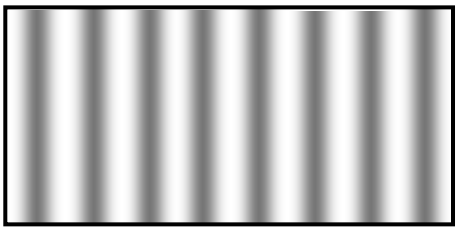
Workshop Tutorials for Physics

WR10: **Physical Optics**

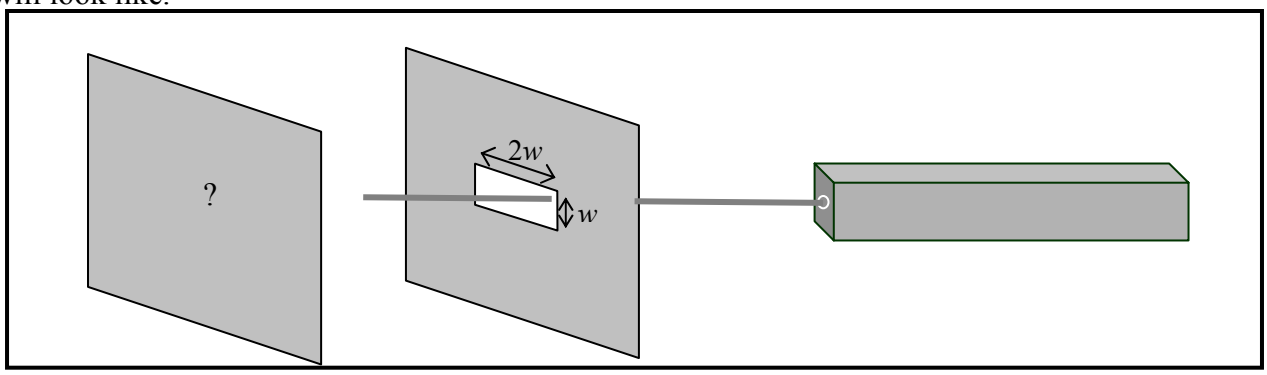
A. Qualitative Questions:

1. Consider light from a laser incident on two narrow slits. The pattern produced by the light is shown opposite.



a. If you treated light as rays moving in straight lines, what sort of pattern would you expect from the slits?
b. Explain why you need to treat light as a wave to explain the pattern that is formed.
Describe what would happen to the pattern if:
c. the distance between slits was decreased
d. the screen was moved closer to the slits
e. the width of each slit is decreased
f. one of the slits is covered.

2. The diagram below shows a light source which shines on a slit. The slit is twice as long as it is wide. The angle between the center of a diffraction pattern and the first minimum is given by $\sin\theta = \lambda/a$ where a is the width of the slit. Given this information, predict what the diffraction pattern for this source and slit will look like.



B. Activity Questions:

1. 2 source interference patterns

Place the circular wave pattern on the transparency over the pattern on the paper so that the sources are at the same point.
Now move them apart until you first get nodal lines.
How far are the sources apart now (in multiples of λ)?
Why can't there be any nodal lines for smaller separations?

2. Single Slit Diffraction

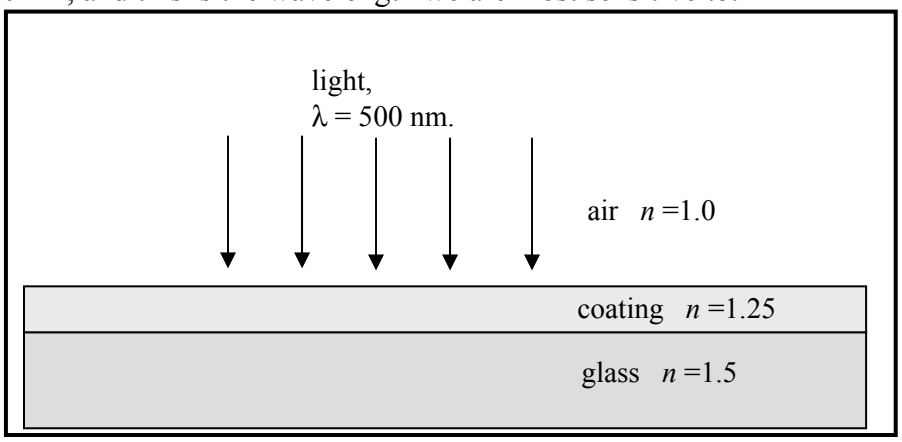
Examine the diffraction pattern produced by the laser beam passing through the slit.
Why do you get maxima and minima?
What happens when you change the slit width? Explain why.

3. CD
Look at the light reflected from the CD.
Why do you see different colours in it?

4. Diffraction patterns
Shine the laser light through the fabric.
What sort of pattern do you see?
How does the pattern change when you stretch the fabric horizontally?
What about when you stretch it vertically?
Explain why this happens.

C. Quantitative Question:

1. When you buy a pair of glasses you are asked whether you want all different sorts of options, like lenses that turn dark when it's sunny, polaroid lenses and anti-scratch and antireflection coatings. Consider a lens as shown below with a coating on the glass. The peak wavelength emitted by our sun is around 500 nm, and this is the wavelength we are most sensitive to.



a. If a ray of sunlight (use $\lambda = 500$ nm) is reflected from the air-coating interface, will it undergo a phase change on reflection?
b. Would it undergo a phase change on reflection from the coating-glass interface?
c. Given your answers to **a** and **b**, write down the condition for destructive interference of the reflected rays.
d. Calculate the minimum thickness of coating required to provide anti-reflection for sunlight.

2. An interference pattern is formed by shining light of wavelength $\lambda = 550$ nm through twin slits. The slits have a width of 0.03 mm and are spaced 0.15 mm apart.
a. How many complete fringes appear between the central maximum and the first minimum of the fringe envelope?
b. Sketch the pattern formed by this arrangement of slits.