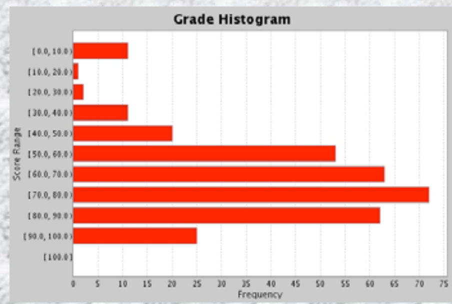
Announcements 10 Apr 09

- Homework
  - Written homework #9 due in class on Monday
  - Online homework #9 due on Tuesday by 8 am
  - Impulse and momentum ranking task:
    - some cars have the same rank
    - drag cars with equal rank so that they are one above the other
- Exam 2
  - Partial grades posted in SPARK (not including last question) avg = 64 points (out of 90 max)
  - Add written question score this weekend



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Exam 2 written problem

A woman at an airport is towing her 10.0 kg suitcase horizontally at *constant* speed by pulling on the strap at an angle 30 degrees above the horizontal. She pulls on the strap with a 90.0 N force, and the suitcase slides on the floor with a significant amount of friction.

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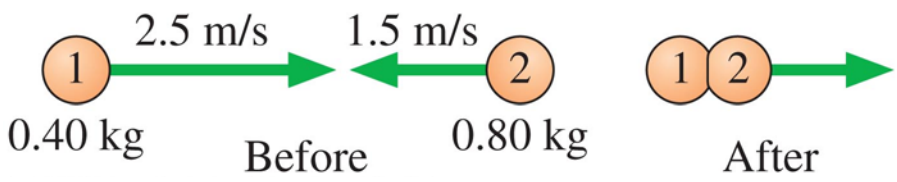
Momentum and collision question 2

PRS

The two particles shown collide and stick together (i.e. the collision is inelastic). After the collision, the combined particles



DEMO: inelastic collision on air track

Momentum problem 2

A 10 g bullet is fired into a 1.0 kg wood block, where it lodges. Subsequently, the block slides 4.0 m across a floor (μ_k = 0.20 for wood on wood). What was the bullet's speed?

1. *Draw before and after picture + define the "system"*
2. *Organize known information, list quantities to find*
3. *Here, we need to work backwards:*
   first, find acceleration of the bullet+block unit after bullet has hit
   second, compute velocity of bullet+block unit after bullet has hit
   third, apply momentum conservation to find the bullet speed

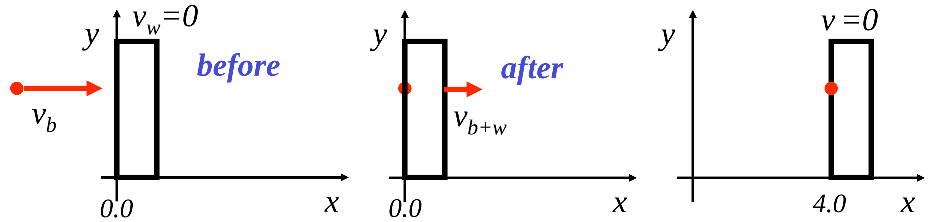
We cannot apply momentum conservation to relate the initial momentum of the bullet+block system to its final momentum (p_f = 0 since the bullet+block comes to a stop after sliding 4.0 m) because during the 4.0 m slide the external friction force on the bullet+block system cannot be ignored

Momentum conservation can be used to relate the initial momentum of the bullet+block system to its momentum immediately after the bullet hits because the bullet-block interaction is very short and the effects of the friction force are very small (and can be ignored) during this very short time

Momentum problem 2

A 10 g bullet is fired into a 1.0 kg wood block, where it lodges. Subsequently, the block slides 4.0 m across a floor (μ_k = 0.20 for wood on wood). What was the bullet's speed?

1. *Draw before and after picture + define the "system"*



System = bullet + wood block

2. *Organize known information, list quantities to find*

Know:
$m_b = 10g = 0.010kg$
$m_w = 1.0kg$
$\mu_k = 0.20$
$x_f = 4.0m$
Find: v_{b+w} and v_b

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Momentum problem 2

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Know:
$m_b = 10g = 0.010kg$
$m_w = 1.0kg$
$\mu_k = 0.20$
$x_f = 4.0m$
Find: v_{b+w} and v_b

3. *Solve by working backwards:*
   find v_{b+w} then v_b

3.1 Compute acceleration due to friction

$$a_x = \frac{\sum F_x}{m} = \frac{-\mu_k n}{m} = \frac{-\mu_k mg}{m} = -\mu_k g$$

$$\Rightarrow a_x = -(0.20) \times (9.8m/s^2) = -1.96m/s^2$$

3.2 Compute bullet + block initial velocity (immediately after bullet hit)

$$(v_x)_f^2 = (v_x)_i^2 + 2a_x \Delta x$$

$$0 = (v_{b+w})^2 + 2(-1.96m/s^2)(4.0m)$$

$$\Rightarrow (v_{b+w}) = 3.96m/s$$

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Momentum problem 2

A 10 g bullet is fired into a 1.0 kg wood block, where it lodges. Subsequently, the block slides 4.0 m across a floor (μ_k = 0.20 for wood on wood). What was the bullet's speed?

3. *Use momentum conservation to find v_b knowing v_{b+w}*

Know:
$m_b = 10g = 0.010kg$
$m_w = 1.0kg$
$\mu_k = 0.20$
$x_f = 4.0m$
Find: v_{b+w} and v_b

3.3 Apply momentum conservation

$$p_i = p_f$$

$$m_b v_b + m_w v_w = (m_b + m_w)v_{b+w}$$

$$m_b v_b + 0 = (m_b + m_w)v_{b+w}$$

$$\Rightarrow v_b = \frac{(m_b + m_w)v_{b+w}}{m_b} = \frac{(0.01kg + 1.0kg)\ 3.96m/s}{0.01kg} = 400m/s$$

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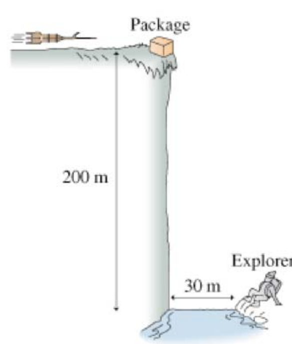
Homework problem 9.60



You are part of a search-and-rescue mission that has been called out to look for a lost explorer. You've found the missing explorer, but you're separated from him by a 200-m-high cliff and a 30-m-wide raging river. To save his life, you need to get a 5.0 kg package of emergency supplies across the river. Unfortunately, you can't throw the package hard enough to make it across. Fortunately, you happen to have a 1.0 kg rocket intended for launching flares. Improvising quickly, you attach a sharpened stick of negligible mass to the front of the rocket, so that it will impale itself into the package of supplies, then fire the rocket at ground level toward the supplies.
What minimum speed must the rocket have just before impact in order to save the explorer's life?

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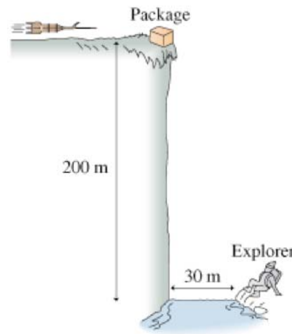
Homework problem 9.60

What minimum speed must the rocket have just before impact in order to save the explorer's life?



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Chapter 10
Energy and Work

Topics:

- Energy, what is it? What are the different forms of energy and how can energy be transformed or transferred?
- Work
- Kinetic, potential and thermal energy
- Law of conservation of energy
- Application to elastic collisions

Sample question:

Using just a fast run-up and flexible pole, how can a pole vaulter reach an astonishing 6 m (20 ft) off the ground?

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Different forms of energy

- What forms of energy do you know of?

- What do we mean by conservation of energy?

DEMO: energy toys, colliding masses

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