

Name of the Student: _____

Max. Marks : 19 Marks

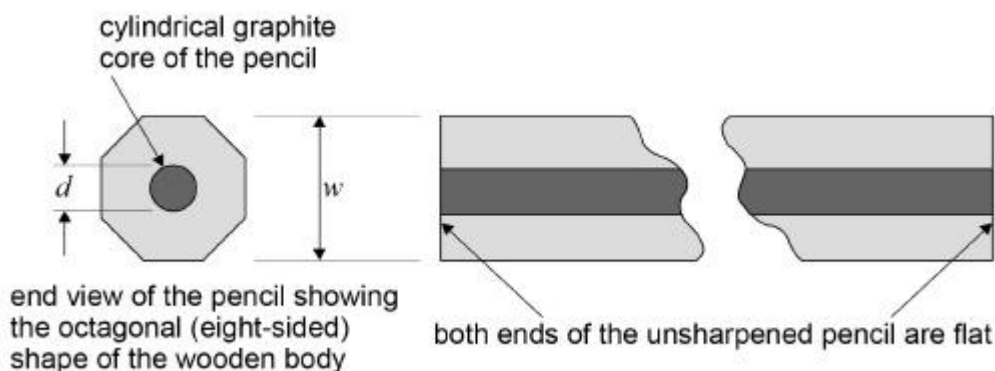
Time : 19 Minutes

Q1.

A pencil, unsharpened at both ends, has a cylindrical graphite core of uniform diameter d surrounded by an octagonal (eight-sided) wooden body.

Figure 1 shows an end view and a cross-sectional slice along the length of the pencil.

Figure 1



- (a) A student used a micrometer to measure the width w at several points along the length of the pencil.

Explain why the student used this procedure to determine a value for w .

(1)

- (b) The student's results are shown in the table.

w_1 / mm	w_2 / mm	w_3 / mm	w_4 / mm	w_5 / mm
7.23	7.10	7.06	7.20	7.16

Determine the percentage uncertainty in the result the student obtains for w .

percentage uncertainty = _____ %

(2)

- (c) The cross-sectional area A of the end of the pencil is given by

$$A = 0.83 w^2$$

The volume of the cylindrical core is known to be 9.0% of the volume of the unsharpened pencil.

The cylindrical core of the graphite has a diameter d .

Determine d .

$$d = \text{_____ mm}$$

(2)

- (d) A student investigates the rate at which a similar pencil wears away through use.

The student measures the length of the pencil using a sliding vernier scale placed alongside a fixed scale. The fixed scale has a precision of 1 mm.

Figure 2 shows the vernier scale in the zero position.

Figure 3 shows the pencil (which is now sharpened) placed next to the fixed scale.

The position of the vernier scale is adjusted so that the length of the pencil can be read.

Read and record the length of the pencil shown in **Figure 3**.

$$\text{length of pencil} = \text{_____ mm}$$

(1)

- (e) The pencil is then removed from the scale and is used to draw 20 lines on a sheet of paper. Each line has a length 25 cm.

The pencil is then replaced next to the fixed scale and the vernier scale adjusted so the new length of the pencil can be read, as shown in **Figure 4**.

Read and record the new length of the pencil shown in **Figure 4**.

$$\text{new length of pencil} = \text{_____ mm}$$

(1)

- (f) $L_{1/2}$ is the length of the line that could be drawn which would cause the original length of the pencil to be halved.

Calculate $L_{1/2}$.

Ignore any decrease in length as a result of sharpening the pencil.

$$L_{1/2} = \text{_____ m}$$

(2)

Figure 2

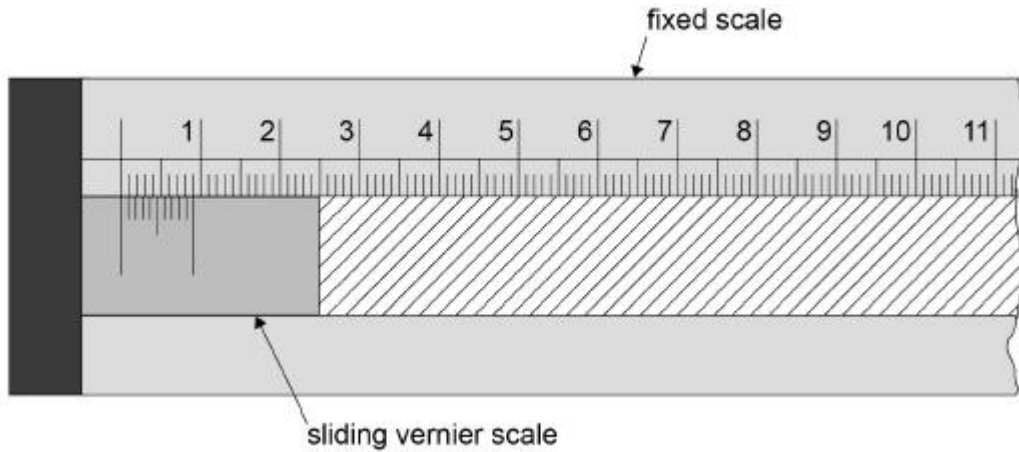


Figure 3

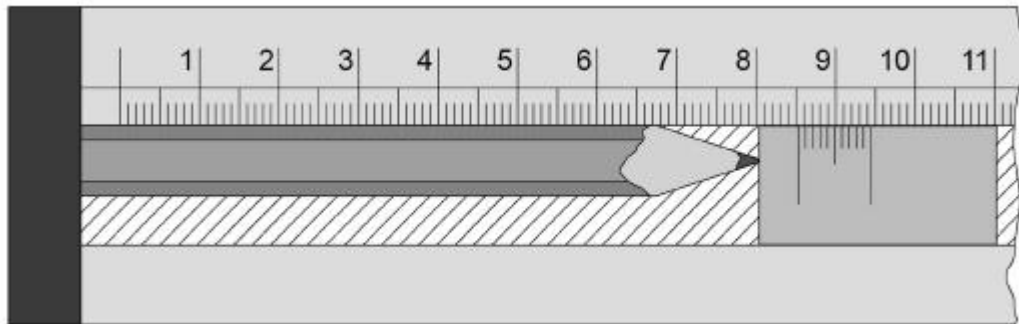
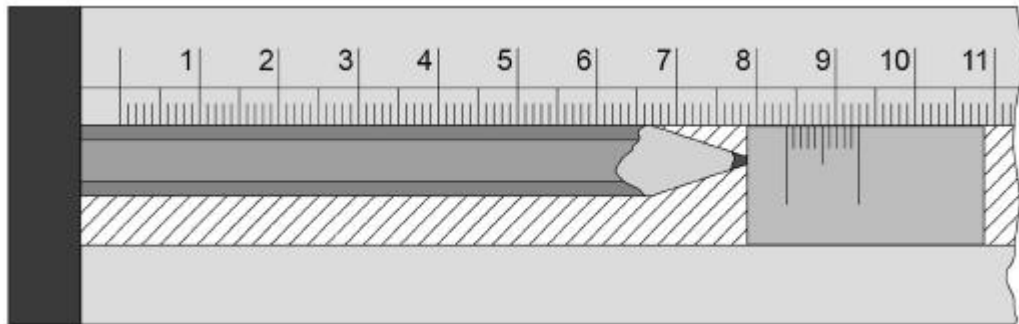


Figure 4



(Total 9 marks)

Q2.

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.

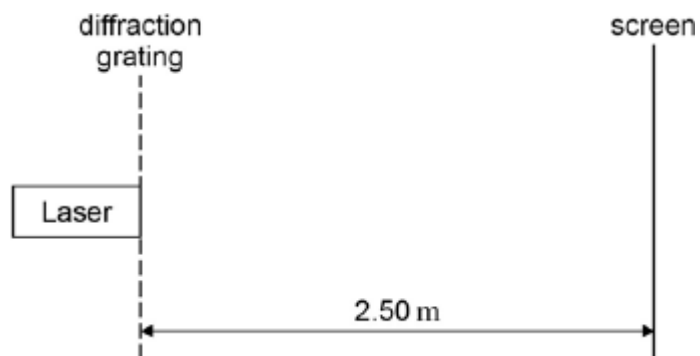
grating spacing = _____ mm (2)

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

absolute uncertainty = _____ mm (1)

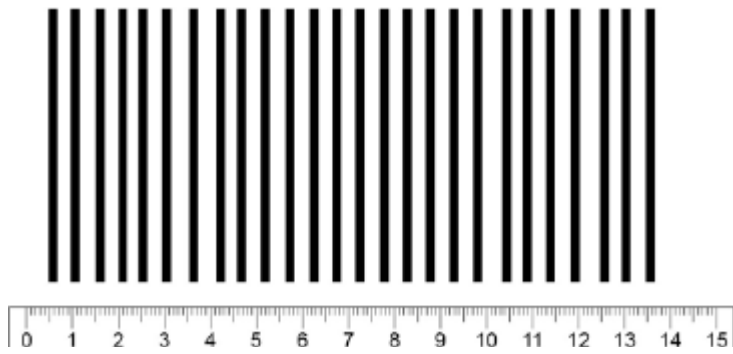
(d) The student sets up the apparatus shown in **Figure 1** in an experiment to confirm the value marked on the diffraction grating.

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)