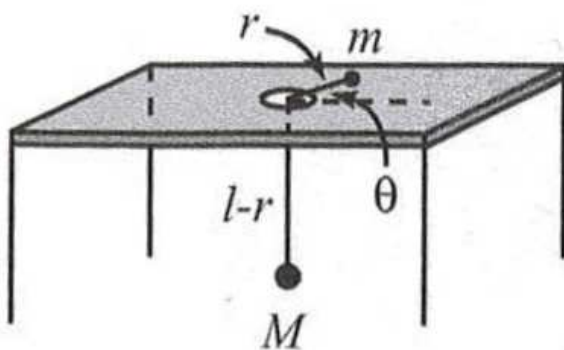


1. A mass  $m$  is free to slide on a frictionless table, and is connected by a string that passes through a hole in a table to a mass  $M$  hanging below the table. See the figure below. Assume that  $M$  can only move vertically, and that the string always remains taut.



- (a) Use the Lagrangian method to find the equations of motion of the system, with  $r$  and  $\theta$  (see figure) as generalized coordinates.
- (b) Show that the *angular momentum*  $L = mr^2\dot{\theta}$  of mass  $m$  is a constant of the motion. Find an expression for the radial acceleration  $\ddot{r}$  for a particular  $L$ .
- (c) There is a particular radius  $r_0$ , for a given  $L$ , such that  $m$  will undergo uniform circular motion. What is this radius?