Performance Task

17.2 Applications of Diffraction, Interference, and Coherence 13.

In this performance task you will create one- and two-slit diffraction and observe the interference patterns that result.

- A utility knife (a knife with a razor blade-like cutting edge)
- Aluminum foil
- A straight edge
- A strong, small light source or a laser pointer
- A tape measure
- A white wall

Procedure

1. Cut a piece of aluminum foil about 15 cm $\times$ 15 cm.
2. Use the utility knife and the straight edge to cut a straight slit several cm long in the center of the foil square.
3. With the room darkened, one partner shines the light through the slit and toward the wall. The other partner observes the pattern on the wall. The partner with the light changes the distance from the foil to the wall and the distance from the light to the foil.
4. When the sharpest, brightest pattern possible is obtained, the partner who is not holding the foil and light makes measurements.
5. Measure the perpendicular (shortest) distance from the slit to the wall, the distance from the center of the pattern to several of the dark bands, and the distance from the slit to the same dark bands.
6. Carefully make a second slit parallel to the first slit and 1 mm or less away.
7. Repeat steps 2 through 5, only this time measure the distances to bright bands.

- NOTE—In your calculations, use 580 nm for λ if you used white light. If you used a colored laser pointer, look up the wavelength of the color. You may find it easier to calculate θ from its tangent rather than from its sine.
    a. Which experiment gave the most distinct pattern—one or two slits?
    b. What was the width of the single slit? Compare the calculated distance with the measured distance.
    c. What was the distance between the two slits? Compare the calculated distance with the measured distance.

Teacher Support

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- This performance task supports NGSS HS-PS4-3: Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other.

Clarification Statement—Emphasis is on how the experimental evidence supports the claim and how a theory is generally modified in light of new evidence. Examples of a phenomenon could include resonance, interference, diffraction, and photoelectric effect.

Assessment Boundary—Assessment does not include using quantum theory.

AND

S&EP—Use mathematical representations of phenomena or design solutions to describe and/or support claims and/or explanations.

a. The double-slit pattern was more distinct.
b. Answers will vary. Calculation should employ $D\sin\theta = m\lambda$ or $\frac{Dy}{L} = m\lambda$.
c. Answers will vary. Calculation should employ $d\sin\theta = m\lambda$.