Kinetic Energy
Lesson Notes

Learning Outcomes
- What is kinetic energy?
- How can you know if an object has kinetic energy?
- What is the kinetic energy formula and how do you use it?

Meaning of Kinetic Energy
Kinetic energy is the energy possessed by an object as a result of its motion.

A moving object possesses kinetic energy regardless of …
… which direction it is moving.
… whether it is speeding up or slowing down.
… how high above the ground it is.

The Kinetic Energy Equation:
The amount of kinetic energy (**KE**) an object possesses depends upon …
- … how much mass is moving (**m**)
- … how fast the mass is moving (**v**)

$$KE = \frac{1}{2} \cdot m \cdot v^2$$

Unit for KE: Joule (abbreviated J); 1 J = 1 N•m = 1 kg•m^2/s^2

The KE Equation as a Guide to Thinking Qualitatively
From the equation for kinetic energy, we would reason that ...
- If **speed** increases … then **KE** increases.
- If **speed** decreases … then **KE** decreases.
- If **speed** is constant … then **KE** is constant.
- Where **speed** is greatest … **KE** is greatest.
- Where **speed** is least … **KE** is least.

Whatever the **speed** does, the **kinetic energy** does the same.

The KE Equation as a Guide to Thinking Proportionally
The kinetic energy (**KE**) of an object is directly proportional to the square of the object's speed (**v**^{2}). And so ...
- If the **v** is ↑ by a factor of 2 (doubled), then the **KE** is ↑ by a factor of 4 (quadrupled).
- If the **v** is ↑ by a factor of 3 (tripled), then the **KE** is ↑ by a factor of 9.
- If the **v** is ↓ by a factor of 2 (halved), then the **KE** is ↓ by a factor of 4 (quartered).

Using the KE Equation in Solving Algebraic Problems

Basic Algebra: The KE equation has three variables: **KE**, **m**, and **v**. If you know the value of 2 variables, you can calculate the value of the 3rd variable.

Three Forms of the KE Equation

1. Solving for Kinetic Energy (KE) ...

   Use **$KE = \frac{1}{2} \cdot m \cdot v^2$**

2. Solving for Mass (m) ...

   Use **$m = (2 \cdot KE) / (v^2)$**

3. Solving for Speed (v) ...

   Use: **$v = \sqrt{[(2 \cdot KE) / (m)]}$**

Example: Calculating Speed

A 4.0-kg object has 72 J of kinetic energy. Determine its speed.

Solution:

Given: KE = 72 J, m = 4.0 kg Determine v

Equation:	$KE = \frac{1}{2} \cdot m \cdot v^2$
Substitute:	$72\ J = \frac{1}{2} \cdot (4.0\ kg) \cdot v^2$
Simplify (and drop units):	$72 = 2.0 \cdot v^2$
Divide each side by 2.0:	$36 = v^2$
Take the $\sqrt{}$ of each side:	**$6.0\ m/s = v$**