ADVANCED PHYSICS CLUB

NOVEMBER 4, 2018

Today's meeting

Today we reviewed harmonic motion and introduced the energy function of harmonic oscillator $E = \frac{1}{2}m\dot{x}^2 + \frac{1}{2}kx^2$. We considered the general solution to the equation of motion ($m\ddot{x} = -k(x - x_0)$) of a harmonic oscillator: $x - x_0 = A\cos(\omega t) + B\cos(\omega t)$. We also considered the following problems.

Discussed problems

1. Using the general solution for harmonic oscillator show that $\frac{mv^2}{2} + \frac{k(x-x_0)^2}{2}$ is time independent if $\omega^2 = \frac{k}{m}$.

2. We discussed the problem of the buoy where we computed oscillations using only $\rho V g$ and mg forces (neglecting the water momentum).

***3.** Consider waves of a wavelength λ propagating in a shallow pool of the depth $H \ll \lambda$. How will the velocity of these waves change if the depth of the pool changes from H to $2H$?
Hint: Use dimensional analysis.

Homework

1. a) Write down the energy functional for a mathematical pendulum of the length L and mass M. Write it in terms of the angular deviation of the pendulum from the vertical ϕ and angular velocity of the pendulum $\dot{\phi}$.

b) Let us assume that ϕ is small. Simplify the energy functional using approximate formulas valid for small $\phi \ll 1$: $\sin\phi \approx \phi$ and $\cos\phi \approx 1 - \phi^2/2$. What is the frequency for small oscillations of the pendulum?

2. The earth, sun and moon are moving approximately on a plane. On Dec 16 1992 the Galileo mission took a picture of the earth-moon system from a distance of 6.4 Million Kms (which is approximately 1000 Earth radii). The distance between earth and the moon is approximately 60 Earth radii. Examining the photo, what is the approximate angle between the moon-earth line and the earth-spacecraft line?