

KINETIC ENERGY PROBLEMS

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:

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

Where:

Mass (m) is measured in kilograms (kg)

Velocity (v) is measured in meters per second (m/s)

E_k is measured in joules (J)

Note: To earn full marks when solving science word problems, you must **Show your work:**

1. State the unknown value. (What are you asked to find?)
2. List the information given in the problem (all the known values)
3. Identify a formula that may help you solve it.
4. Manipulate the formula so that the unknown is on the left side.
5. Substitute in the known values.
6. Calculate the answer. (Yes, now you may pick up your calculator)
7. State your answer with the correct units

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:

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

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

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?