Physics 9A Section A Discussion Questions: Week 10

Question 1: Conservation of angular momentum on a water slide

You are building a slide for a water pike. In a sitting position, park guests will slide a vertical distance h down the slide (which has negligible friction). At the bottom of the slide, they grab the bottom end of a 6.00-m-long uniform pole. The pole hangs vertically, initially at rest, and the upper end of the pole pivots about a stationary, frictionless axle. The pole with the person hanging on the end swings up through an angle of 72.0°, then the person lets go and drops into a pool of water.

i: The pole's moment of inertia is given by $I = \frac{1}{3}ML^2$, where the length of the pole L = 6.00 m, and its mass M = 24.0 kg. If the person has a mass of 70.0 kg, what is the initial height h such that the pole cannot rotate more than 72.0° after the collision?

Question 2: Building a pyramid

Ancient pyramid builders are balancing slabs of stone tipped at an angle of θ above the ground using a rope. This situation is depicted in the figure to the right. The rope is held by five workers who each exert an equal force.

i: If θ = 20.0°, what force does each worker exert on the rope?

ii: As θ increases, does each worker have to exert more or less force than in part (a), if the rope is kept at the same angle? Why?

iii: At what angle do the workers need to exert *no force* to balance the slab? What happens if θ exceeds this value?

Figure **P11.80**

1.75 m

3.75 m

Rope

58.0°

θ
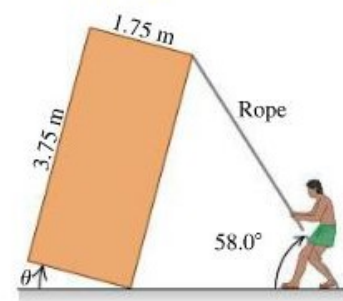
Question 3: Planetary Exploration

Your spaceship, the *Serenity*, lands on the mysterious planet Mongo. As the ship scientist, you make the following measurements: A 2.50 kg stone thrown upward from the ground at 12.0 m/s returns to the ground in 4.80 s; the circumference of Mongo at the equator is 2.00 x 10^5 km; and there is no atmosphere on Mongo. The spaceship commander, Malcom Reynolds, asks for the following information:

i: What is the mass of Mongo?

ii: If *Serenity* goes into a circular orbit 30,000 km above the surface of Mongo, how many hours will it take the ship to complete one orbit?

Question 4 (if time)**:** Balancing a door

A door 1.0 m wide and 2.0 m high weighs 330 N and is supported by two hinges, one 0.50 m from the top and the other 0.50 m from the bottom. Each supports half the total weight of the door. Find the horizontal components of the force exerted on each hinge by the door, assuming the door's center of gravity is at its center.