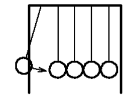
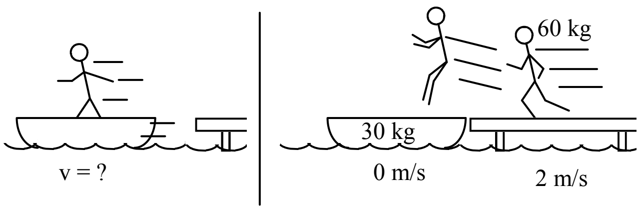
PreAP Momentum 4

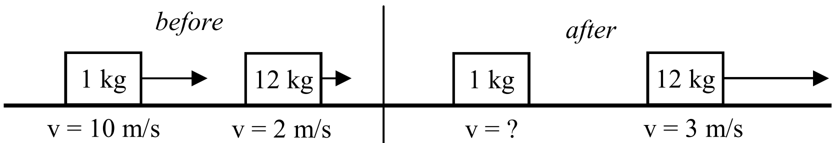
With some Energy 11



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 thru 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.

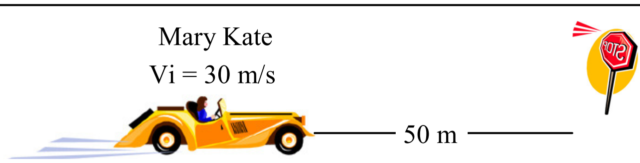


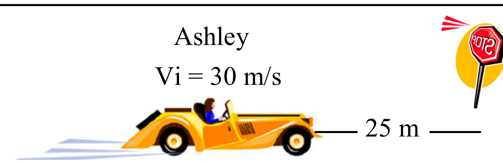
2) A 1 kg object moving 10 m/s to the right bumps into a 12 kg object moving 2 m/s to the right. Afterwards the 12 kg object is moving 3 m/s to the right.
   A. * Under the diagram, calculate the final velocity of the 1 kg object.

$\Sigma KE_{before} =$

$\Sigma KE_{after} =$

   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.



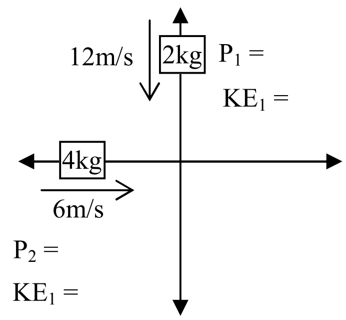


$p_b =$ $\qquad$ $p_a =$ $\qquad$ $p_b =$ $\qquad$ $p_a =$

$\Delta p =$ $\qquad$ $\Delta p =$

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 Δp 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.*)



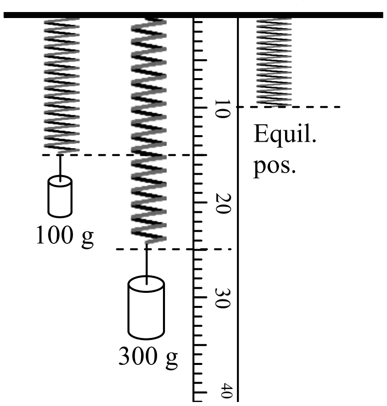
4) Imagine you are looking down on two moving masses, as shown.

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 ½kx^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 (½kx^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: ΣKE_{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: $p_{before} - J = p_{after}$ 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.