

UNIVERSITY OF HYDERABAD
SCHOOL OF PHYSICS

M.Sc.-I/IMSc.-IV
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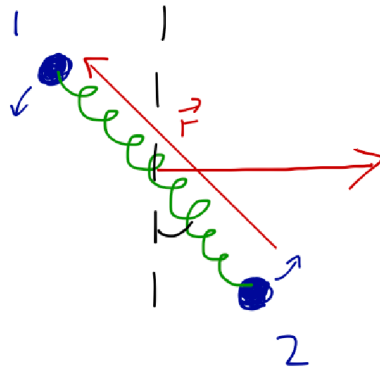
Classical Mechanics

June 30, 2018

MM:

TEST-I

- [1] Suppose we connect two bodies of masses $m_1 = m_2 = m$ by a spring with constant k and natural length ℓ , and then allow them to slide across a horizontal frictionless table.



Two bodies connected by a spring

- (a) Setup the Lagrangian for the system in Cartesian coordinates \vec{r}_1, \vec{r}_2 . [4]
 (b) Is this an example of central force force problem? [2]
 (c) Define the center of mass \vec{R} and relative coordinate \vec{r} [4]

$$\vec{R} = \frac{\vec{r}_1 + \vec{r}_2}{2}, \quad \vec{r} = \vec{r}_1 - \vec{r}_2$$

and express the Lagrangian in terms of

- (i) new coordinates \vec{r} and \vec{R}
 (ii) polar coordinates r, ϕ defined by $x = r \cos \phi, y = r \sin \phi$ for relative motion.
 (d) Find cyclic coordinates and conserved quantities. [5]
 (e) Find the effective potential for the radial motion and plot it for (i) zero angular momentum, and (ii) non zero angular momentum. [2+3]