

KINETIC AND POTENTIAL ENERGY WORKSHEETName: _____ **KEY**

Determine whether the objects in the following problems have kinetic or potential energy. Then choose the correct formula to use: **KE = 1/2 m v²** OR **PE = mgh = F_wh**

1. You serve a volleyball with a mass of 2.1 kg. The ball leaves your hand with a speed of 30 m/s. The ball has **kinetic** energy. Calculate it.

$$KE = \frac{1}{2} m v^2 = \frac{1}{2} (2.1 \text{ kg})(30 \text{ m/s})^2 = \mathbf{945 \text{ Joules}}$$

2. A baby carriage is sitting at the top of a hill that is 21 m high. The carriage with the baby weighs 12 N. The carriage has **potential** energy. Calculate it.

$$PE = F_w h = (12 \text{ N})(21 \text{ m}) = \mathbf{252 \text{ Joules}}$$

3. A car is traveling with a velocity of 40 m/s and has a mass of 1120 kg. The car has **kinetic** energy. Calculate it.

$$KE = \frac{1}{2} m v^2 = \frac{1}{2} (1120 \text{ Kg})(40 \text{ m/s})^2 = \mathbf{896000 \text{ Joules}}$$

4. A cinder block is sitting on a platform 20 m high. It weighs 79 N. The block has **potential** energy. Calculate it.

$$PE = F_w h = (20 \text{ m})(79 \text{ N}) = \mathbf{1580 \text{ Joules}}$$

5. There is a bell at the top of a tower that is 45 m high. The bell weighs 190 N. The bell has **potential** energy. Calculate it.

$$PE = F_w h = (45 \text{ m})(190 \text{ N}) = \mathbf{8550 \text{ Joules}}$$

6. A roller coaster is at the top of a 72 m hill and weighs 966 N. The coaster (at this moment) has **potential** energy. Calculate it.

$$PE = F_w h = (72 \text{ m})(966 \text{ N}) = \mathbf{69552 \text{ Joules}}$$

7. What is the kinetic energy of a 3-kilogram ball that is rolling at 2 meters per second?

$$KE = \frac{1}{2} m v^2 = \frac{1}{2} (3 \text{ kg})(2 \text{ m/s})^2 = \mathbf{6 \text{ Joules}}$$

8. The potential energy of an apple is 6.00 joules. The apple is 3.00-meters high. What is the mass of the apple?

$$PE = mgh \quad 6 \text{ J} = (3 \text{ m})(9.8 \text{ m/s}^2)(\underline{\quad \text{m}}) \quad \mathbf{m = 0.20 \text{ Kg}}$$

9. Two objects were lifted by a machine. One object had a mass of 2 kilograms, and was lifted at a speed of 2 m/sec. The other had a mass of 4 kilograms and was lifted at a rate of 3 m/sec.

a. Which object had more kinetic energy while it was being lifted?

$$KE = \frac{1}{2} m v^2 = \frac{1}{2} (2\text{kg}) (2 \text{ m/s})^2 = \mathbf{4 \text{ Joules}} \quad \text{OR} = \frac{1}{2} (4 \text{ kg}) (3 \text{ m/s})^2 = \mathbf{18 \text{ Joules}} \quad \text{this one had more KE}$$

b. Which object had more potential energy when it was lifted to a distance of 10 meters? Show your calculation.

$$PE = mgh = (2\text{kg}) (9.8 \text{ m/s}^2) (10 \text{ m}) = \mathbf{196 \text{ Joules}} \quad \text{OR} = (4\text{kg}) (9.8 \text{ m/s}^2) (10 \text{ m}) = \mathbf{392 \text{ Joules}} \quad \text{this one has more}$$

10. You are on roller blades on top of a small hill. Your potential energy is equal to 1,000.0 joules. The last time you checked your mass was 60.0 kilograms.

a. What is your weight in newtons?

$$W = mg = (60 \text{ kg}) (9.8 \text{ m/s}^2) = \mathbf{588 \text{ N}}$$

b. What is the height of the hill? $PE = mgh$ $1000 \text{ J} = 588\text{N} (h)$ $\mathbf{h = 1.70\text{m}}$

c. If you start skating down this hill, your potential energy will be converted to kinetic energy. At the bottom of the hill, your kinetic energy will be equal to your potential energy at the top. What will be your speed at the bottom of the hill?

$$KE = \frac{1}{2} m v^2 \quad 1000\text{J} = \frac{1}{2} (60 \text{ kg}) (v)^2 \quad 1000 \text{ J} = 30 v^2 \quad v^2 = 33.333 \quad \mathbf{v = 5.77 \text{ m/s}}$$

11. Answer the following:

a. What is the kinetic energy of a 1-kilogram ball is thrown into the air with an initial velocity of 30 m/sec?

$$KE = \frac{1}{2} m v^2 = \frac{1}{2} (1 \text{ kg}) (30 \text{ m/s})^2 = \mathbf{450 \text{ Joules}}$$

b. How much potential energy does the ball have when it reaches the top of its ascent?

$\mathbf{450 \text{ Joules}}$, because $ME = KE + PE$, and Ke would be 0 at the top of the ascent

c. How high into the air did the ball travel? $**KE = PE$

$$PE = mgh \quad 450 \text{ J} = (1\text{kg}) (9.8 \text{ m/s}^2) (h) \quad \mathbf{h = 45.9 \text{ m}}$$

12. What is the potential energy of a 3 kilogram-ball that is on the ground?

$$PE = mgh = (3\text{kg}) (9.8 \text{ m/s}^2) (0 \text{ m}) = \mathbf{0 \text{ Joules}}$$

13. What is the kinetic energy of a 2,000-kilogram boat moving at 5 m/sec?

$$KE = \frac{1}{2} m v^2 = \frac{1}{2} (2000\text{kg}) (5 \text{ m/s})^2 = \mathbf{25000 \text{ Joules}}$$

14. What is the velocity of a 500-kilogram elevator that has 4,000 joules of energy?

$$KE = \frac{1}{2} m v^2 \quad 4000 \text{ J} = \frac{1}{2} (500 \text{ kg}) (v)^2 \quad v^2 = 16 \quad \mathbf{v = 4 \text{ m/s}}$$

15. What is the mass of an object that creates 33,750 joules of energy by traveling at 30 m/sec?

$$KE = \frac{1}{2} m v^2 \quad 33,750 \text{ J} = \frac{1}{2} (m) (30 \text{ m/s})^2 \quad \mathbf{m = 75 \text{ kg}}$$