Virtual Learning

Physics

Nonconservative Forces & Conservation of Energy

May 21, 2020

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Nonconservative Forces & Conservation of Energy:
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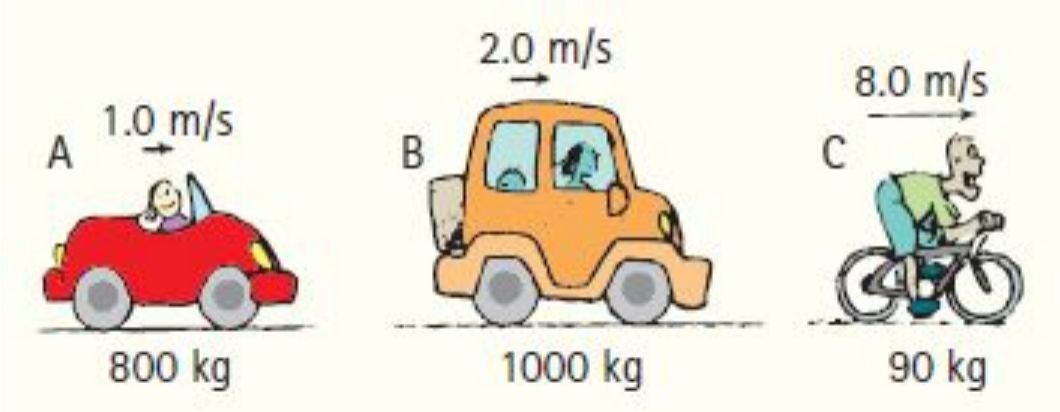
Objective/Learning Target:

Students will examine conservation of energy and use it to solve various problems.

Quick Review #1

The mass and speed of the three vehicles, A, B, and C, are shown. Rank them from greatest to least for the following:

a. Kinetic energy
b. Work done to bring them up to their respective speeds from rest



Quick Review #1 Answer

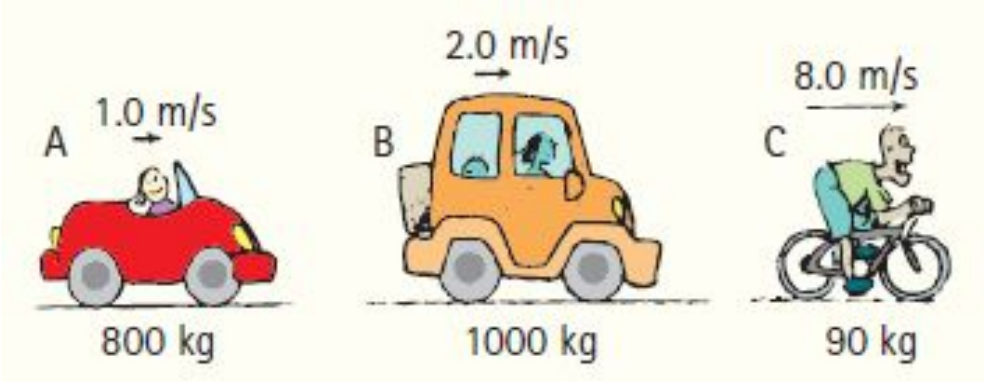
a. Kinetic energy - ½ mv^2

A = 400 J, B = 2000 J C = 2880 J

Greatest to least: C>B>A

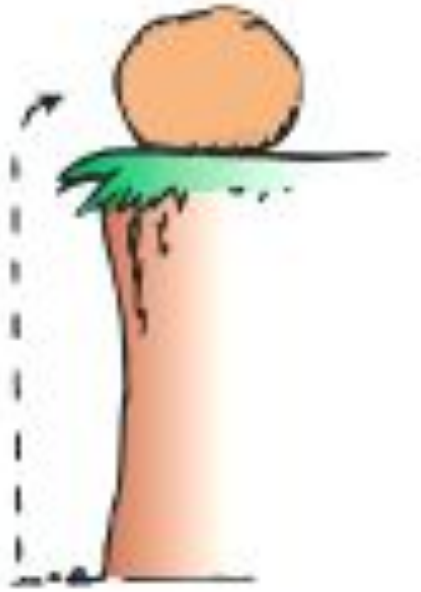
b. Work = ΔKE

Greatest to least: C>B>A



Quick review # 2

A 200 kg boulder is raised above the ground so that its potential energy relative to the ground is 6000 J. Then it is dropped. What is its velocity just before it hits the ground?



Quick review # 2

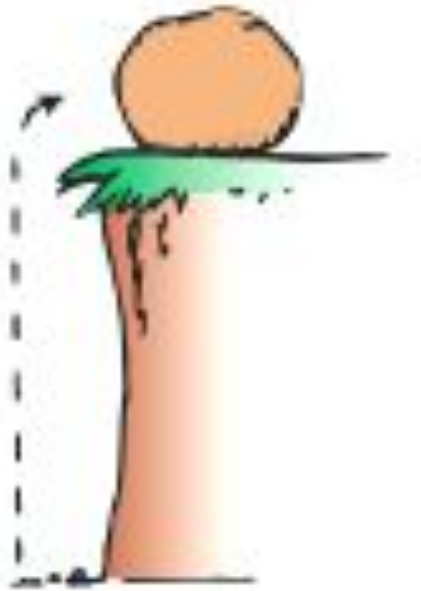
PE at the top equals the amount of KE just before striking the ground.

$PE_{top} = KE_{bottom}$

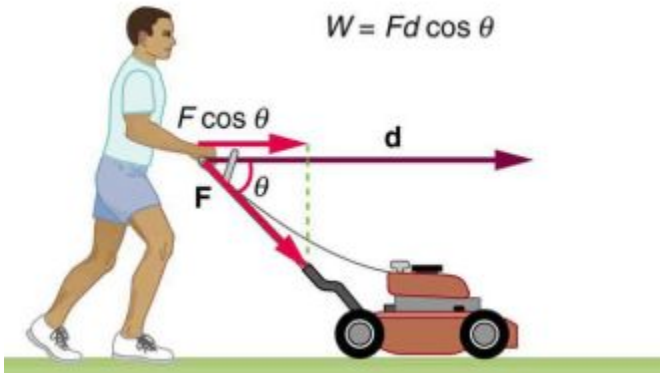
$6000\ J = \frac{1}{2}\ mv^2$

$6000\ J = \frac{1}{2}\ 200kg \times v^2$

$v = \sqrt{(2 \times 6000J / 200\ kg)} = 7.75\ m/s$



Energy Conservation



Link: [Nonconservative Forces]
[Conservation of Energy]

Directions:

- Read through Nonconservative Forces & Conservation of Energy.
- Work through any examples on a separate piece of paper before you scroll down to the solution.
- On a separate piece of paper complete the practice problems on the following slides.
- Check your answers.
- For additional practice check out the conceptual questions and the problems and exercises in the table of contents for the online text linked above.

Practice Problem #1

The driver of a 1000 kg car travelling at a speed of 16.7 m/s applies the car's brakes when he sees a red light. The car's brakes provide a frictional force of 8000 N. Determine the stopping distance of the car.

Practice Problem #1 Answer

Work = ΔKE

$Fd\cos\theta = KE_f - KE_i$

$-8000N \times d \times \cos 180° = 0\ J - \frac{1}{2} \times 1000\ kg \times (16.7\ m/s)^2$

$$d = \frac{-\frac{1}{2} \times 1000kg \times (16.7\ m/s)^2}{-8000N \times \cos 180°}$$

$= 17.4\ m$

Actors in black and white movies were often putting their lives in danger during driving scenes, as they weren't able to tell if the traffic light was red or green.

Practice Problem #2

A 75kg person, starting from rest, slides down a slide 4.0 m long,and inclined at an angle of 35° with the ground. The person reaches the bottom at a speed of 6.0 m/s. What percent of the potential energy was converted to heat?

Practice Problem #2 Answer

$PE = mgh = 75kg \times 9.8\ m/s^2 \times 4.0m \times \sin 35° = 1686\ J$

$KE = \frac{1}{2}\ mv^2 = \frac{1}{2} \times 75kg \times (6.0\ m/s)^2 = 1350\ J$

$$\%\ \text{lost to heat} = \frac{PE - KE}{PE} \times 100\%$$

$$= \frac{1686\ J - 1350\ J}{1686} \times 100\%$$

$= 20\%$

Practice Problem #3

Felix Baumgartner, better known as Fearless Felix, has broken the **sound barrier** during his daredevil jump from space and landed back on earth safely. The 43-year-old Austrian **skydiver** plunged around 39 km (24 miles) after he stepped out of his balloon which was airborne in the earth's stratosphere above New Mexico.

Assume there is no air drag. How far must a skydiver fall before they break the sound barrier? Speed of sound is 343 m/s. Use energy conservation to solve.

Practice Problem #3

PEtop = KEbottom

$mgh = \frac{1}{2} mv^2$

$h = \frac{\frac{1}{2} v^2}{g} = \frac{\frac{1}{2} (343 m/s)^2}{9.8 m/s^2} = 6000 m$

Additional Practice

For additional practice check out the conceptual questions and the problems and exercises in the table of contents from the online text linked above.