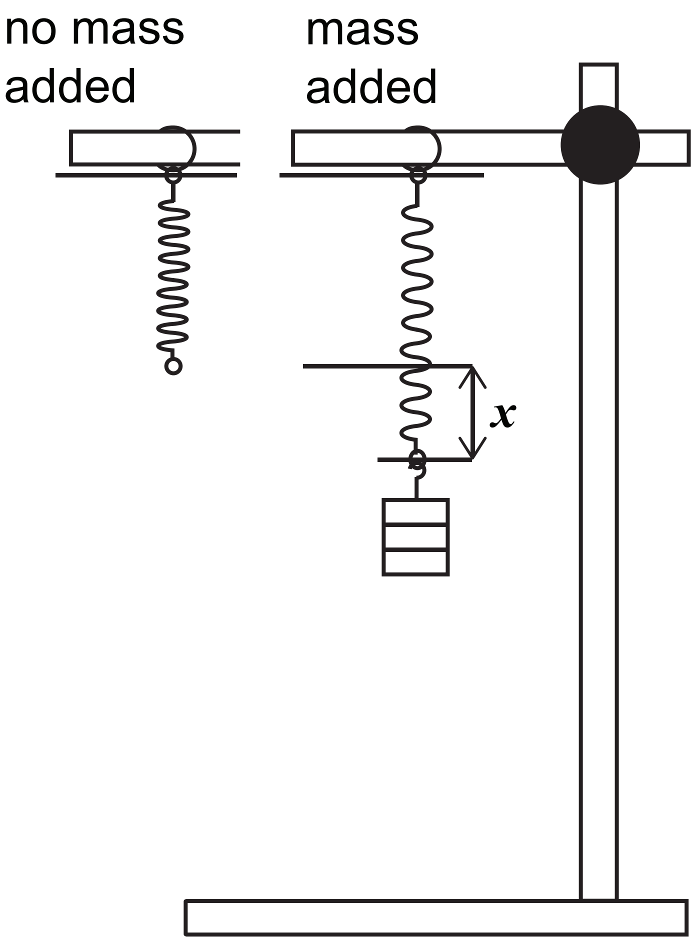


Fig. 3.1

A value for the acceleration of free fall, g, can be determined using **Equation 3.1**

$$g = \frac{4\pi^2 x}{T^2} \qquad \textbf{Equation 3.1}$$

where x is the extension of the spring produced by the mass and T is the period of oscillation. [1 mark]

(a) Remove the mass from the spring and measure the unextended length of the spring.

Unextended length of the spring = ______________ mm

Return the mass to the end of the spring and measure the new length of the spring.

New length of the spring = ______________ mm

Determine the extension caused by the mass.

x = ______________ mm

(b) Displace the mass a small vertical distance downward and release it.
Take suitable readings that will allow you to determine an accurate value for *T*, the period of the oscillation. [2 marks]

T = ______________ s

(c) Use **Equation 3.1** and your results to determine a value for the acceleration of free fall. [2 marks]

g = ______________ $m s^{-2}$

4 In this experiment you are provided with a box containing seven **identical** resistors in three different arrangements. A single resistor is connected between O and A. Three resistors are connected between O and B and three resistors are connected between O and C.

(a) You are also provided with a pre-connected open circuit containing a power supply, an ammeter, a voltmeter and connecting leads as shown in **Fig. 4.1**. To complete the circuit, one lead should be connected to O and the other lead connected to A, B and C in turn.

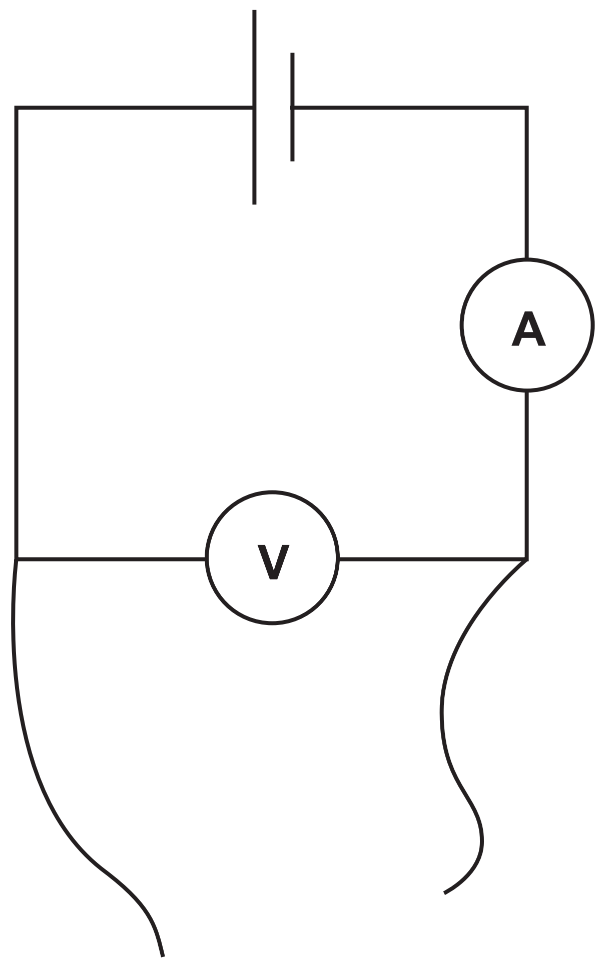


Fig. 4.1

Use the circuit to take readings of current and voltage for each connection and record the measurements in the **Table 4.1**.
Calculate the corresponding resistance for each connection and include this in **Table 4.1**. [3 marks]

Table 4.1

	OA	OB	OC
I/mA			
V/V			
R/Ω			

(b) Deduce how the resistors are arranged between OB and OC and draw a diagram to show the arrangement in each case. [2 marks]

(i) OB

(ii) OC

Section B

5 The density of air

The density of air was measured at atmospheric pressure P of 101 kPa for a range of temperatures. The results are shown in **Table 5.1.**

Table 5.1

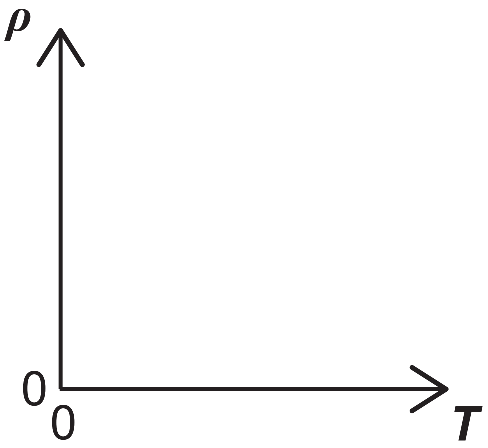
T / ___	ρ/kg m^{-3}	$\frac{1}{T}$/___
273	1.29	
313	1.13	
353	1.00	
393	0.878	
433	0.815	
473	0.746	

The relationship between the density of air, ρ, and its thermodynamic temperature T in kelvin is given by **Equation 5.1**

$$\rho = \frac{P}{ST} \qquad \textbf{Equation 5.1}$$

where S is a constant.

(a) Use **Equation 5.1** to sketch the graph obtained if ρ is plotted against T. [2 marks]



Data Processing

(b) (i) State the number of significant figures to which the densities have been recorded. [1 mark]

Number of significant figures = ______________

(ii) In **Table 5.1**, insert the appropriate units for columns 1 and 3. [1 mark]

(iii) In column 3 of **Table 5.1**, calculate $\frac{1}{T}$ for each temperature. [1 mark]

(iv) On the grid of **Fig. 5.2**, draw the graph of ρ (*y*-axis) against **1/*T***. Choose suitable scales and plot the points. Draw the best fit straight line. [4 marks]

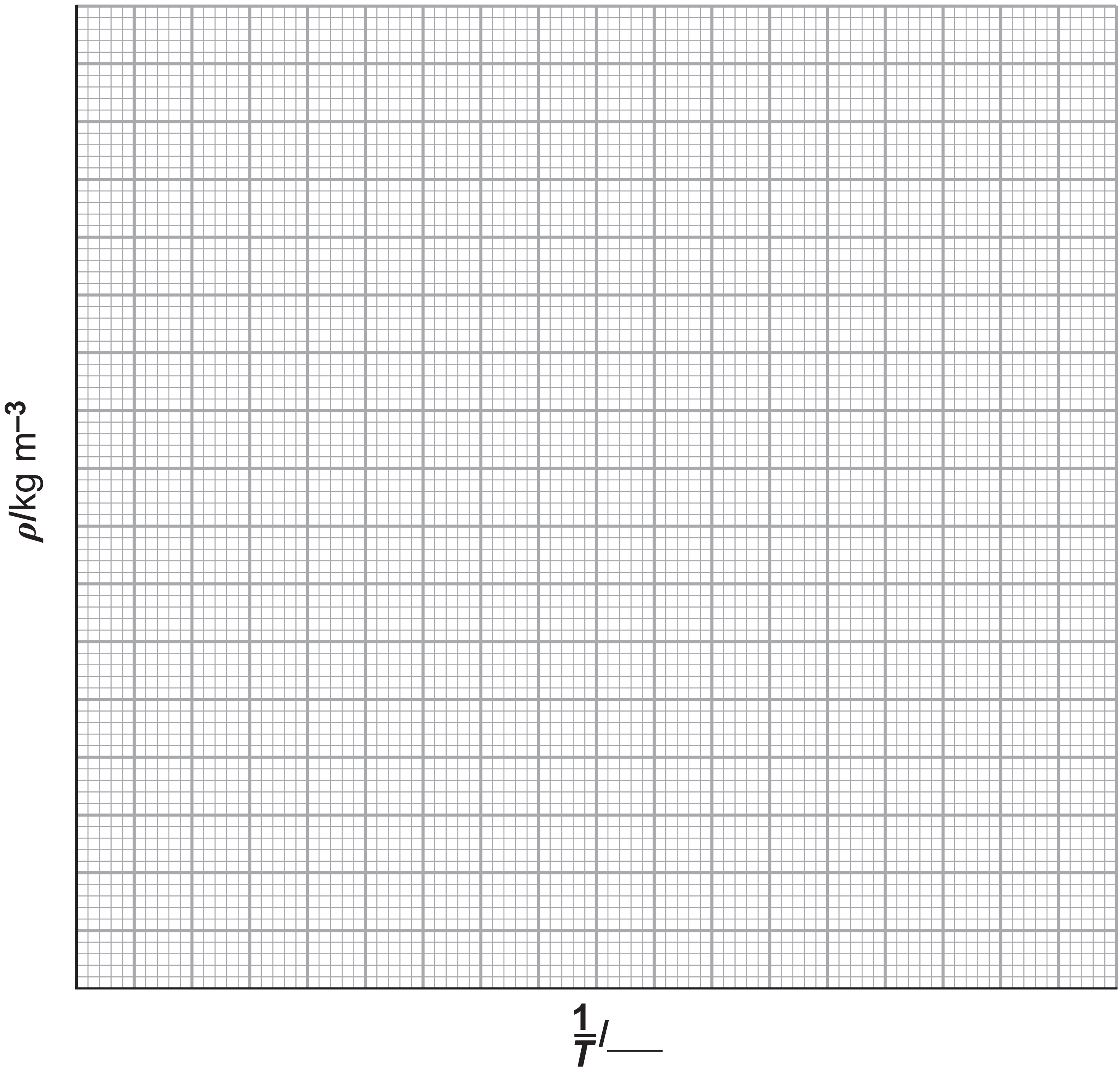


Fig. 5.2

(c) Analysis

(i) Determine the gradient of the graph. Include an appropriate unit. [4 marks]

Gradient **=** ________________ Unit **=** ________________

(ii) Determine the value of S. Include an appropriate unit. [4 marks]

S **=** ________________ Unit **=** ________________

(d) Evaluation

Use your graph to determine the percentage uncertainty in the value of S. [3 marks]

Uncertainty in S **=** ______________ **%**

THIS IS THE END OF THE QUESTION PAPER

Question Number	Marks	Remark
1		
2		
3		
4		
5		

Total Marks		