1. An object of mass $m$ starts from rest and slides along a loop. What should be the initial height $h$ so that $m$ pushes against the top of the track (at A) with a force equal to its weight? Ignore all friction. \textit{(ans: $h = 3R$)}

2. An object of mass $m$, starting at the point shown above, moves along a circle of radius $R$ cut out of a large block of mass $M_B$. Block $M_B$ rests on a table, and both \underline{blocks can move} without friction. Both objects are initially at rest. Find the speed of the object as it leaves the block $M_B$. \textit{(ans. clue: if $m = M_B$, $v = \sqrt{gR}$).}
3. A small block slides from rest from the top of a frictionless sphere of radius \( R \) (the sphere is fixed to the floor, as shown above, so that it cannot move). How far below the top, \( x \), does the block lose contact with the sphere? (ans: \( R / 3 \))

4. A circular hoop of mass \( M_H \) hangs from the ceiling as shown above. Two beads of mass \( m \) are simultaneously released from rest at the top and slide down the opposite sides of the hoop. Show that the hoop will start to rise if \( m > 3M_R / 2 \), and find the angle at which this occurs. Ignore all friction. (ans. clue: if \( M_R = 0 \), \( \theta = \arccos \frac{2}{3} \))
5. A block of mass $M_B$ (having velcro on top) on a horizontal frictionless table is connected to a spring having a spring constant $k$. The block is set in motion so that it oscillates about its equilibrium point with an amplitude $A_0$ and period

$$T_0 = 2\pi \sqrt{\frac{M_B}{k}}.$$

(a) Another block of mass $m$ (having velcro on the bottom) is dropped onto the bottom block and immediately sticks to it. The top block hits $M_B$ at the instant when the velocity of $M_B$ is zero. Find

(i) The new period
(ii) The new amplitude
(iii) The change in the mechanical energy of the system

(b) Repeat part (a), but this time assume that the top block hits $M_B$ at the instant when $M_B$ has its maximum velocity.

6. You friend in culinary school has decided to weigh a length of noodle he is proud to have made from scratch. The noodle has length $L$ and mass $M$, and initially it is suspended vertically with its lower end just about to touch the scale. The noodle is released and falls onto the scale. Determine for your culinary friend the reading of the scale when a length of noodle, $x$, has fallen.