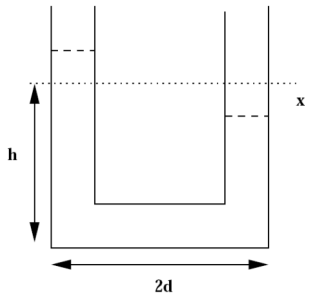
Tutorial 1 for PH11001 course [Spring 2020], IIT Kharagpur
(From topics of Lecture 1-3): SHM & Damped oscillations

1. A liquid is kept in a U-shaped tube. If h is the equilibrium height of liquid in both arms and 2d is the separation between the two arms of the U tube then find the equation of motion for the vertical displacement x of the liquid surface. Also find the frequency of oscillation from the equation of motion.



2. Consider the potential energy of a point mass (m) given by, $V(x) = a - bx - cx^2$. Find out:
   a) the sign of the coefficient c such that the particle undergoes harmonic oscillation
   b) the origin around which the particle oscillates
   c) the oscillation frequency

3. A point performs damped oscillations according to the law: $x = a_0 e^{-\beta t} \sin(\omega t)$. Find:
   a) The oscillation amplitude and the velocity of the point at the moment $t = 0$;
   b) The moments of time at which the point reaches the extreme positions.

4. A simple pendulum oscillates in a medium for which the logarithmic decrement is equal to $\lambda_0 = 1.50$. What will be the logarithmic decrement if the resistance of the medium increases by a factor $n = 2.00$? By what factor has the resistance of the medium to be increased for the oscillations to become impossible?

5. A spring-mass system has an undamped time period $T_0 = 2\pi$ seconds. It is then subjected to critical damping. The mass is pulled to one side and released from rest at $t = 0$. Find the time τ in seconds, $(0 < \tau < \infty)$, at which the damping force exactly balances the spring force.