<b>Potential</b>	and	Kinetic	<b>Energy</b>	Calcs	2018
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## **ENERGY DEFINITION AND UNITS**

Energy is the ability to do work or cause change. Energy is measured in joules (J) or Newton-meters.

## **POTENTIAL ENERGY**

Potential energy (PE) is stored energy. The formula for the PE of an object is: GPE = mgh where m equals mass in kg, g is the acceleration of gravity in m/s<sup>2</sup>, and h equals the height of the object in m. The mass (m) of the object times the acceleration of gravity (g) is the same as the weight of the object in newtons. The acceleration of gravity is equal to 9.8 m/sec<sup>2</sup>.

Sample Problem: What is the potential energy of a 10.0-newton book that is placed on a shelf that is 2.5 meters high?

Looking for: Gravitational Potential Energy Given: W = 10.0 Newtons, h = 2.5 meters

Solution: The book's weight (10.0 N) is equal to its mass times the acceleration of gravity. (W = mg) Therefore, you can easily use this value in the potential energy formula: GPE = mgh The GPE is 25 Joules (or 25 Newton-meters).

## POTENTIAL ENERGY CALCS

1.	The potential ene	rgy of an apple is 6.00 Joules. The apple is 3.00 meters high. What is the mass
	of the apple?	6.005 = m (9.8 m/s2)(3.00m)
P	E= 6,005	
-	h = 3.00m	m = 204  Ka

2. Determine the amount of potential energy of a 5.0-Newton book that is moved to three different shelves on a bookcase. The height of each shelf is 1.0 meter, 1.5 meters, and 2.0 meters.

PE = (5.0N)(1.0m) PE = (5.0N)(1.5m) PE = (5.0N)(2.0m) PE = 5.0J PE = 10.J

3. 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.

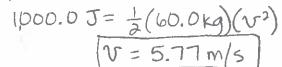
a. What is your weight in Newtons?

b. What is the height of the hill?

s the height of the hill?  

$$1,000.0 \ J = (588 \ N) \ h$$
  $h = 1.70 \ m$ 

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 MAX PEWIII be your speed at the bottom of the hill?



Kinetic energy (KE) is energy of motion. The formula for the KE of an object is: KE = 1/2 mv<sup>2</sup> where m equals mass in kilograms and v equals the velocity or speed of the object in meters per second. To do this calculation, square the velocity value. Next, multiply by the mass, and then, divide by 2.

Sample Problem: A 50.-kilogram boy and his 110-kilogram father went jogging. Both ran at a rate of 5.0 m/sec. Who had more kinetic energy? Looking for: Who had more KE? Given: boy's mass = 50. kg, father's mass = 110 kg, velocity for both = 5.0 m/s Solution: Boy's KE =  $\frac{1}{2}$  (50. kg)(5 m/s)<sup>2</sup> = 625  $\rightarrow$  630 J Father's KE =  $\frac{1}{2}$  (110 kg)(5 m/s)<sup>2</sup> = 1.375  $\rightarrow$  1.400 Joules KINETIC ENERGY CALCS 4. What is the kinetic energy of a 2,000.0-kilogram boat moving at 5.00 m/sec? KE = ± (2,000.0 kg) (5.00 m/s) = 25,000 → 2.50 × 10 J 5. What is the velocity of an 500.0-kilogram elevator that has 4,000.0 Joules of energy? 4,000.0 J = = = (500.0 kg) (V2) [V = 4.000 m/s 6. What is the mass of an object that creates 33,750.0 Joules of energy by traveling at 30.0 m/sec? 33,750.0 J = \( \( \text{M} \) (30.0 m/s) | M = 75.0 kg | **ENERGY CONSERVATION** The law of conservation of energy states that energy is never destroyed or created, only transferred. Therefore, you can assume that the energy in a system remains the same unless work is done. You can use the following equation in an energy conservation question.  $KE_i + PE_i + W_{ext} = KE_f + PE_f$ >W= F.X Sample Problem: A 4768-kg roller coaster train full of riders approaches the loading dock at a speed of 17.1 m/s. It is abruptly decelerated to a speed of 2.2 m/s over a distance of 13.6 m. Determine the resisting force that acts upon the roller coaster cars. Looking for: Resisting force on the roller coaster cars <u>Given:</u> mass = 4768 kg,  $v_i$  = 17.1 m/s,  $v_f$  = 2.2 m/s, d = 13.6 m Solution:  $\frac{1}{2}$  (4768 kg)(17.1 m/s)<sup>2</sup> - F (13.6 m) =  $\frac{1}{2}$  (4768 kg)(2.2 m/s)<sup>2</sup> 697,105 J - F (13.6m) = 11538 J  $F = 5.0 \times 10^4 \text{ Newtons}$ pile is not in motion & docsn't have h to begin with) 7. A physics teacher exerts a force upon a 3.29-kg pile of snow to both lift it and set it into motion. The snow leaves the shovel with a speed of 2.94 m/s at a height of 0.562 m. Determine the work done upon PET + Wext = KE<sub>f</sub> + PE<sub>f</sub> Wext =  $\frac{1}{a}(3.29 \text{ kg})(2.94 \text{ m/s})^2 + (3.29 \text{ kg})(9.8 \text{ m/s}^2)(.562 \text{ m})$ W = 19.29 + 18.120 = 32.3 J the pile of snow. 8. A 250.-gram cart starts from rest and rolls down an inclined plane from a height of 0.541 m. Determine its speed at a height of 0.127 m above the bottom of the incline. No work ext force is 588 N, then what was the speed of the baseball at the moment of contact with the catcher's mitt? The VEC + Pt. + Wext = KE, # When something slows down (.071)  $V^2 = 75.852$  J nr ctops W is 2 mo direction V = 32.7 m/s