Torques and Angled Forces Homework

Full Name, Period, AP/Honors: due: 12/3

1 Stuff, and Things

1. You build a series of gears, each of which interlocks with the one before. Each gear has a radius that is twice the radius of the previous gear. If you apply a torque of τ to the edge of the zeroth gear, what will be the torque on the nth gear? Assume that the gears are friction-less and cannot deform. The gears are not moving.

   A. $2n\tau$

   B. $\frac{\tau}{2n}$

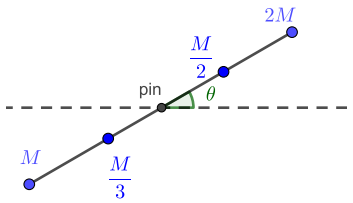
   C. $(\frac{1}{2})^n\tau$

   D. $2^n\tau$

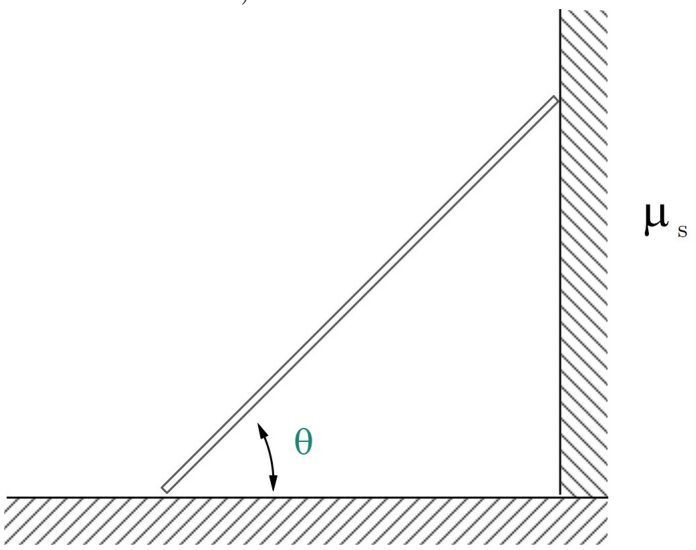
   E. τ

2. A bar is placed on the edge of a building. What fraction of a bar of length L and mass $2M$ must remain on a surface if a person with mass M needs to be able to walk to the end of the bar without the bar rotating?

3. You have a mass-less rod of length L. You pin the rod in the center (at $x = 0$) and place masses as seen in the diagram. The masses are evenly spaced along the rod. You incline the rod so that it makes an angle of θ with the horizontal axis. What is the angular acceleration of the system?



4. You lean a ladder against a wall. The top of the ladder has a friction coefficient of μ_s with the wall, but the ground has negligible friction. The end of the ladder resting on the wall has negligible friction. Can the ladder ever balance in this scenario? Circle one, then explain your answer (as usual 1-2 sentences is sufficient, points will be taken off for incorrect or irrelevant comments. Your score on this problem can be as low as -1.)



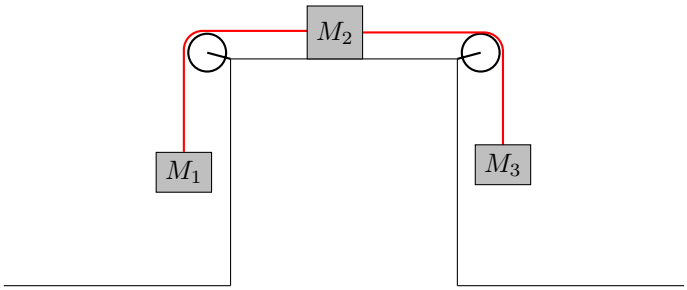
(a) Yes, but there is a maximum angle $\theta < 90°$ that the ladder can have.

(b) Yes, but there is a minimum angle $\theta < 90°$ that the ladder can have.

(c) Yes, and all angles work.

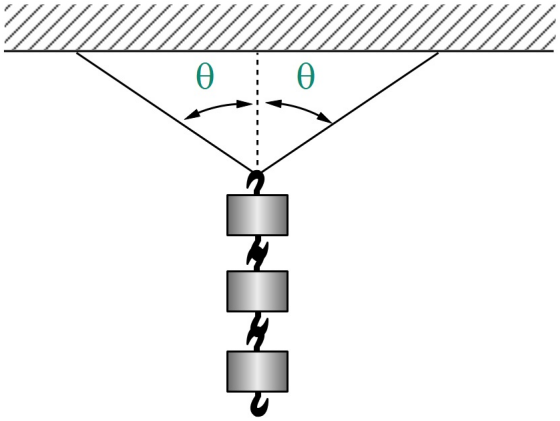
(d) No, no angle $\theta < 90°$ works

5. While in an elevator accelerating upwards at a_e. You build the system shown below. Both pulleys have mass $\frac{M}{2}$. What is the acceleration of the system as seen from inside the elevator?



6. You are dragging a mass (M) with a constant velocity across a surface with friction using a rope. If the rope is making an angle of θ above the horizontal, what is the tension in the rope?

7. You want to hang 3 masses of mass M as shown below. Your string can have a maximum tension T before snapping.



(a) If the angle was $\theta = 0$ degrees, what would be the largest that M could be?

(b) Explain what would happen if $\theta = 90°$ and why.

(c) Find the maximum that the angle θ can be.