

PHY 2053C Test 3

Chapter 9 - Chapter 11

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. What are the conserved quantities we have learned in this class? What are the circumstances under which each is conserved?
2. Newton's Third Law of Motion is equivalent to which conservation law?
3. What is the difference between an elastic and an inelastic collision?
4. A 2.7-kg block of wood sits on a frictionless table. A 3-g bullet, fired horizontally at a speed of 500 m/s, goes completely through the block, emerging at a speed of 220 m/s. What is the speed of the block immediately after the bullet exits?
5. Sam's job at the amusement park is to slow down and bring to a stop the boats in the log ride. If a boat and its riders have a mass of 1200 kg and the boat drifts in at 2 m/s, how much work does Sam do on the boat to stop it?
6. What minimum speed does a 100-g puck need to make it to the top of a frictionless ramp that is 10 meters long and inclined at 30 degrees?
7. At the county fair, Chris throws a 0.15-kg baseball at a 0.75-kg wooden milk bottle, hoping to knock it off its stand and win a prize. The ball bounces straight back at 20 percent of its incoming speed, knocking the bottle straight forward. What is the bottle's speed, as a percentage of the ball's incoming speed?
8. A ball of mass m traveling at a speed v hits and sticks to a block of mass M sitting at rest on a frictionless table. Your answers for this problem will be in terms of the variables m , v , M and g . **(a)** What is speed of the block after the collision? **(b)** Show that the mechanical energy is not conserved in this collision. What percentage of the ball's initial kinetic energy is lost?
9. In a physics lab experiment, a spring clamped to the table shoots a ball of mass m horizontally. When the spring is compressed by r , the ball travels horizontally a distance d and lands on the floor a height h below the point at which it left the spring. What is the spring constant? Your answer will be in

terms of m , r , d , h and g .

10. A 1500-kg weather rocket accelerates upward at 10 m/s^2 . It explodes 2 s after liftoff and breaks into two fragments, one twice as massive as the other. Photos reveal that the lighter fragment traveled straight up and reached a maximum height of 530 m. What were the speed and direction of the heavier fragment just after the explosion?

11. The maximum energy a bone can absorb without breaking is surprisingly small. For a healthy human of mass 60 kg, experimental data show that the leg bones of both legs together can absorb about 200 J. (a) From what maximum height could a person jump and land rigidly upright on both feet without breaking his legs? Assume that all the energy is absorbed in the leg bones in a rigid landing? (b) People jump from much greater heights than this; explain how this is possible. Think about how people land when they jump from greater heights.