

Ph1a - Flipped Section

Problems

October 10, 2019

1. Accelerometer

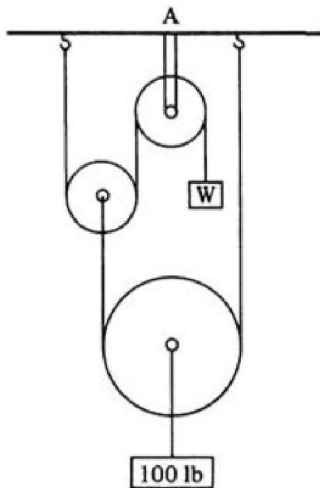
An accelerometer is a device that measures acceleration. It's easy to build your own accelerometer. It consists of a ball on a string hanging from the roof of your car. When the car is stopped or cruising at a constant speed, the ball hangs straight down. But, when it is accelerating, the ball hangs down at an angle, which we'll call θ .

- Identify the forces acting on the ball and draw a free body diagram that depicts these forces. (Neglect air resistance.)
- You now want to try out your new accelerometer, so you get in your car and hit the gas. As you accelerate, you notice the ball hanging down at an angle of $\theta = 83^\circ$ from the ceiling. How fast were you accelerating?

2. Pulley System

(Frautschi 6.19)

The pulleys in the picture below are frictionless and weightless. Find the weight W and the tension in each rope such that the system is in equilibrium, and find the downward pull of the support at A on the ceiling.



3. Leaning ladder

Consider a ladder of uniform mass m and length d which leans against a friction-less wall. The coefficient of static friction between the ground and the ladder is μ . Let θ be the angle that the ladder makes with respect to the ground. For what angles θ will the ladder be stable (as opposed to sliding down)?

4. Inclined Block

Consider a wedge-shaped block of mass M , on which sits a smaller mass m . (You should really think of the large block as basically an inclined plane, but with finite mass M , so that it can potentially move.) The slope of M is at an angle θ with respect to the ground.

The small block is let go, so that it slides down the slope of the large block. This will in turn push the large block in the opposite direction. What is the acceleration A of the large block?

5. Three Clowns

(Frautschi 6.25)

Two clowns, Orsene and Waldo, support a 3 m-long, 10 kg plank while a third, Bobo, rides a unicycle back and forth between the two ends at a steady speed. Bobo and the unicycle together come to 55 kg. If Orsene can't hold masses over 40 kg for more than 5 s, how fast should Bobo ride?

