

Kinetic Energy



Key Concepts:

- What is **kinetic energy**?
- What factors might contribute to an object's kinetic energy?

Kinetic Energy is the energy associated with movement. In mechanical kinetic energy this deals with a mass moving.

$$E_k = \frac{1}{2} mv^2$$

For heat, we look at the movement of atoms within a mass. If you recall the kinetic molecular theory, the hotter an object gets, the faster the atoms are moving. This is a type of kinetic energy as well that we will deal with later. Like all Energy, Kinetic energy is measured in Joules, J.

To calculate Mechanical Kinetic Energy, you need a mass in kg, moving at a speed measured in m/s. The easiest questions look like:

Calculate the mechanical kinetic energy of a 2.3kg mass moving at 3.8 m/s

$$\begin{aligned} E_k &= \frac{1}{2} mv^2 \\ &= \frac{1}{2} (2.3 \text{ kg})(3.8 \text{ m/s})^2 \\ &= 17 \text{ J} \end{aligned}$$

But what if the mass is in grams, g?

Before you can find the E_k , you need to convert the grams into kg by dividing the grams, g by 1000:

$$\begin{aligned} 200 \text{ g} &= 200/1000 = 0.2 \text{ kg} \\ 3 \text{ g} &= 3 / 1000 = 0.003 \text{ kg} \end{aligned}$$

Calculate the kinetic energy of a 25g paint ball moving at 33m/s.

$$E_k = \frac{1}{2} mv^2$$

$$25 \text{ g} = 25/1000 = 0.025 \text{ kg}$$

$$= \frac{1}{2} (0.025 \text{ kg})(33 \text{ m/s})^2$$

$$= 14 \text{ J}$$

But what if the speed is given in km/h?

Before you can find the E_k , you need to convert the km/h into m/s by dividing the km/h by 3.6:

$$100 \text{ km/h} = 100/3.6 = 28 \text{ m/s}$$

$$30 \text{ km/h} = 30/3.6 = 8.3 \text{ m/s}$$

Calculate the kinetic energy of a 5.3 kg bowling ball moving at 18 km/h.

$$E_k = \frac{1}{2} mv^2$$

$$18 \text{ km/h} = 18/3.6 = 5 \text{ m/s}$$

$$= \frac{1}{2} (5.3 \text{ kg})(5 \text{ m/s})^2$$

$$= 66 \text{ J}$$

Practice Problems

1. A freight elevator with a mass of 120 kg is moving with a speed of 2.50 m/s. What is its kinetic energy?
2. A car with a mass of 1500 kg is moving at a speed of 50 km/h. What is its E_k ? (remember to convert km/h into m/s!)
3. A student with a mass of 55 kg is jogging at a speed of 1.6 m/s. What is the student's kinetic energy?

4. A wrecking ball, as seen in the diagram below, has a mass of 315 kg. If it is moving at a speed of 5.12 m/s, what is its kinetic energy?



5. A freight elevator with a mass of 120 kg is moving with a speed of 2.50 m/s. What is its kinetic energy?

6. A hockey puck has a mass of 210 g. If the hockey puck has 73 J of kinetic energy, what is its speed? (remember to convert g into kg!)

7. An electron with a mass of 9.11×10^{-31} kg is moving at a speed of 2.19×10^7 m/s. What is the kinetic energy of the electron?

8. A basketball that is moving with a speed of 6.1 m/s has 8.4 J of kinetic energy. What is the mass of the basketball?

9. A bowling ball is moving at a speed of 2.21 m/s. If the kinetic energy of the bowling ball is 15.7 J, what is its mass?

10. What is the speed of a 0.155 kg billiard ball that has 12.0 J of kinetic energy?

11. You are paddling a canoe. The combined mass of the canoe and your body is 115 kg. If you and the canoe have a kinetic energy of 75 J, how fast are you paddling the canoe?

12. A 15 kg child is sliding down a playground slide. If the child's kinetic energy is 77J, how fast is the child sliding?