PHYS 2022 -- Homework 11 -- Practice problems for Midterm 3
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Problems:

1. A plane wave $\xi = A \cos(\omega t - kx)$ falls normally on a wall and reflects back. 25% of the energy of the incident wave is lost to the wall. Write down the solution of the wave equation for the *reflected* wave.

2. The phase velocity of waves in a medium varies with their wavelength as $v_p = \frac{C}{\sqrt{k}} = C\sqrt{\frac{\lambda}{2\pi}}$, where C is a constant.
   How does the group velocity vary with λ?

3. The equation of a traveling sound wave is $\xi = 10 \sin(180\, t - 0.628\, x)$, where ξ is in micrometers, t is in seconds, and x is in meters.
   a. Find the speed of sound and the wavelength of the wave.
   b. As the wave passes through air, what is the maximum *speed of the air particles*?

4. A plane monochromatic light wave falls normally on two vertical slits, and a fringe pattern is observed on a screen behind the slits. How would the pattern change if, instead of air, the entire system (the slits and the screen) were placed in water (n=1.3)? Explain.

5. When a light with λ_1=650 nm falls normally on a diffraction grating, the angle of diffraction for the *first* order maximum is θ_1=10 degrees. Find the angle of diffraction for the *second* order maximum for a λ_2=500 nm light. You can use a small-angle approximation.

6. You observe a thin oil film on the surface of a puddle. What is the minimum thickness of the film at a location where you see a green (λ=500 nm) interference stripe? The index of refraction in oil is *smaller* than in water.