Academic Year 2023-24
Tutorial #06
PH100: Mechanics and Thermodynamics

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1. Find the driving frequency for which the velocity of a forced damped oscillator is exactly in phase with the driving force.

2. A particle of mass 50 g moves under an attractive central force of magnitude $4r^3$ dynes. The angular momentum is equal to 1,000 g*cm^2 /s.
   a. Find the effective potential energy.
   b. Indicate on a sketch of the effective potential the total energy for circular motion.
   c. The radius of the particle's orbit varies between r_o and $2r_0$. Find r_o.

3. A particle moves in a circle under the influence of an inverse cube law force. Show that the particle can also move with uniform radial velocity, either in or out. (This is an example of unstable motion. Any slight perturbation to the circular orbit will start the particle moving radially, and it will continue to do so.) Find \theta as a function of *r* for motion with uniform radial velocity *v*.

4. A 2-kg mass on a frictionless table is attached to one end of a massless spring. The other end of the spring is held by a frictionless pivot. The spring produces a force of magnitude 3r Newtons on the mass, where *r* is the distance in meters from the pivot to the mass. The mass moves in a circle and has a total energy of 12 J.
   a. Find the radius of the orbit and the velocity of the mass.
   b. The mass is struck by a sudden sharp blow, giving it instantaneous velocity of 1 m/s radially outward. Show the state of the system before and after the blow on a sketch of the energy diagram.