# Topic 9 – Guidance for Practical 1

## *Determination of wavelength using Young's double-slit experiment*

### Safety

Although great care has been taken in checking the accuracy of the information provided in this guidance, Cambridge University Press shall not be responsible for any errors, omissions or inaccuracies.

Teachers and technicians should always follow their school and departmental safety policies. You must ensure that you consult your employer's model risk assessments and modify them as appropriate to meet local circumstances before starting any practical work. Risk assessments will depend on your own skills and experience, the skills and experience of your students, and the facilities available to you. Everyone has a responsibility for his or her own safety and for the safety of others. The notes below should not be regarded as a risk assessment.

You should carry out the practical yourself before presenting it to students. Make sure you are comfortable with the procedures, and can anticipate any difficulties your students may encounter.

### Guidance

Students will practice measuring angles, recording measurements in appropriate tables and using graphical methods to determine experimental values.

### Apparatus and materials

Each group will need:

- laser
- double-slit aperture of known slit separation
- support for aperture
- screen
- ruler
- metre rule

### Setting up the practical

Use a low-power output laser, for example Class 2. Class 3B and Class 4 are unsuitable for use in schools. Make sure that all entrances to the room where the experiment takes place have a 'Laser in use' sign.

Another way to ensure that students' eyes are not close to the laser beam is for students to use a digital camera to take pictures of the diffraction patterns with a ruler next to them. They can analyse these images later to measure the distance of the first secondary maximum to the central maximum.

### Answers to questions

**1** It is not clear where exactly the positions of the maxima are.

**2** Bright fringes closer to each other.

**3** Every wavelength would produce an interference pattern. All have a bright central fringe, therefore there would be a bright central white fringe. The other fringes would not coincide so they would be less distinct, with a blue inside area and a red outside area.

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# Topic 9 – Guidance for Practical 2

## *Measuring the vibrations of a tuning fork using a sonometer*

### Safety

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You should carry out the practical yourself before presenting it to students. Make sure you are comfortable with the procedures, and can anticipate any difficulties your students may encounter.

### Guidance

Students will practice using a sonometer, recording measurements in appropriate tables and using graphical methods to determine experimental values.

### Apparatus and materials

Each group will need:

- sonometer (box, fixed peg F, two fixed bridges A and B, movable bridge C, pulley P, mass hanger and slot masses W)
- steel wire (diameter 0.5 mm)
- micrometer
- set of tuning forks and rubber bung

### Setting up the practical

With the same experimental setup, some variations of the experiment can be performed.

**1** Keeping the load constant, students change the length, $L$, to match the frequency of the fork and plot $f$ against $\frac{1}{L}$. They can determine the density of the material from the value of the gradient of their graph.

**2** Keeping the tension, $T$, constant, students change the material or the diameter of the wire and measure $L$ $f \propto \frac{1}{L}$ and $L\sqrt{\rho}$ is constant for each wire. They will plot $f$ against $\sqrt{\rho}$ if they change the material and $f$ against $\frac{1}{r}$ if they change the diameter of the wire.

### Answers to questions

**1** Inversely proportional.

**2** They are equal.

**3** $f = \frac{1}{\lambda}\sqrt{\frac{T}{\mu}}$ hence $\mu = \frac{T}{(f\lambda)^2} = \frac{mg}{(f\lambda)^2} = \frac{5 \times 9.81}{(200 \times 2)^2} = 3 \times 10^{-4}\,\text{kg m}^{-1}$

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