

QUESTION (2): (12 Points)

A block of mass 200 g is attached to a horizontal spring with $k = 0.85 \text{ N/m}$. When in motion, the system is damped by a force that is linear in velocity, with $b = 0.2 \text{ kg/s}$.

(a) Write the differential equation of motion for the system. ... (2 points)

(b) Show that the system is under-damped. Calculate the oscillation period and compare it to the natural period. (2 Points)

(c) How long does it take for the oscillating block to lose 99.9% of its initial total mechanical energy? By what factor does the amplitude decrease during this time? (4 points)

(d) If the system is driven by a sinusoidal force of maximum value 10.0 N and angular frequency 10.0 rad/s. What is the resonant amplitude of the oscillations? (4 points)

QUESTION (3): (10 Points)

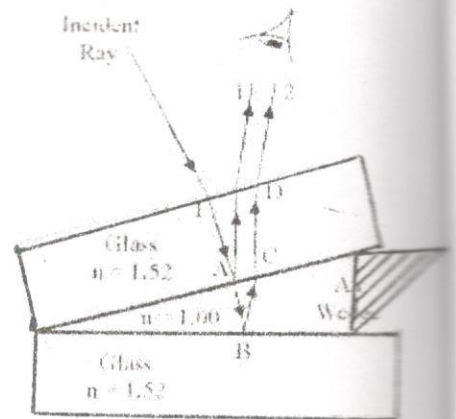
(a) Suppose that the wave equation, $y(x, t) = 2A \sin(kx) \cos(\omega t)$, represents the transverse wave generated on a stretched string with both end at $x=0$ and $x=L$ are fixed at all times. Drive the allowed wavelengths λ_n and the allowed frequencies f_n of the normal modes (4 points)

(b) Sketch the wave function y as a function of x for the first three harmonics..... (2points)

(c) Two speakers emit sound waves in phase with $\lambda=6\text{m}$. Speaker S_1 is located at $x=+5\text{m}$, and speaker S_2 is located at $x=-5\text{m}$. Obtain an expression for the path difference from the two speakers to any point on the x -axis between the speakers. Use this to find the positions on x -axis where the sound intensity is zero. (4 points)

QUESTION (4): (8 Points)

(a) In order to measure the thickness of thin metallic plate, it is placed between two perfectly flat pieces of glass as shown in figure. A sodium light source ($\lambda=589\text{nm}$) was used such that the light ray incident and reflected perpendicularly to the surface as shown in figure. It was found that the edge of the metallic plate coincides with the 40th dark fringe. Find out the thickness of the metallic plate. (4 Points)



(b) Monochromatic light with wavelength 538 nm is incident on a slit with width 0.025 mm , the distance between the screen and the slit is 3.5 m . Consider a point on the screen 1.1 cm from the central maximum. Calculate the relative intensity at this point. ... (4 points)

Good Luck

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