

PHY 2053C Test 2

Chapter 5 - Chapter 8

Directions: Please do all problems and **show all work**. You will be graded on your work in addition to your answers, so if you do not show your work you risk losing points. To simplify your math please use $g = 10 \text{ m/s}^2$.

Note: Please do not write on the test. Write all work and answers on a separate sheet of paper. Please clearly indicate all answers. Remember to draw a free-body diagram on problems where you use Newton's Three Laws.

1. Write the rotational form of the kinematics equations.
2. Write the rotational form of Newton's Second Law.
3. Define equilibrium. What is the difference between static and dynamic equilibrium? What is the difference between stable and unstable equilibrium?
4. Two workers are sliding a 100-kg crate across the floor. One worker pushes forward on the crate with a force of 270 N while the other pulls in the same direction with a force of 130 N using a rope connected to the crate. Both forces are horizontal, and the crate slides with a constant speed. In this problem you will ultimately be solving for the coefficient of kinetic friction between the crate and the floor. **(a)** Draw a free-body diagram. **(b)** Find the coefficient of kinetic friction.
5. You're driving your pickup truck around a curve that has a radius of 45 m. How fast can you drive around this curve before a toolbox slides along the bed of your truck? The coefficient of static friction between the toolbox and the truck is 0.5, and the coefficient of kinetic friction between the toolbox and the truck is 0.3.
6. The engine of a small airplane is specified to have a torque of $500 \text{ m} \cdot \text{N}$. The engine drives a 2-m-long, 40-kg, single-bladed propeller. On startup, how long does it take the propeller to reach 200 rad/s ? (Note: you can model the propeller as a rotating rod with the axis of rotation about one end).
7. You're carrying a pole of length L and mass m when you decide to stop for a rest. You place one end of the pole on a fence post and hold the other end of the pole a distance d from its tip. How much force must you exert to keep the pole motionless in a horizontal position? Your answer will be in terms of the symbols L , M , d and g .
8. An astronaut lifts off in a rocket from the surface of the moon, where $g = 1.6 \text{ m/s}^2$. What vertical acceleration should his rocket have so that his apparent weight is equal to his true weight on earth?

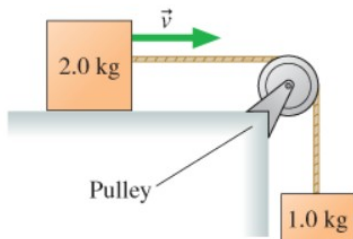


Figure 1: Problem 9

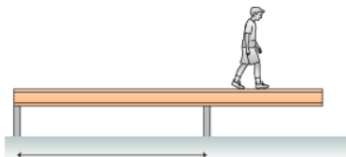


Figure 2: Problem 10

9. Two blocks are connected by a string as in Figure 1. What is the upper block's acceleration if the coefficient of kinetic friction between the block and the table is 0.2?

10. A beam of length L and mass M is supported by, but not attached to, the two posts in Figure 2. A boy of mass m starts walking along the beam. How close can he get to the right end of the beam without it tipping? The distance between the two posts is w . Your answer will be in terms of L , M , m and w .