Interference & Diffraction

Physical optics · 5 questions · step-by-step answers at the end

Name: Date: Score: / 5

USEFUL EQUATIONS

$\Delta r = m\lambda$ $\Delta r = (m + ½)\lambda$ $d \sin\theta = m\lambda$ $\Delta y = \lambda L/d$ $a \sin\theta = m\lambda$

Questions

Show your working in the space under each question.

1. A grating has 600 lines per mm. At what angle is the first-order maximum for 500 nm light?

2. Green light (λ = 550 nm) passes through two slits 0.20 mm apart onto a screen 1.5 m away. Find the fringe spacing.

3. A double-slit experiment is moved into water (n = 1.33). What happens to the fringe spacing?

4. A single slit is made narrower. What happens to the central bright band?

5. Why don't two separate light bulbs make an interference pattern?

Step-by-step answers

Interference & Diffraction

1. $d = 1/600$ mm $= 1.67$ µm; $\sin\theta = \lambda/d = 0.30 \rightarrow \theta \approx$ **17°**.

2. 1. $\Delta y = \lambda L/d = (550 \times 10^{-9})(1.5)/(0.20 \times 10^{-3})$.
2. $\Delta y =$ **4.1×10^{-3} m** $= 4.1$ mm.
3. Check the small-angle assumption: $\theta \approx \Delta y/L = 0.0027$ rad. That's tiny ✓
4. Red light (longer λ) would spread the fringes further apart.

Answer: $\Delta y \approx 4.1$ mm

3. λ shrinks by 1.33, so the fringes move **closer together** by a factor of 1.33.

4. It gets **wider** ($\sin\theta = \lambda/a$ grows).

5. They are **not coherent**: their phase relationship changes randomly, so the pattern washes out.