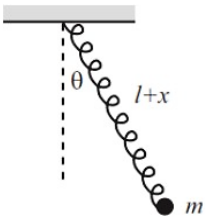
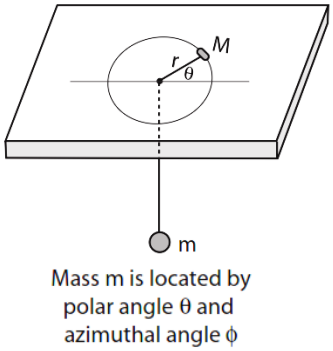
Dept. of Physics, PSSHDA
Classical Mechanics (UNIT-I) 20 Marks

1) The Lagrangian of a particle is given by $L = \dot{q}^2 - q\dot{q}^2$, which of the following statement is true?
(a) This is a free particle, (b) The particle is experiencing velocity dependent damping, (c) The particle is executing simple harmonic motion, (d) The particle is under constant acceleration.

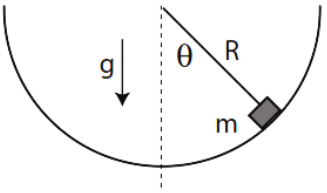


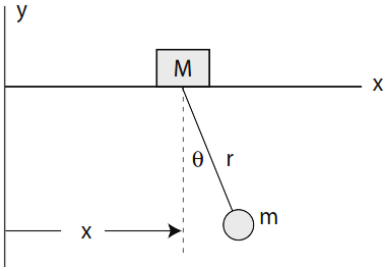
2) Consider a pendulum made of a spring with a mass m on the end (see Fig.) The spring is arranged to lie in a straight line (which we can arrange by, say, wrapping the spring around a rigid massless rod). The equilibrium length of the spring is l. Let the spring have length $l + x$, and let its angle with the vertical be θ.Assuming that the motion takes place in a vertical plane. Write Lagrangian and Generalized Coordinates.

3) The figure shows a mass M connected to another mass m. Mass M moves without friction along a circle of radius r on the horizontal surface of a table. The two masses are connected by a massless string of length ℓ that passes through a hole in the table. At given time the mass M is located by r and θ. Write Lagrangian and Generalized Coordinates.



4) A particle of mass m is free to move without friction on the inside of a hemispherical bowl whose axis is aligned along the vertical. The radius of the hemisphere is R and the particle is located by the polar angle θ and the azimuthal angle φ. Write Lagrangian and Generalized Coordinates.





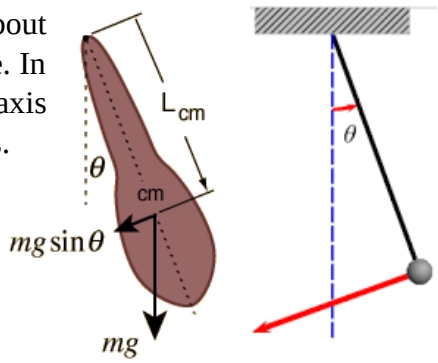
5) Figure shows a simple pendulum consisting of a string of length r and a bob of mass m that is attached to a support of mass M. The support moves without friction on the horizontal plane. Write Lagrangian and Generalized Coordinates.

6) For conservative systems, the potential energy ν does not depend upon generalized velocity and hence: a) $\nu = 0$, b) $\frac{\partial \nu}{\partial q_k} = 0$, c) $\frac{\partial \nu}{\partial \dot{q}_k} = 0$, c) $\frac{\partial \nu}{\partial \dot{p}_k} = 0$

7) The Lagrangian of the particle of mass ***'m'*** executing simple harmonic motion in one dimension can be given as:
a) $\frac{p^2}{2m}$, b) $\frac{p^2}{2m} + \frac{1}{2}kx^2$, c) $\frac{p^2}{2m} - \frac{1}{2}kx^2$, c) $\frac{1}{2}kx^2$

8) The Lagrangian for a mechanical system is $L = a\dot{q}^2 + bq^4$, where q is a generalized coordinate and a and b are constants. The equation of motion for this system is…a) $\dot{q} = \sqrt{\frac{b}{a}}q^2$, b) $\dot{q} = \frac{2b}{a}q^3$,c) $\ddot{q} = -\frac{2b}{a}q^3$, d) $\ddot{q} = +\frac{2b}{a}q^3$

9) Compound pendulum is a rigid object capable of oscillating in a vertical plane about horizontal axis. Consider a compound pendulum of mass m oscillating in xy plane. In the figure the point 'o' is the point of suspension through which the horizontal axis passes and C is the center of mass. Write Lagrangian and Generalized Coordinates.



10) The unit of Lagrangian is the unit of :
a) Force, b) Angular Momentum, c) Energy, d) Linear Momentum

********** ALL THE BEST**********