

# extra kinetic energy practice problems

Science 10 Energy Unit

Name: \_\_\_\_\_ Block: \_\_\_\_\_

Kinetic energy ( $E_k$ ) is the energy of motion, which may be in any direction (like vertical or horizontal), or spinning motion. To calculate the  $E_k$  of a moving object, use the following formula:

$$KE = \frac{1}{2} \text{ mass} \times \text{velocity}^2 \quad \text{or} \quad KE = \frac{1}{2} mv^2$$

## Example Problem:

Roger Federer serves a tennis ball with a velocity of 35.0 m/s. If the ball has a mass of 0.150 kg, what is the kinetic energy ( $E_k$ ) of the ball?

Known Values:

$$m = 0.150 \text{ kg,}$$

$$v = 35.0 \text{ m/s}$$

$$\text{Formula: } E_k = \frac{1}{2} mv^2$$

$$= 0.5 \times 0.150 \times 35.0^2$$

$$= 0.5 \times 0.150 \times 1225$$

$$= 91.875 \text{ (not rounded)}$$

$$= 91.9 \text{ J (rounded, with units)}$$

**Practice Questions:** (Your solutions should be organized similar to the example problem. Show all your steps please)

1. A cheetah can run briefly with a speed of 31.0 m/s. Suppose a cheetah with a mass of 47.0 kg runs at this speed. What is the cheetah's kinetic energy?
  
  
  
  
  
  
  
  
  
  
2. A ping pong ball has a mass of about 2.45 grams. Suppose that Forrest Gump hits the ball across the table with a speed of about 4.00 m/s. What is the ball's  $E_k$ ?

3. The largest land predator is the male polar bear, which has a mass of around 500.0 kg. If the top speed of a male polar bear is 11.0 m/s, how much  $E_k$  does it have?
  
  
  
  
  
  
  
  
  
  
4. Though slow on land, the leatherback turtle holds the record for the fastest water speed of any reptile. The largest leatherback yet discovered could swim at a speed of 9.78 m/s. If its  $E_k$  was 60,800 J, what was its mass?
  
  
  
  
  
  
  
  
  
  
5. What is the  $E_k$  of a 1.00 kg hammer swinging at 20.0 m/s?
  
  
  
  
  
  
  
  
  
  
6. Japan's fastest high speed "bullet" trains, also known as the Shinkansen, travel at a speed of 88.9 m/s. It has an estimated mass of 480,000 kg. What is the maximum  $E_k$  of this train?
  
  
  
  
  
  
  
  
  
  
7. If a falling snowflake has a speed of 0.920 m/s, and has 1.27 mJ of kinetic energy, what is its mass?

8. The spring of a dart gun exerts a force on a 0.0200 kg dart as it is launched from the gun with 4.00 J of  $E_k$ . At what velocity does the dart come out of the gun?
  
9. What would happen to the amount of  $E_k$  if the mass of an object were to double, but its speed stayed the same?
  
10. What would happen to the amount of  $E_k$  if the mass of an object were to stay the same, but its speed doubled?

## extra potential energy practice problems

Gravitational potential energy ( $E_p$ ) is the energy of a mass due to its position in a gravitational force field. For example: when you hike up a hill, you are moving your mass away from the center of the Earth. You are lifting your mass up inside Earth's gravitational force field, and that means that you could fall back down in the future. Because your mass now has the ability to

make things move (you falling) , you have more potential energy. You gain  $E_p$  as you climb.

To calculate the  $E_p$  of an object (relative to a place where  $h = 0$ ), use the following formula:

$$E_p = mgh$$

### **Example Problem:**

A ball of mass 1.30 kg is thrown upward and reaches a height of 24.0 m above the ground. What is the potential energy ( $E_p$ ) of the ball relative to the ground?

Known Values:

$$m = 1.30 \text{ kg}$$

$$h = 24.0 \text{ m}$$

$$g = 9.80 \text{ N/kg (on Earth)}$$

[we can assume we are on Earth unless otherwise mentioned]

Formula:  $E_p = mgh$

$$= (1.30)(9.80)(24.0)$$

$$= 305.76 \text{ (not rounded)}$$

$$= 306 \text{ J (rounded, with units)}$$

**Practice Questions:** (Your solutions should be organized similar to the example problem. Show all your steps please)

1. A goat jumps up in the air and reaches a height of 39.0 m above the surface of the Earth. How much potential energy will the 31.0 kg goat have at this height?
2. If a rock has 250 MJ of potential energy while sitting on the edge of a cliff 42.0 m above the valley floor, what is its mass?
3. The International Space Station is 405 km above the Earth's surface and has a mass of 419 000 kg. If the gravitational field strength is only 8.72 N/kg at this altitude, how much potential energy does the ISS have?
4. If you had a job lifting books from the floor up onto a bookshelf ( $h = 1.70$  m), and the average book had a mass of 1.20 kg, and you had 1000 books to put away, how much extra potential energy would all those books have when you were done? Where did this energy come from?
5. If 9.75 kJ of  $E_p$  was given to a lemon while lifting it, and the lemon had a mass of 218 g, how high was it lifted?

