

PHYS 211 Homework Assignment

Chapter 6

Problem 1 A coffee cup on the horizontal dashboard of a car slides forward when the driver decelerates from 45 km/h to rest in 3.5 s or less, but not if she decelerates in a longer time. What is the coefficient of static friction between the cup and the dash?

Problem 2 Two blocks, connected by a rope, sit on an inclined plane with an angle $\theta = 30^\circ$. Block A is above block B and has a mass of 5 kg; block B has a mass of 3 kg. The coefficient of static friction for both blocks is $\mu_s = 0.7$.

- Draw a free body force diagram for each block and decompose all of the forces relative to your choice of axis.
- Apply $\sum \vec{F} = m\vec{a}$ (assume the rope stays tight and their acceleration is the same). What are your unknowns?
- Solve for your unknowns. Do the blocks move?

(note: if you use variables until the end, you will see that the masses of the blocks are *irrelevant*.)

Problem 3 A 2 kg block on a 50 cm string moves in a circle on a frictionless horizontal table at 60 rpm (revolutions per minute).

- What is the speed of the block?
- What is the force of tension in the string?

Problem 4 The weight of passengers on a roller coaster increases by 50% as the car goes through a dip with a 30 m radius of curvature. What is the roller coaster's speed at the bottom of the dip? (hint: here, the "weight" is not the force due to gravity, but how hard the seat pushes up against you.)

Problem 5 A satellite of mass 5500 kg orbits the Earth and has a period of 6200 s with an altitude (height from the surface) of 10^6 m.

- What is the magnitude of the Earth's gravitational force on the satellite?
- How does this force compare to the magnitude of the Earth's gravitational force if the satellite were on the ground?

Problem 6 A small mass sits on the surface of a sphere. If the coefficient of static friction is $\mu_s = 0.50$, at what angle from the top would the mass start sliding?

Problem 7 How long would a day be if the Earth were rotating so fast that objects at the equator were apparently weightless?