Physics 2204
Unit 3: Work, Power and Energy
Worksheet 6: Kinetic Energy

Student Name:_____

Kinetic energy (K.E. OR E_k) is the energy of motion. An object which has motion - whether it be vertical or horizontal motion - has kinetic energy

The formula for calculating kinetic energy is:

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

mass (m) is measured in kg

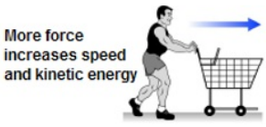
velocity ($\vec{v}$) is measured in m/s

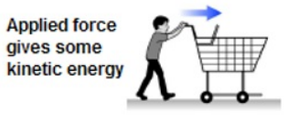
kinetic energy (KE) is measured in Joules (J)

There are two factors that affect the kinetic energy of an object:

1) Mass

2) Velocity





Example 1:

What is the kinetic energy of a 900 kg moose is running at 2.0 m/s?

Example 2:

While a 23 gram bullet is in the barrel of a rifle, it accelerates at 2.25 x 10^5 m/s^2 for 2.00 x 10^{-2} s. What is the KE of the bullet as it leaves the rifle?

Example 3:

A 2.4 kg can of paint falls 2.7 m from the top rung of a ladder to the ground. By the time it hits the ground, all of its 64 J of PE_{grav} have been changed into KE. With what speed does it hit the ground?

PART A: MULTIPLE CHOICE

Instructions: Shade the letter of the correct answer on the computer scorable answer sheet provided

1. As a baseball flies through the air after being hit, which of the following types of energy does it have?

   (A) Chemical energy
   (B) Kinetic energy
   (C) Mechanical energy
   (D) Potential energy

2. Which of the following is referred to as the energy of motion?

   (A) Elastic Potential Energy
   (B) Gravitational Potential Energy
   (C) Kinetic energy
   (D) Work

3. In which situation is potential energy converted to kinetic energy?

   (A) A ball rolling on a flat surface is slowed by friction
   (B) A ball rolls slower and slower as it rolls uphill
   (C) A horizontal spring is compressed by a force
   (D) A rock in a sling shot is launched horizontal

4. What happens to the kinetic energy of a moving object if the net work done is positive?

   (A) The kinetic energy increases
   (B) The kinetic energy decreases
   (C) The kinetic energy remains the same
   (D) The kinetic energy is zero

5. Which of the following is the units for kinetic energy?

   (A) kg •m/s
   (B) kg •m/s^2
   (C) J
   (D) J/ m/s

6. What would happen to an object's kinetic energy if its velocity triples?

   (A) Decrease by a factor of 3
   (B) Decrease by a factor of 9
   (C) Increase by a factor of 3
   (D) Increase by a factor of 9

7. Object A has half the mass and four times the speed as Object B. How does the kinetic energy of Object A compare to the kinetic energy of Object B?

   (A) A has 2 times the energy of B.
   (B) A has 4 times the energy of B.
   (C) A has 8 times the energy of B.
   (D) A has 16 times the energy of B.

8. Ball A has triple the mass and speed of ball B. What is the ratio of the kinetic energy of ball A to ball B?

   (A) 3
   (B) 6
   (C) 9
   (D) 27

9. What is the kinetic energy of a 3.0 kg ball that is moving at 2.0 m/s?

(A) 3.0 J
(B) 6.0 J
(C) 12 J
(D) 18 J

10. What is the kinetic energy of a 0.060 kg tennis ball travelling at 55 m/s?

(A) 1.7 J
(B) 3.3 J
(C) 91 J
(D) 180 J

11. What is the kinetic energy of a 4.00 kg bicycle that is moving at 8.50 m/s?

(A) 17.0 J
(B) 68.0 J
(C) 145 J
(D) 289 J

12. What is the speed of a 2.9 kg object that has 16 J of kinetic energy?

(A) 1.6 m/s
(B) 2.7 m/s
(C) 3.3 m/s
(D) 5.5 m/s

13. A small 30. kg canoe is floating downriver at a speed of 2.0 m/s. What is the canoe's kinetic energy?

(A) 32 J
(B) 60 J
(C) 120 J
(D) 900 J

14. A 12 kg sled is moving at a speed of 3.0 m/s. At which of the following speeds will the sled have twice as much kinetic energy?

(A) 1.5 m/s
(B) 4.2 m/s
(C) 6.0 m/s
(D) 9.0 m/s

15. What is the kinetic energy of a 24 kg dog running at 22 km/h?

(A) 4.5×10^2 J
(B) 5.8×10^3 J
(C) 1.2×10^4 J
(D) 2.6×10^2 J

16. What is the kinetic energy of a 68.1 kg jogger traveling at 5.36 m/s?

(A) 1.96×10^3 J
(B) 978 J
(C) 365 J
(D) 183 J

17. What is the kinetic energy a 80.0 g bullet traveling at 300.0 m/s?

(A) 12.0 J
(B) 3.60×10^3 J
(C) 1.20×10^4 J
(D) 3.60×10^6 J

PART B: WRITTEN RESPONSE

1. Evaluate the following:

   a. A 2000 kg car is moving at 10.0 m/s. Calculate its KE. **Answer is 100 000 J**
   b. Suppose that the speed of the car in part (a) doubled to 20.0 m/s. What would be the new value of its KE? **Answer is 400 000 J**
   c. Explain how you can use the answer from part (a) to get the answer to part (b) without using the formula for KE. **Answer :the speed means four times**

2. Do the same for the following:
   a. A 900 kg moose is running at 2.0 m/s. Calculate its KE. **Answer is 1800 J**
   b. Suppose that the moose triples its speed to 6.0 m/s. Calculate the new value for the KE without using the formula. **Answer is 16200 J**

3. A ball with a mass of 0.40 kg is estimated to have a KE equal to 80.0 J. Calculate its speed. **Answer is 20 m/s**

4. The KE of a speeding bullet is estimated to be 2240 J. If the mass is 0.028 kg, what is the speed? **Answer is 400 m/s**

5. A 75 kg cyclist, on a 5 kg bicycle speeds up from 10 m/s to 20 m/s.
   a. What is the kinetic energy before speeding up? **Answer is 4000 J**
   b. What is the kinetic energy after speeding up? **Answer is 16000 J**
   c. Based on (a) and (b) what happened to kinetic energy as speed doubles. **Answer is 4 x increase**
   d. By what factor would the kinetic energy change if the speed increased by a factor of 3? Explain your reasoning. **Answer is 9**

6. A moving object is estimated to have a KE equal to 40 J.
   a. If you increased the speed by a factor of 5 what would be the KE? **Answer is 1000 J**
   b. If you increased the speed by a factor of 10 what would be the KE? **Answer is 4000 J**
   c. If you DECREASED the speed by a factor of 2, what would be the KE? (That is, what would be the KE if the speed was cut in half?) **Answer is 10 J**

7. A hot wheels car with a mass of 0.050 kg is moving at 0.80 m/s along a track. It passes through a battery powered launcher which increases its speed to 1.40 m/s. By what FACTOR was the kinetic energy increased? **Answer is 3.0625 (note you can SQUARE the factor by which the speed changed)**

8. A speeding bullet is only going about 10 times as fast as you could throw it. It packs about 100 times the WHALLOP, though. Why? **Increasing the speed by a factor of 10 means that the KE is actually 100 times greater.**

9. Rolling ball has 18 J of kinetic energy and is rolling 3.0 m/s. Find its mass. **Answer is 4.0 kg**

10. Calculate the kinetic energy of a 45 g golf ball travelling at:
    a) 20. m/s **Answer is 9.0 J**
    (b) 40. m/s **Answer is 36 J**
    (c) 60. m/s **Answer is 81 J**