2 A student places a slide with a double slit on a support clamped to the bench as shown in Fig. 2.1.

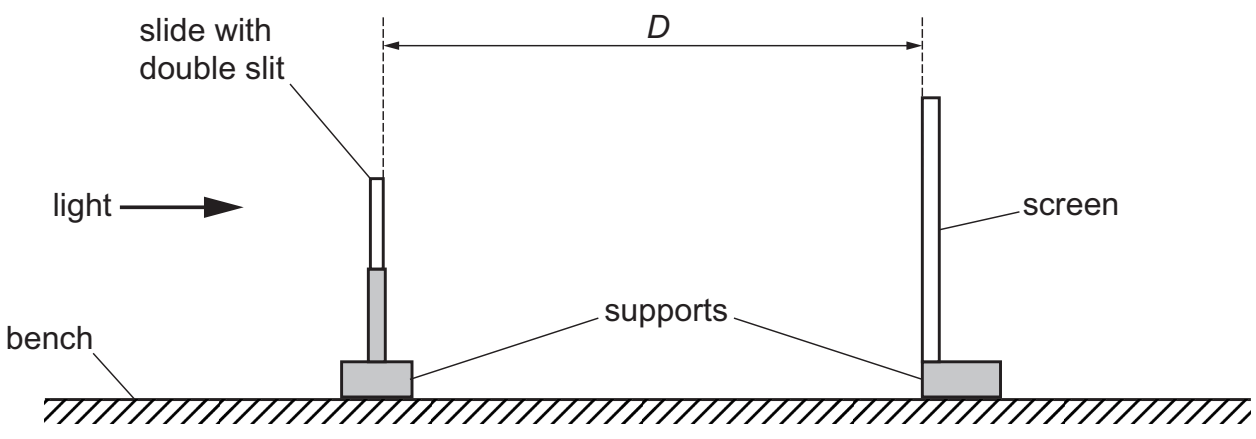


Fig. 2.1

The distance between the slide and the screen is D.

The separation s of the slits is determined.

Light from a laser is incident normally on the double slit. An interference pattern is observed on the screen. The distance w across 10 fringes is measured. The distance y between the centres of adjacent fringes is calculated using the equation

$$y = \frac{w}{10}.$$

The experiment is repeated with slides of different slit separation s.

It is suggested that y and s are related by the equation

$$\lambda = \frac{sy}{D}$$

where λ is the wavelength of the incident light.

(a) A graph is plotted of y on the y-axis against $\frac{1}{s}$ on the x-axis.

Determine an expression for the gradient.

gradient = ... [1]

(b) Values of s and w are given in Table 2.1.

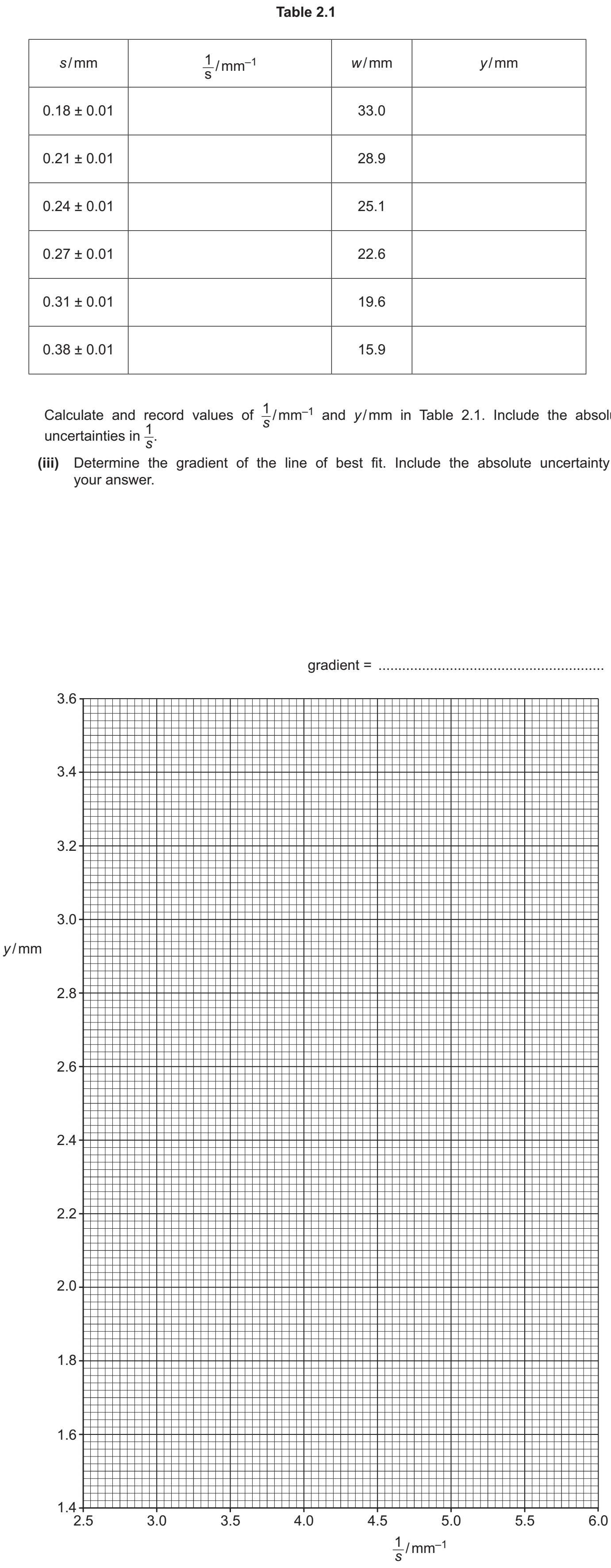
Table 2.1

s/mm	$\frac{1}{s}$/mm^{-1}	w/mm	y/mm
0.18 ± 0.01		33.0	
0.21 ± 0.01		28.9	
0.24 ± 0.01		25.1	
0.27 ± 0.01		22.6	
0.31 ± 0.01		19.6	
0.38 ± 0.01		15.9	

Calculate and record values of $\frac{1}{s}$/mm^{-1} and y/mm in Table 2.1. Include the absolute uncertainties in $\frac{1}{s}$. [2]

(iii) Determine the gradient of the line of best fit. Include the absolute uncertainty in your answer.

gradient = ... [2]



(d) The distance between the slide and the screen is measured several times:

0.929 m 0.918 m 0.913 m 0.918 m 0.927 m.

Determine the mean distance D. Include the absolute uncertainty.

D = ... m [1]

(e) **(i)** Using your answers to **(a)**, **(c)(iii)** and **(d)**, determine the value of λ. Include an appropriate unit.

λ = ... [2]

(ii) Determine the percentage uncertainty in λ.

percentage uncertainty in λ = ...% [1]

(f) The experiment is repeated. Determine the slit separation s that gives a value of y of (0.500 ± 0.005) cm. Include the absolute uncertainty.

s = ... m [2]

[Total: 15]