

Name of the Student: _____

Max. Marks : 20 Marks

Time : 20 Minutes

Q1.

A student has a diffraction grating that is marked 3.5×10^3 lines per m.

- (a) Calculate the percentage uncertainty in the number of lines per metre suggested by this marking.

percentage uncertainty = _____ %
(1)

- (b) Determine the grating spacing.

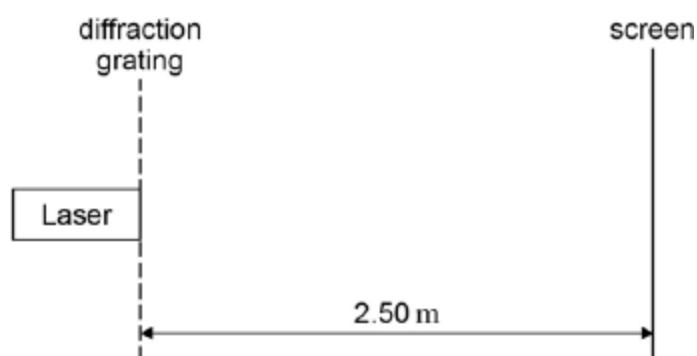
grating spacing = _____ mm
(2)

- (c) State the absolute uncertainty in the value of the spacing.

absolute uncertainty = _____ mm

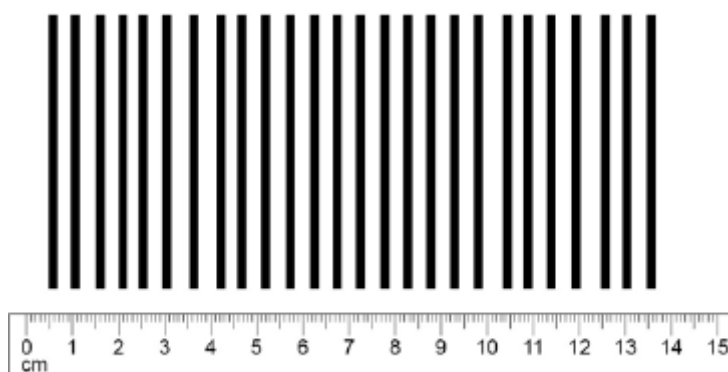
- (d) The student sets up the apparatus shown in **Figure 1** in an experiment to confirm the value marked on the diffraction grating.

Figure 1



The laser has a wavelength of 628 nm. **Figure 2** shows part of the interference pattern that appears on the screen. A ruler gives the scale.

Figure 2



Use **Figure 2** to determine the spacing between two adjacent maxima in the interference pattern. Show all your working clearly.

spacing = _____ mm

(1)

- (e) Calculate the number of lines per metre on the grating.

number of lines = _____

(2)

- (f) State and explain whether the value for the number of lines per m obtained in part (e) is in agreement with the value stated on the grating.

(2)

- (g) State **one** safety precaution that you would take if you were to carry out the experiment that was performed by the student.

(1)

(Total 10 marks)

Q2.

Data analysis question

Capillary action can cause a liquid to rise up a hollow tube. **Figure 1** shows water that has risen to a height h in a narrow glass tube because of capillary action.

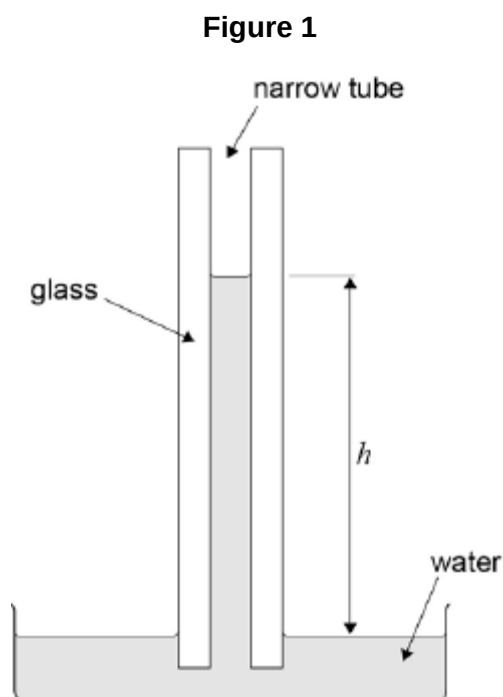
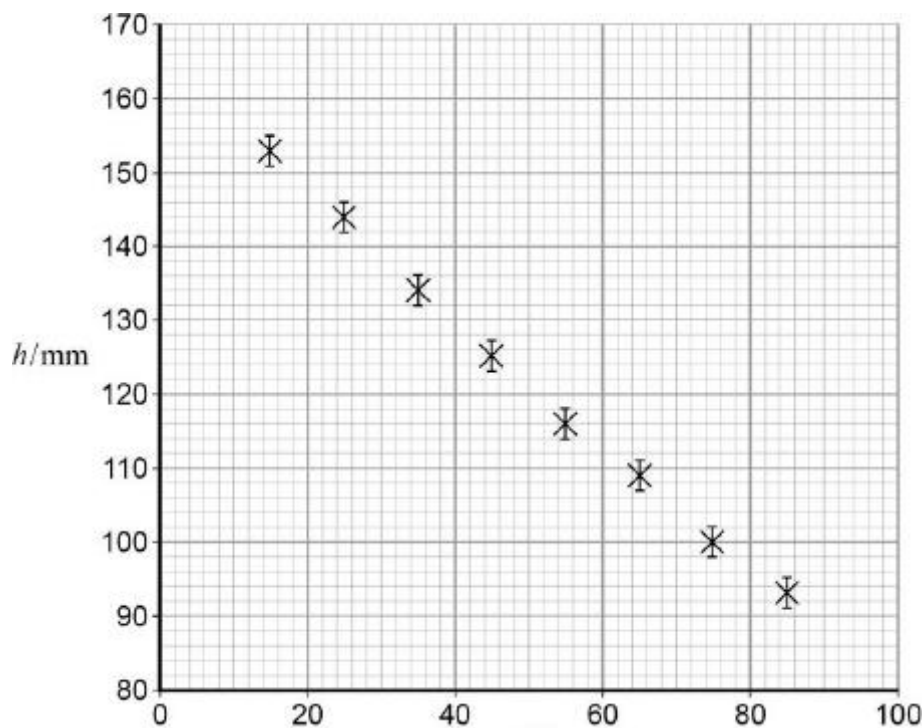


Figure 2 shows the variation of h with temperature θ for this particular tube.

Figure 2



The uncertainty in the measurement of h is shown by the error bars. Uncertainties in the measurements of temperature are negligible.

- (a) Draw a best-fit straight line for these data (**Figure 2**).

(1)

- (b) It is suggested that the relationship between h and θ is

$$h = h_0 - (h_0 k) \theta$$

where h_0 and k are constants.

Determine h_0 .

$$h_0 = \underline{\hspace{2cm}} \text{ mm}$$

(1)

- (c) Show that the value of $h_0 k$ is about 0.9 mm K^{-1} .

(3)

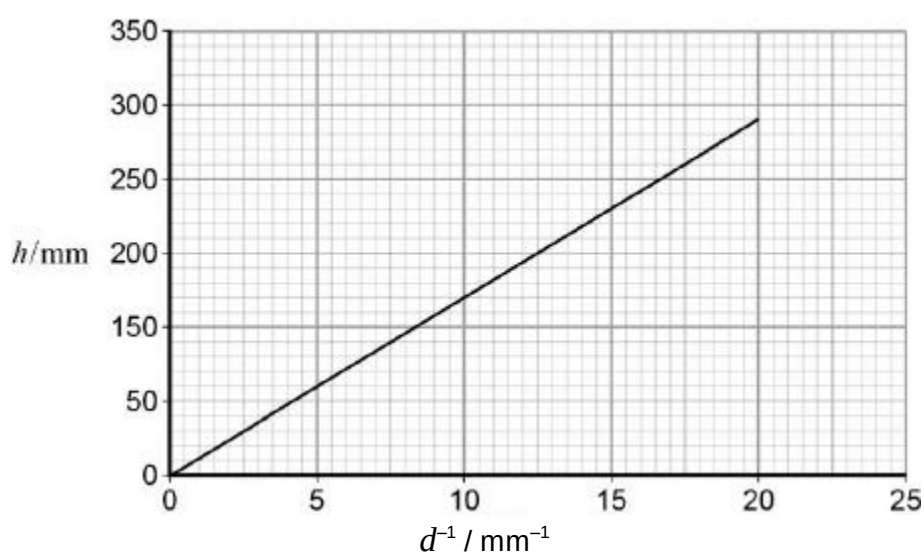
- (d) Determine k . State a unit for your answer.

$$k = \underline{\hspace{2cm}} \text{ unit} = \underline{\hspace{2cm}}$$

(2)

- (e) A similar experiment is carried out at constant temperature with tubes of varying internal diameter d . **Figure 3** shows the variation of h with $\frac{1}{d}$ at a constant temperature.

Figure 3



It is suggested that capillary action moves water from the roots of a tree to its leaves.

The gradient of **Figure 3** is 14.5 mm^2 .

The distance from the roots to the top leaves of the tree is 8.0 m .

Calculate the internal diameter of the tubes required to move water from the roots to the top leaves by capillary action.

(2)

- (f) Comment on the accuracy of your answer for the internal tube diameter in part (v).
