Conceptual Physics Review (Chapters 7 & 8) Momentum & Energy

Chapter 7

- Define momentum, in words.
- Be able to compare the momentums of two objects, given information about their relative masses and/or relative velocities.
- Be able to calculate the momentum of an object, including the proper units.
- Define impulse, in words, and describe how it affects momentum.
- Be able to calculate impulse, including the proper units.
- Explain why an impulse is greater when an object bounces than when the same object comes to a sudden stop.
- State the law of conservation of momentum.
- Distinguish between elastic and inelastic collisions.
- Do calculations using the law of conservation of momentum, for both elastic and inelastic collisions.

Chapter 8

- Define work, in words.
- Be able to calculate the work done on one object by another object, including the proper units.
- Define power, in words.
- Be able to calculate power, including the proper units.
- Define potential energy, and more specifically, gravitational potential energy.
- Be able to calculate the gravitational potential energy of an object, given the work required to raise it above the earth or given the mass of the object and the distance it is raised above the earth.
- Define kinetic energy, and give an equation for how to calculate it given the mass and velocity of an object.
- Describe the work-energy theorem.
- State the law of conservation of energy.
- Explain how the gravitational potential energy and kinetic energy of an object change when it falls from some height above the earth down to the surface of the earth.

Labs

- Review Impulse/Change in Momentum (Kickball) Lab
- Review Conservation of Energy (Pendulum) Lab
- Review Momentum & Energy (Tarzan & Jane) Lab

Homework Assignments

- Review all assigned problems from the end of Chapter 7, the end of Chapter 8, and Appendix F, Chapters 7 & 8
- Review Worksheets 7-1, 8-2, and 8-3

Sample Calculations

1. Tiger Woods hits a 0.050-kg golf ball, giving it a speed of 75.0 m/s.

a) What change in momentum does the golf ball undergo?

b) What impulse does Tiger impart to the ball?

c) Why is it impossible to determine what impact force Tiger exerts on the ball?

2. Compare the momentums of the following pairs of objects, stating whether their momentums are the same, or stating which one has greater momentum, or stating that it is impossible to tell from the information given.

a) A jogging elephant and a sprinting elephant, each with the same mass.

b) A jogging elephant and a sprinting gazelle.

c) A mouse and an elephant traveling at the same speed.

d) A 5-kg dog running at 3 m/s and a 7.5-kg dog running at 2 m/s.

3. A 0.060-kg tennis ball is traveling at 10.0 m/s toward Venus Williams's tennis racket. She hits the ball and sends it in the opposite direction with a speed of 36.0 m/s.

a) What change in momentum does the tennis ball undergo? (Don't forget that it changes direction.)

b) If the ball is in contact with the racket for 0.020 seconds, with what average force of impact has Venus hit the ball?

4. If a 1000.0-kg car is sent toward a cement wall (in a crash test) with a speed of 14.0 m/s and the impact brings it to a stop in 8.00×10^{-2} s, with what average force is it brought to rest?

What could you do differently to decrease the average force of impact?

5. Tubby and his twin brother Chubby have a combined mass of 200.0 kg and are zooming along in a 100.0-kg amusement park bumper car at 10.0 m/s. They bump Melinda's car (also 100.0 kg), which is sitting still. Melinda has a mass of 25.0 kg. After the collision, the twins continue ahead with a speed of 4.12 m/s. How fast is Melinda's car bumped across the floor? (She moves in the same direction as the twins.)

6. If an 800.0-kg sports car slows to 13.0 m/s to check out an accident scene and the 1200.0 -kg pickup truck behind him continues traveling at 25.0 m/s, with what velocity will the two move if they lock bumpers after a rear-end collision?

7. Charlotte, a 65.0-kg skin diver, shoots a 2.0-kg spear with a speed of 15.0 m/s at a fish that darts away quickly without getting hit. How fast does Charlotte move backwards when the spear is shot?

8. Peggy, a moonlighting professional wrestler (The Waitress) with a mass of 150.0 kg, jumps on her opponent, Tara the Terrible. How much work does she do on Tara when she knocks her to the ground, 2.0 m below?

9. After eating dinner, Marcus pulls his 75.0-kg body out of the dining room chair and climbs up the 6.00-m-high flight of stairs to his bedroom.

a) How much work does Marcus do in ascending the stairs?

b) What is Marcus' potential energy relative to the dining room floor once he is upstairs?

c) If it took him 45.0 seconds to climb the flight of stairs (he was really full from dinner), how much power did he generate?

d) The next night, he runs up the same flight of stairs in 5.0 seconds. Is the amount of ***work*** done by him less than, the same as, or greater than the night before? What about the amount of ***power*** he generates?

10. Marissa does 3.2 J of work to lower the window shade in her bedroom a distance of 0.8 m. How much force must Marissa exert on the window shade?

11. Legend has it that Isaac Newton "discovered" gravity when an apple fell from a tree and hit him on the head. If a 0.20-kg apple fell 7.0 m before hitting Newton, what was its *change* in PE during the fall?

12. A greyhound at a racetrack can run at a speed of 16.0 m/s. What is the KE of a 20.0-kg greyhound as it crosses the finish line, traveling at that speed?

13. In a wild shot, Bo flings a pool ball of mass 0.50 kg off the edge of a 0.68-m-high pool table, and the ball hits the floor with a speed of 6.0 m/s.

a) What is the kinetic energy of the pool ball just before it hits the floor?

b) What is the gravitational potential energy of the pool ball just before it hits the floor?

c) What is the total mechanical energy of the pool ball just before it hits the floor?

d) How much potential energy did the pool ball have (relative to the floor) when it was on the table?

e) Assuming a negligible (too little to notice) amount of mechanical energy was converted to thermal energy (heat) during the pool ball's fall, how much kinetic energy did the pool ball have when it first left the table? (Hint: Use the Law of Conservation of Energy)

f) How fast was it going when it left the table? (Hint: Use your answer from part e)

14. A 500.0-kg pig is standing on the top of a muddy hill on a rainy day. The hill is 100.0 m long with a vertical drop of 30.0 m. The pig slips and begins to slide down the hill. What is the pig's speed at the bottom of the hill? (Hint: Use the law of conservation of energy, meaning the total of the potential energy and kinetic energy for the pig remains constant, whether the pig is at the top of the hill or at the bottom.)