

Expectations for Work, Energy and Power

Part 1

1. Students should understand that total energy is conserved, but that energy may change forms. They should be able to draw pie graphs to show how total energy is divided among its many forms.

Examples:

2. Students should understand that when work is done, energy is transformed from one type to another. They should be familiar with all the forms of energy we discussed in class.

Energy forms:

3. Students should be familiar with the relation between work and the change in energy. They should be able to solve problems using this relation.

Relationship:

Sample problem:

4. Students should be familiar with the relationships (equations) that define kinetic energy, gravitational potential energy, and elastic potential energy. They should be able to solve problems involving these relationships.

Relationships:

5. Students should understand that kinetic energy is conserved only in elastic collisions, but that total energy is conserved in all interactions.
6. Students should understand that the relationship between the force required to stretch a spring and the extension are related linearly ($F=kx$) and that the spring constant describes the physical properties of the spring or other elastic material.
7. Students should recognize the relationship between the concepts we've studied and practical applications, such as car crashes and complex mechanical devices.

Practice Problems

- 1) A spring with $k=50 \text{ N/m}$ is compressed 1 meter. A bowling ball with mass 5 kg is put on top of the spring. The spring is then let go and the bowling ball is launched directly upwards into the air. Draw a picture labeling all important parts and draw energy pie charts for 4 key locations. How high does the ball go? How high would it go if it had a mass of 10kg? (hint: use conservation of energy)
- 2) A car with mass 2000kg accelerates from 0 to 60 mi/hr in 4sec. How much work was done? What is the power output of the car?
- 3) a kid lifts his puppy off the floor. The puppy weighs 15 pounds and is lifted to height of 2 feet. Find the work done in foot-lbs and $\text{N}\cdot\text{m}$. If this takes 1 sec, what is the kid's power output in Horsepower and watts?
- 4) a force acts on a 5kg mass for a distance of 2 meters and increases its energy by 300 joules. How large was the force?
- 5) You need to lift 200 lbs of bricks to a height of 2 meters. you have 2 pulleys and a rope. Draw a diagram that would allow you to lift the bricks using the least force. Assuming an efficiency of 1 (ie. No friction), how much force would you need to pull with, and how far would you need to pull on the rope? Explain why.
- 6) you want to drop an egg from a height of 5m like in our eggstream challenge. Using the following numbers to calculate the length of rope needed:
 - $k=50\text{N/m}$
 - unstretched length = .5m
 - mass = 1kg
 - height = 5m
 - safety margin = 0 (go for the gold baby!)