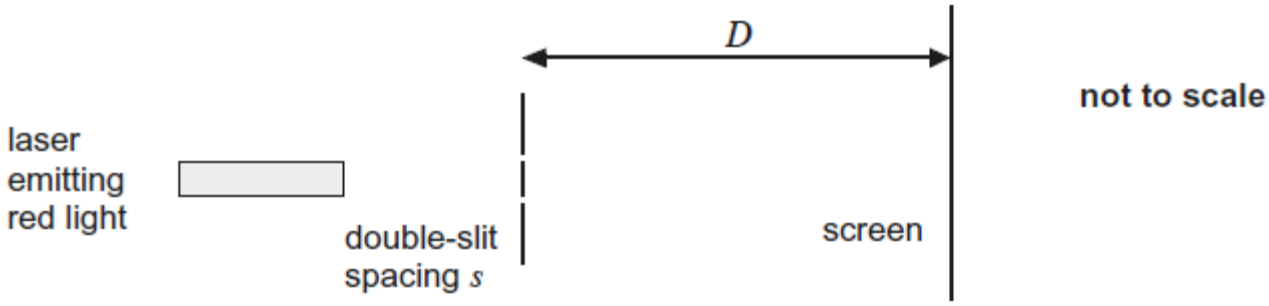
**Name of the Student**:_____
**Max. Marks : 20 Marks** **Time : 20 Minutes**

## Q1.

The diagram shows the arrangement of apparatus in an experiment to measure the wavelength of red light emitted by a laser. The light is incident on a double-slit so that an interference pattern is produced on the screen.




A student sets up the apparatus and measures the fringe width *w* of the interference pattern and the distance *D* between the double-slit and screen.

The student makes further measurements of *w* using the same laser but with different values of *D* and different slit spacing *s*.

The student's results are shown in the table below

| ***D*/m** | $S/10^{-3}$ m | $\left(\frac{D}{S}\right)/10^{3}$ | $w/10^{-3}$m |
|---|---|---|---|
| 1.000 | 0.70 | | 1.03 |
| 0.900 | 0.70 | | 0.93 |
| 0.800 | 0.70 | 1.14 | 0.84 |
| 1.000 | 1.00 | 1.00 | 0.76 |
| 0.800 | 1.00 | 0.80 | 0.62 |
| 0.600 | 1.00 | 0.60 | 0.50 |

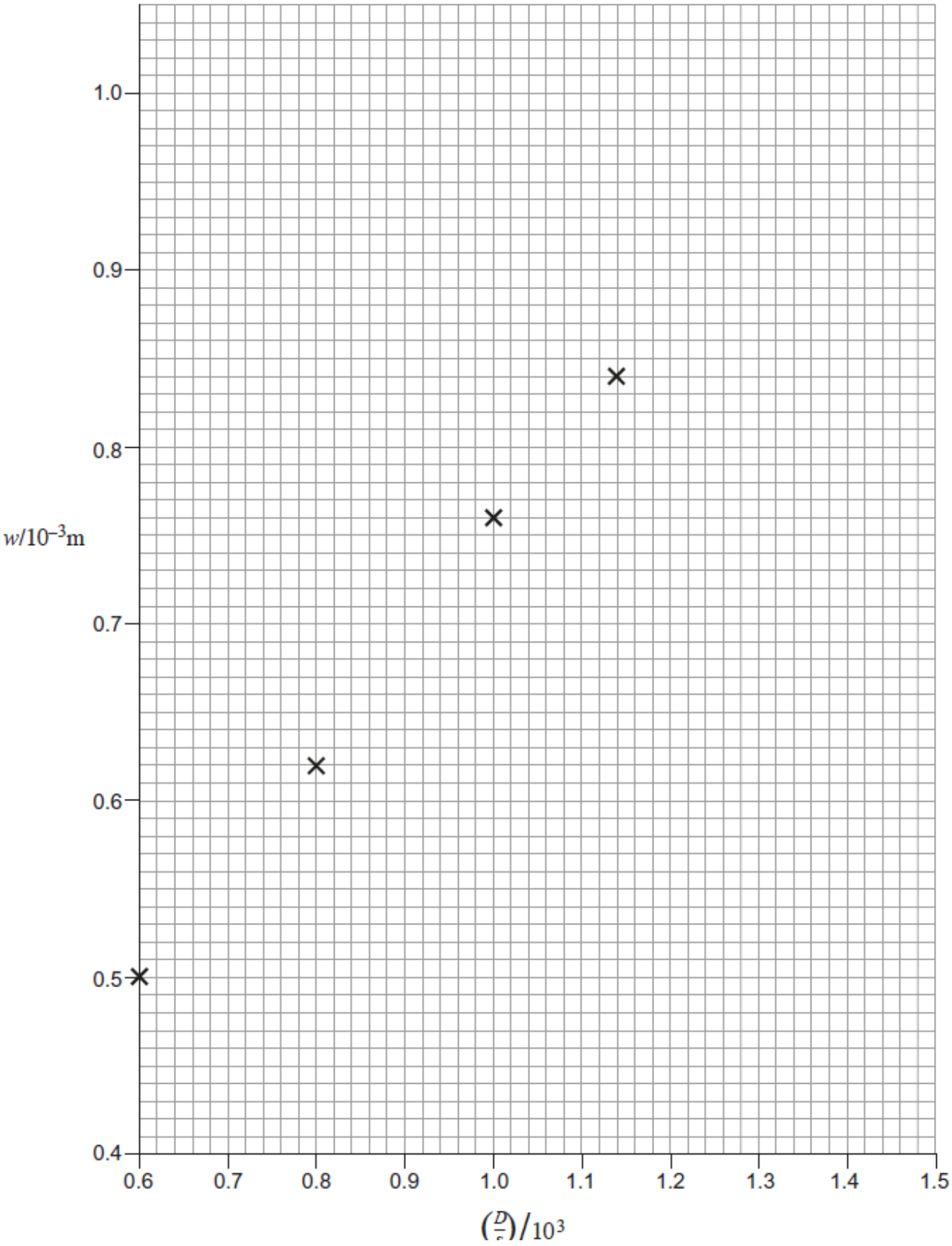
(a) Complete the table above.

**(1)**

(b) Complete the graph below by plotting the two remaining points and drawing a best fit straight line.

**(2)**

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(c) (i) Determine the gradient of the graph above.

_____

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**(3)**

(ii) Determine the wavelength of the red laser light used in this experiment.

_____

_____

_____

_____

_____

**(1)**

(d) (i) Theory suggests that the graph above should go through the origin.

State and explain what this suggests about the relationship between *w* and $\frac{D}{S}$.

_____

_____

_____

_____

**(2)**

(ii) The student discovers that the best fit line drawn in the graph does not go through the origin.

Determine, using information from the graph above, the value of *w* corresponding to $\left(\frac{D}{S}\right) = 0$.

_____

_____

_____

**(2)**

(iii) The graph suggests a systematic error in a measurement.

Identify the measurement.

_____

**(1)**

(e) The interference pattern produced on the screen is much brighter in the centre of the screen than at the edges.

State what causes this effect.

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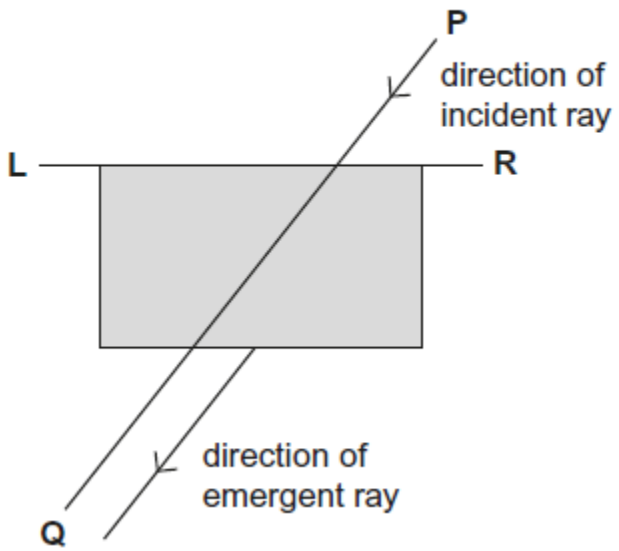
**(1)**

**(Total 13 marks)**

## Q2.

A student aligns the longer edge of a rectangular glass block along a line **LR**, as shown in **Figure 1**.

**Figure 1**



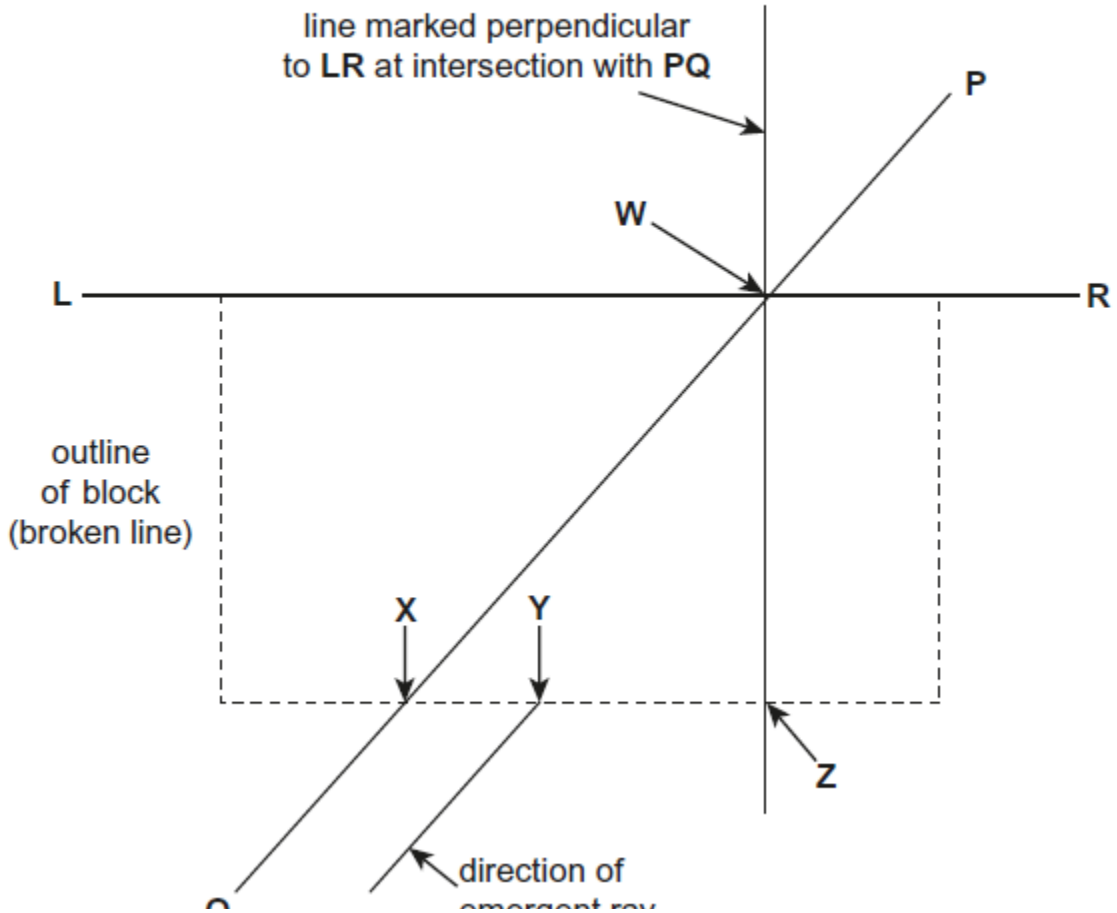

The student marks the outline of the block and directs a ray along **PQ**.

The student marks the direction of the emergent ray then removes the block and marks a line perpendicular to **LR** where **PQ** and **LR** intersect.

The student then marks the points **W**, **X**, **Y** and **Z** that are defined in **Figure 2**.

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**Figure 2**




(a) Show that the refractive index $n$ of the block is given by the equation

$$n = \frac{XZ \times WY}{YZ \times WX}$$

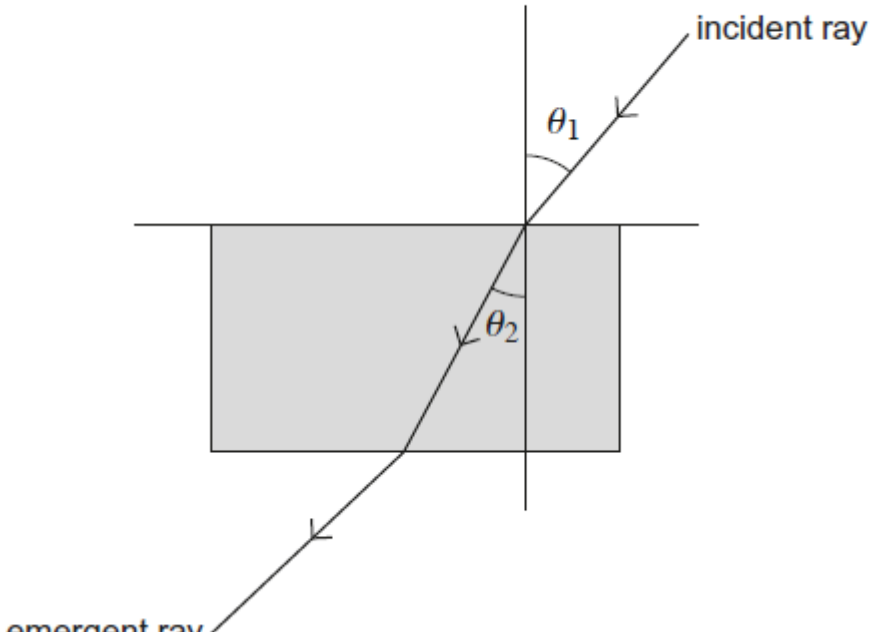
You may wish to use the equation $n = \frac{\sin\theta_1}{\sin\theta_2}$

where $\theta_1$ and $\theta_2$ are the angles shown in **Figure 3**.

You may also wish to illustrate your answer with a diagram.

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**Figure 3**




**(2)**

(b) The student repeats the procedure for different directions of the incident ray **PQ**. The student measures **XZ**, **WX**, **YZ** and **WY** for each direction of **PQ**.
State and explain how the student can use these results to obtain a value of $n$ by a graphical method.

**(2)**

(c) The student used a block with dimensions 114 mm × 65 mm × 19 mm to perform the experiment.

The student's data are shown in the table below.

| WX/mm | WY/mm | XZ/mm | YZ/mm |
|---|---|---|---|

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| | | | |
|---|---|---|---|
| 130 | 78 | 113 | 44 |
| 103 | 75 | 80 | 38 |
| 90 | 73 | 63 | 33 |
| 81 | 71 | 49 | 27 |
| 75 | 69 | 38 | 22 |
| 67 | 66 | 15 | 10 |

Explain whether the range of measurements made by the student is suitable.

_____

_____

_____

_____

_____

_____

**(3)**

**(Total 7 marks)**

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