Honors Physics
Momentum and energy

This unit will allow each student to:

a. gain a better understanding of momentum and energy in the interactions of objects around us
b. continue making proper scientific measurements and calculations
c. define and properly use all vocabulary
d. properly apply all terms and concepts in describing/explaining real world examples
e. continue making and interpreting scientific graphs
f. teach someone else the concepts discussed
g. practice proper laboratory safety

This will be accomplished by each student that is able to:

1. recognize and relate SI and USCS units of force, momentum, work, energy, and power
2. recognize a force, momentum, work, energy, and power by the units only
3. relate momentum to inertia
4. recognize differences in the momentum of different objects
5. relate momentum and impulse
6. use the concept of impulse as an extension of Newton's laws of motion
7. state the law of conservation of momentum
8. distinguish between elastic and inelastic collisions
9. apply the law of conservation of momentum and Newton's Laws to collisions
10. recognize energy as the root cause of change in the universe
11. list various forms of energy
12. distinguish between work, potential energy , gravitational potential energy, and kinetic energy
13. state the law of conservation of energy
14. apply the law of conservation of energy to a real object interacting with its environment
15. state the work-energy theorem
16. apply the work energy theorem to real situations in conjunction with energy conservation
17. relate actual units of power and energy to those used on your home's electric bill
18. perform calculations using proper problem solving techniques to determine: (a) gravitational potential energy, (b) kinetic energy, (c) work (d) power, (e) momentum and impulse

Textbook Reference – Physics

Chapter 5 - Work and Energy; Chapter 6 - Momentum and Collisions

Key Terms

momentum, impulse, elastic collision, inelastic collision, system, law of conservation of momentum, **energy, kinetic energy, potential energy, gravitational potential energy, Hooke's law, elastic potential energy, work, power, mechanical energy, law of conservation of energy**

Momentum Review Questions

1. Distinguish between mass and momentum. Which is inertia and which is inertia in motion?

2. Which has the greater mass, a heavy truck at rest or a rolling skateboard?

3. Distinguish between impact and impulse. Which designates a force and which multiplies force and time?

4. When the force of impact on an object is extended in time, does the impulse increase or decrease?

5. Distinguish between impulse and momentum. Which is force times time and which is inertia in motion?

6. Does impulse equal momentum, or a change in momentum?

7. For a constant force, suppose the duration of impact on an object is doubled.
   a. How much is the impulse increased?

   b. How much is the resulting change in momentum increased?

8. In a car crash, why is it advantageous for an occupant to extend the time during which the collision takes place?

9. If the time of impact in a collision is extended by four times, how much does the force of impact change?

10. Why is it advantageous for a boxer to ride with a punch? Why should he avoid moving into an oncoming punch?

11. You are standing on a skateboard.
   a. When you throw a ball, do you experience an impulse?

   b. Do you experience an impulse when you catch a ball of the same speed?

   c. Do you experience an impulse when you catch it and then throw it out again?

   d. Which impulse is greatest?

12. Why is more impulse delivered during a collision when bouncing occurs than during one when it doesn't?

13. In terms of momentum conservation, why dies a cannon recoil when fired?

14. What does it mean to say that momentum is conserved?

15. Distinguish between an elastic and an inelastic collision.

16. Imagine that you are hovering next to the space shuttle in earth orbit. Your buddy of equal mass, who is moving at 4 km/hr with respect to the shuttle, bumps into you. If he holds onto you, how fast do you both move with respect to the ship?

17. Is momentum conserved for colliding objects that are moving at angles to one another? Explain.

18. a. What is the momentum of an 66 lbs bowling ball rolling at 2 m/sec?

   b. If the bowling ball rolls into a pillow and stops in 0.5 sec, calculate the average force it exerts on the pillow.

   c. What average force does the pillow exert on the ball?

19. a. What is the momentum of a 100 lbs carton that slides at 4 m/sec across an icy surface?

   b. The sliding carton skids onto a rough surface and stops in 3 sec. Calculate the force of friction it encounters.

Work and Energy review questions

1. A force sets an object in motion. When the force is multiplied by the time of its application, we call the quantity *impulse,* which changes the *momentum* of that object. What do we call the quantity *(force)(distance)* and what quantity can this change?

2. Work is required to lift a barbell. How many times more work is required to lift the barbell three times as high?

3. Which requires more work, lifting a 10 kg load a vertical distance of 2 m or lifting a 5 kg load a vertical distance of 4 m?

4. How many joules of work are done on an object when a force of 10 N pushes it a distance of 10 m?

5. How is power increased?

6. In which situation is more power required: Slowly lifting a book bag full of books up the stairs or quickly lifting the same book bag full of books up the same stairs?

7. How much power is required to do 100 J of work on an object in a time of 0.5 sec? How much power is required if the same work is done in 1 sec?

8. What are the two main forms of mechanical energy?

9. a. If you do 100 J of work to elevate a bucket of water, what is the gravitational potential energy relative to its starting position?

   b. What would the gravitational potential energy be if the bucket were raised twice as high?

10. A boulder is raised above the ground so that its potential energy relative to the ground is 200 J. Then it is dropped. What is its kinetic energy just before it hits the ground?

11. Suppose an automobile has 2000 J of kinetic energy. When it moves at twice the speed, what will be its kinetic energy? What's its kinetic energy at three times the speed?

12. What will be the kinetic energy of an arrow having a potential energy of 50 J after it is shot from a bow?

13. What does it mean to say that in any system, the total energy score stays the same?

14. In what sense is energy from coal actually solar energy?

15. How does the amount of work done on an automobile by its engine relate to the energy content of the gasoline?