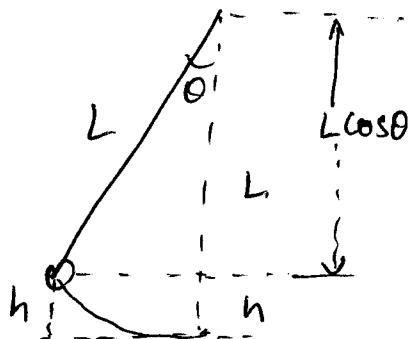


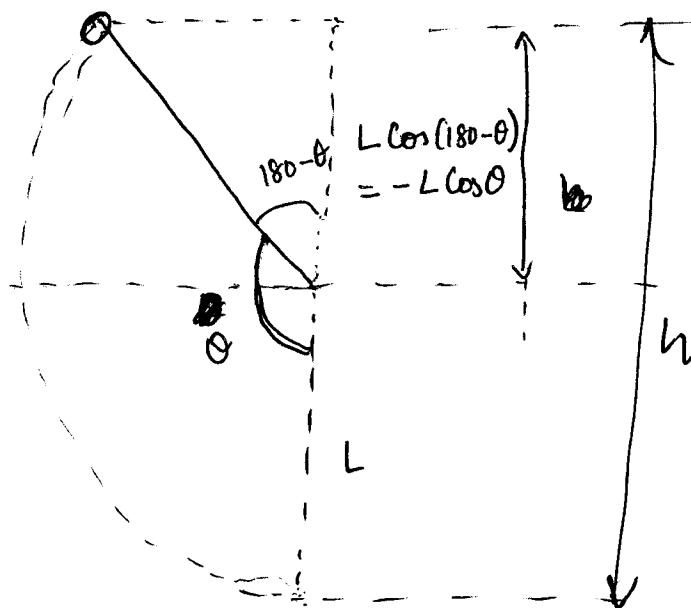
Notes

Finding the height of a pendulum bob at any angle θ from the position at the bottom



$$h + L \cos \theta = L$$

$$h = L(1 - \cos \theta)$$



~~Work~~

$$\begin{aligned} h &= L + L \cos(180 - \theta) \\ &= L(1 - \cos \theta). \end{aligned}$$

$$\cos(180 - \theta) = -\cos \theta.$$

so the answer is the same if the angle is considered from the position at the bottom

If you are uncomfortable with this, use an angle $180 - \theta$ as ϕ and work out the calculation.

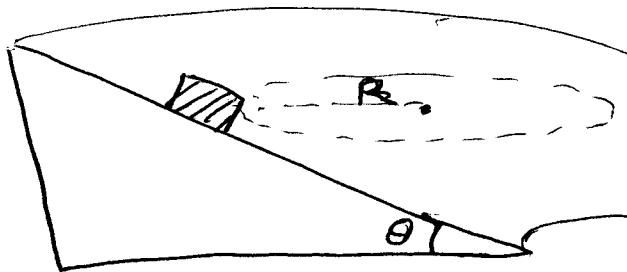
$$L \cos \phi + L = h.$$

find ϕ and you can find $\theta = 180 - \phi$ if required.

(P1) In class we considered a car along a banked curve and derived the angle of banking as $\tan\theta = \frac{v^2}{rg}$. Ignoring friction in the calculation.

Now consider the static friction between the tires and the road.

~~Derive~~ Derive an expression for the ^{magnitude of} maximum and minimum velocity that a car can go around a curve of radius R so that it does not slip.

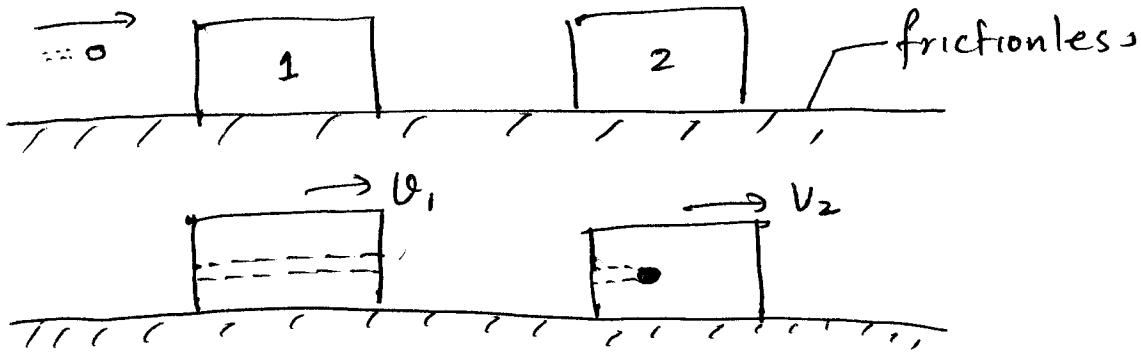


your answer should contain the following variables ONLY
(μ_s , $\tan\theta$, g , R)

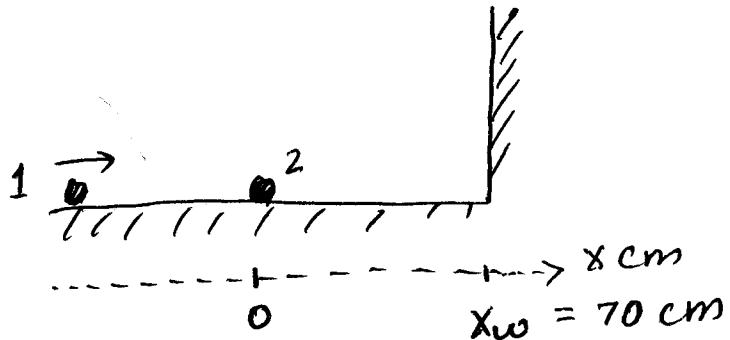
Hint. Which way does the car tend to slip if it's moving too slow? What about when it is moving too fast?

P2 A 3.50 g bullet ~~is fired~~ fired horizontally at two blocks at rest on a frictionless table. The bullet passes through block 1 (mass 1.20 kg) and embeds itself in block 2 (mass 1.80 kg). The blocks end up with speeds $v_1 = 6.30 \text{ m/s}$ and $v_2 = 1.40 \text{ m/s}$. Neglecting the material removed from block 1 by the bullet, find the speed of the bullet as it

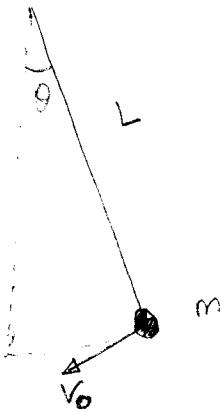
- leaves
- enters block 1



- (P3) A particle 1 of mass $m_1 = 0.30 \text{ kg}$ slides rightward along an x axis on a friction less floor with a speed of 2.0 m/s . When it reaches $x=0$, it undergoes a one-dimensional elastic collision with stationary particle 2 of mass 0.40 kg . When particle 2 then reaches a wall at $x_w = 70\text{cm}$, it bounces from the wall with NO LOSS of speed. At what position on the x axis does particle 2 then collide with particle 1?



PS1 Figure shows a pendulum of length $L = 1.2\text{ m}$. Its bob (of mass m , consider string as massless) has a speed v_0 when the cord makes an angle $\theta_0 = 40.0^\circ$ with the vertical.



- a) What is the speed of the bob when it is in its lowest position if $v_0 = 8.00\text{ m/s}$?

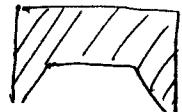
(Why can you conserve energy in this process?)

- b) What is the least value that v_0 can have if the pendulum is to swing down and then up to a horizontal position?
On Repeation
- c) To a vertical position with the cord remaining straight?

- d) Do the answers to (b) and (c) increase, decrease, or remain the same if θ_0 is increased by a few degrees?

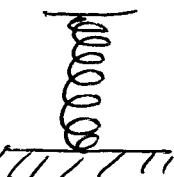
Answers a) 8.35 m/s b) 4.33 m/s c) 7.45 m/s

PX1 A block of mass $m = 2.0\text{ kg}$ is dropped from a height $h = 40\text{ cm}$ onto a spring of spring constant $k = 1960\text{ N/m}$.



- a) Find the maximum distance the spring is compressed? (0.1 m)

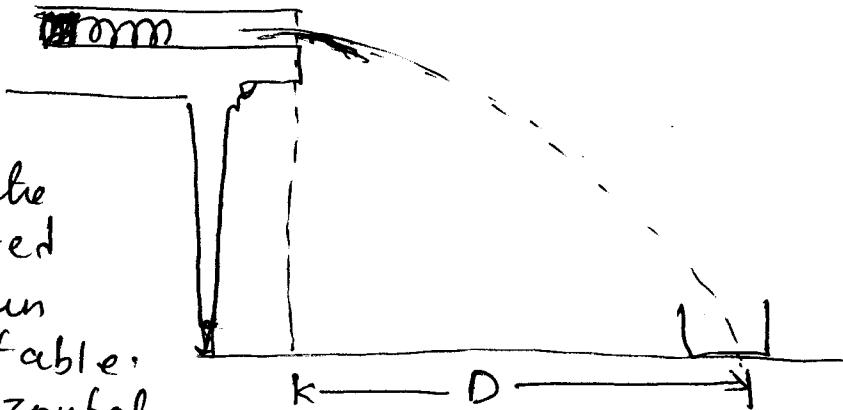
- b) What are the forces acting during this interval? Are they conservative?



(Note: Do not ignore the change in U_g during compression).

~~Q~~
PS2

Two children are playing a game in which they try to hit a small box on the floor with a marble fired from a spring loaded gun that is mounted on a table. The target box is horizontal distance $D = 2.20\text{ m}$ from the edge of the table.



~~B~~ Bobby compresses the spring 1.10 cm but the center of the marble falls 27.0 cm short of the center of the box. How far should Rhonda compress the spring to score a direct hit? Neglect friction. (1.25 m)

(Note): Assume a height of the table and carry out projectile calculations.

~~PSB~~ Figure shows an 800 kg stone at rest on a spring. The spr