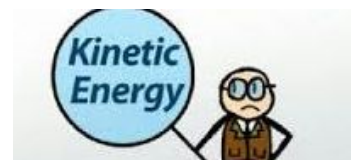


Work and Kinetic Energy



Your goal: Figure out how work and kinetic energy are related.

Kinetic Energy: The kinetic energy of an object depends on its mass and its speed. K is directly related to mass and is directly related to the square of speed. Specifically:

$$K = 1/2 \cdot m \cdot v^2$$

where K is kinetic energy in Joules

m is mass in kg

v is speed in m/s (meters/second)

Question: What is the kinetic energy of a 4.0 kg rabbit running at a speed of 11 m/s? _____

Work: Work is the transfer of energy through the application of force. Work is directly related to both force and distance. Specifically,

$$W = F \cdot d$$

where W is work in Joules

F is force in Newtons

d is the distance over which the force is applied, in meters

Question: What work is done by a 50 Newton force acting over a distance of 12 m? _____

You can see that W and KE share the same unit - the joule.

Go to tandftechnology.com. Pick Lab Simulations, and then find the **Work to KE Lab**.
<http://tandftechnology.com/Physics/Programs/Labs/WorkToKELab/index.html>

The astronaut, Wally, is drifting in open space. Lucky for him, he has a fire extinguisher. As he blasts the extinguisher, the extinguisher puts a force on the escaping gases, and in accordance with Newton's 3rd Law, the gases put an equal and opposite force on Wally. You can adjust Wally's mass, the force that the fire extinguisher exerts, and the distance over which the force is exerted. You can measure Wally's speed as he passes between two photogates that are 10 m apart.

1. First, in the space below, draw a LOL diagram for this situation. The system consists of Wally only. The fire extinguisher is not in the system. Don't forget the qualitative energy equation!

2. Hopefully, you have written that in this situation, $W = K_{(B)}$. You also know that $W = F \cdot d$. Test this out - try 4 different combinations of force and distance that have equal products (for example, 50 N and 40 m and 200 N and 10 m), and try to confirm that Wally has an equivalent speed for each. Does he? What combination of forces and distances did you use?

3. These instructions apply to sections 4 and 5 as well, with minor variation. Next investigate ***the effect of distance*** (the distance over which the work is applied) **on v and on v^2** . When you do this, keep the other variables (force, mass) constant. You can easily graph your data using the quick graph program (tandftechnology, Helpful Tools, Quick Graph) which you should open in a separate tab (open a new tab for each graph). Using the "data" option in Quick Graph, you can change v to v^2 with one click. Once you get a graph of v vs d , sketch it (just the general shape) and write the best-fit equation. Then change v to v^2 , get a new graph of v^2 vs d , sketch it, and write the best-fit equation.

Graph of v vs d	Graph of v^2 vs d
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4. Next investigate **the effect of force on v and on v^2** . When you do this, keep the other variables constant.

Graph of v vs F	Graph of v^2 vs F
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5. Finally, investigate **the effect of mass on v and on v^2** . When you do this, keep the other variables constant.

Graph of v vs m	Graph of v^2 vs m
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