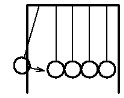
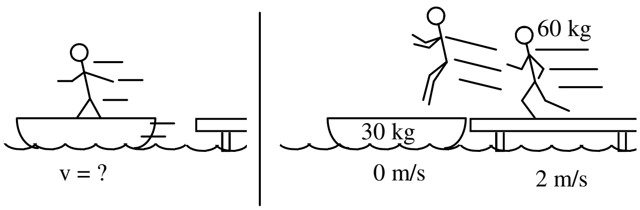
**Due Thurs, Dec 6**

# 2012 PreAP Momentum 4

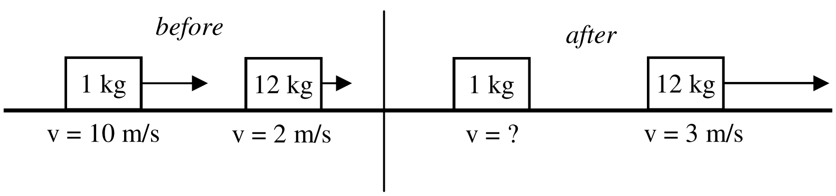
*With some Energy 11*



| Type of Collision | Momentum | Kinetic Energy | Objects Combine? | Example |
|---|---|---|---|---|
| Elastic | Conserved | Conserved ($\Sigma KE_B = \Sigma KE_A$) | No | Pool balls/ Newton's Cradle (see above) |
| Inelastic | Conserved | Not conserved | No | Bullet goes something, cars hit each other, there is damage. |
| Perfectly Inelastic | Conserved | Not conserved | Yes | Catching a ball; arrow sticks into a target |




1) Slim Jim is running 2m/s to the left and jumps into a boat.
   A. * How much momentum is there before?
   B. How much momentum does there have to be afterwards?
   C. What is the combined mass of Jim and the boat?
   D. * What kind of collision is this?
   E. * Under the diagram, write the conservation of momentum equation and solve for the final velocity.

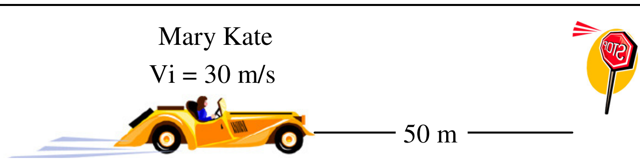



2) A 1 kg object moving 10 m/s to the right bumps into a 12 kg object moving 2 m/s to the right. Afterwards the 12 kg object is moving 3 m/s to the right.
   A. * Under the diagram, calculate the final velocity of the 1 kg object.

$\Sigma KE_{before}$ =

$\Sigma KE_{after}$ =

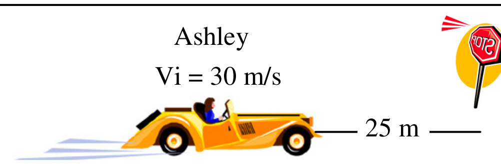
   B. * Calculate the total kinetic energy before and afterwards and decide what kind of collision it was from the chart at the top of the page.




$p_b$ =

$p_a$ =

$\Delta p$ =



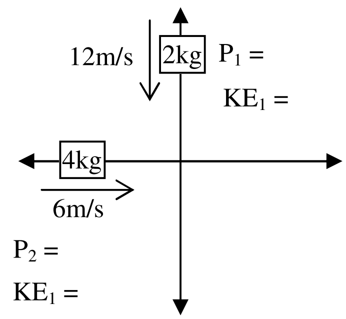

$p_b$ =

$p_a$ =

$\Delta p$ =

3) The Olsen Twins are driving identical 1,000 kg cars (*it's a twins thang*).
   A. Calculate and label the initial momentum of each.
   B. When they stop, what is their final momentum?
   C. * Calculate and label $\Delta p$ for each car.
   D. Which one had a bigger change of momentum?
   E. Which one took more time to stop?
   F. Which one needed a bigger force to stop?
   G. * Remembering that impulse (Ft) equals the change of momentum, which one had the bigger impulse?
   H. * Using a kinematic equation, find the time for Mary Kate to stop. (*Show your work or NO credit.*)

   I. * If Ashley's brakes apply 18,000 N of force in stopping, use conservation of momentum to calculate Ashley's stopping time. (*Show your work or NO credit.*)



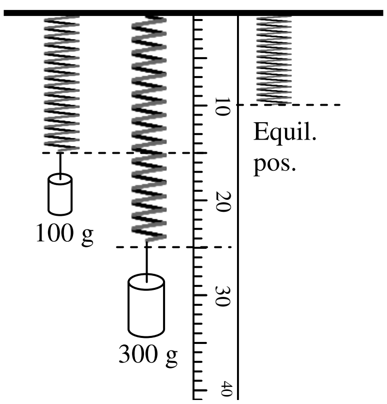

4) Imagine you are looking down on two moving masses, as shown.

A. * Calculate momentum 1 (the 2 kg object).
B. Calculate momentum 2.
C. Calculate the magnitude of the net momentum.

D. Sketch the direction of $p_{net}$ starting at the origin.
E. Just by looking at the numbers, what is the direction of the net momentum?

F. * Calculate the kinetic energy of the 2 kg object.
G. Calculate the kinetic energy of the 4 kg object.
(*Notice that the mass of one is doubled, but the velocity of the other is doubled and v is squared, so v matters more*.)
H. * Calculate the net kinetic energy of the two objects.

Energy 11, Q8—In the equation ½$kx^2$, x is the distance a spring stretches or compresses from its equilibrium position. The equilibrium position is the spring's relaxed position. Assume the picture shows different masses on the same spring. The ruler is a meter stick (it is 1 meter long).




A. * What is the equilibrium position for this spring?
B. * What is x for the 100g mass?
C. * Calculate the spring constant for the spring in N/m.

D. * Calculate the potential elastic energy of the 100g mass.

E. What is x for the 300g mass?
F. * Calculate the elastic energy of the 300g mass.
G. * $x_{300g}$ is ____ times as great as $x_{100g}$.
H. Divide part F by part C.

*Notice that x was tripled and PEel increased by a factor of 9.*
*You could see this in the equation. Since x is squared (½$kx^2$),*
*3 times the distance is 9 times the elastic energy.*

1A: −120 kgm/s (moving left) 1D: Perfectly inelastic: they combine afterwards. 1E: −1.33 m/s
2A: −2m/s 2B: $\Sigma KE_{before}$ = 74 J do the after 3C: −30,000 kgm/s (final minus initial) 3G: same
3H: -10 points for not showing how you get this answer. Find a kinematic equation, work it out. Don't just write the answer.
Answer: 3.33 sec 3I: Hint: $p_{before} - I = p_{after}$ 4A: −24 kgm/s (down or left is neg)
4F: 144 J 4H: 216 J (scalars)
E11Q8) A: 10 cm or 0.1 m; B: x = 0.05 m C: divide newtons by meters and get 20N/m
D: 0.25 J F: 0.225 J G: 3 times as great.