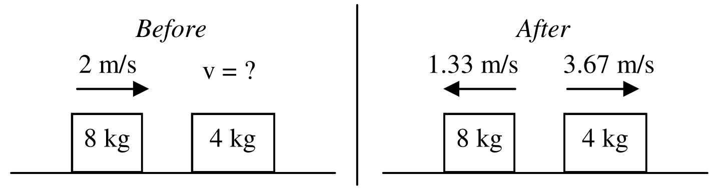
B-Day: Due Fri., Dec 10
A-Day: Due Mon., Dec 13

2010 PreAP Momentum 3

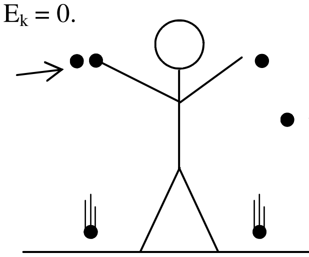
1. Two object collide as shown in the picture at the right.
   A. * Working under the diagram, calculate the initial velocity of the 4 kg object.
   B. What kind of collision could this not be?



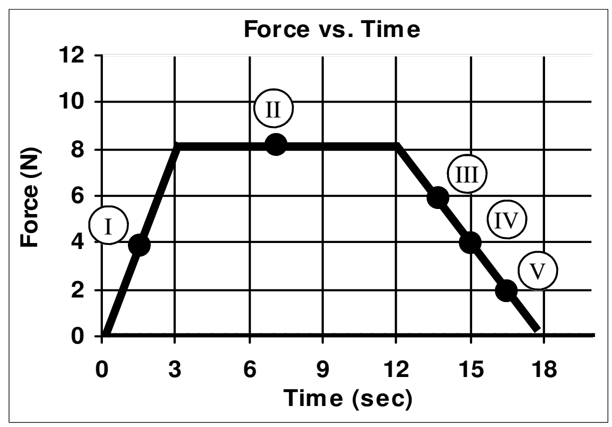
   C. Why?
   D. Calculate the net kinetic energy before:
   E. Calculate the net kinetic energy before:
   F. What kind of collision is this?
   G. Were the objects damaged in the collision?
   H. * How do you know?

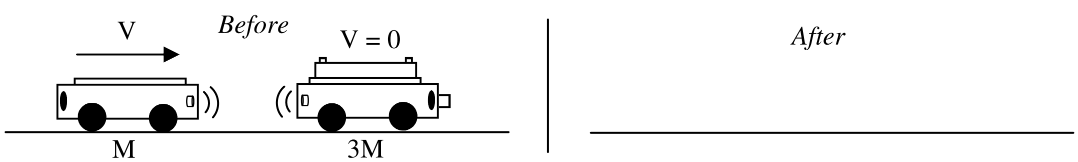
2. Given group of objects, are they moving or not moving?
   A) ____ * If $p_{net} = 0$, but $E_k \neq 0$. B) ____ If $p_{net} \neq 0$, but $E_k \neq 0$. C) ____ If $p_{net} = 0$, and $E_k = 0$.

3. Are the following elastic, inelastic, or perfectly inelastic? (*or some combination*)
   A) ____ The spaceshuttle docking with the International Space Station.
   B) ____ If an object is moving and it explodes into multiple pieces.
   C) ____ A superball bouncing off the ground (imagine it comes back to your hand).
   D) ____ Two cars collide, do not stick, and the cars are badly damaged.
   E) ____ * If there is a lot of sound during a collision.
   Slim Jim drops 2 balls. The arrow shows how high the ball bounces after it hits the ground.
   F) ____ The left ball. G) ____ The right ball.

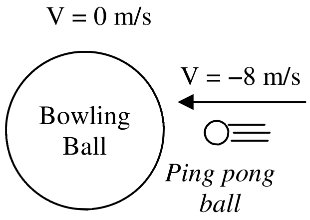


4. An object is at rest. The graph at the right shows the force acting on the object during 18 seconds.
   A. At I, is the force positive or negative?
   B. So, from 0 to 3 seconds, does it have a + or – acceleration?
   C. At II is the force positive or negative?
   D. From 3 to 12 seconds, does the object speed up or slow down?
   E. At III is the force positive or negative?
   F. Where on the graph is a negative force?
   G. Where does the object slow down?
   H. * Calculate the impulse from 3 to 12 seconds.





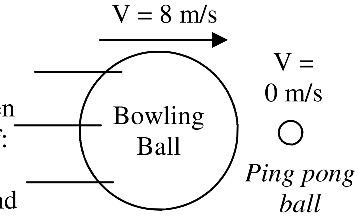
5. The following refers to the diagram above.
   A. Draw what happens after.
   B. How much momentum does the right cart have before the collision?
   C. How much net momentum is there before (*use variables*)?
   D. How much net momentum must there be afterwards?
   E. As the right cart gets heavier, what happens to the left cart?
   F. If the right cart were infinitely heavy (or held in place),
      I. What is the final velocity of the left cart?
      II. * Remembering that $\Delta v = v_f - v_i$, what is the change of velocity of the left cart?



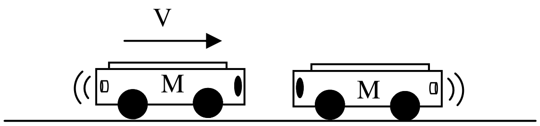
6. * A. The distance between the balls is closing at what speed?

   B. Afterwards the distance between them is increasing at a speed of:

   C. The balls Δv between before and after is:



7. If the ping pong ball is at rest and struck by the bowling ball going 8 m/s, what is the final speed of the ping pong ball?



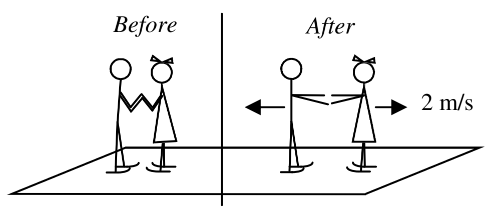
8. The two carts at the left collide and stick. Both have equal mass M. The left cart is moving at V and the right cart is at rest.
   A. * What is Σp_{before}?
   B. What does Σp_{after} have to be?
   C. Since the objects are combined after, what kind of collision is this?

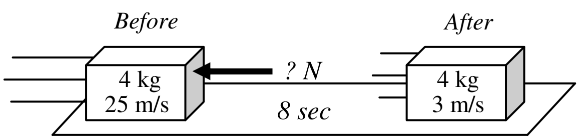
   D. What is the combined object's mass after the collision?
   E. Calculate the combined object's velocity.

9. Choose the Conservation of Momentum Equation at the left that matches the following situations. You will not use all of the equations.
   A. _______A person moving on a rolling chair throws a medicine ball.
   B. _______A car moving 15 m/s uses its brakes to slow down.
   C. _______A moving object stops.
   D. _______Pool balls collide and ricochet off each other.
   E. _______A car starts to move.
   F. _______A gun is fired.

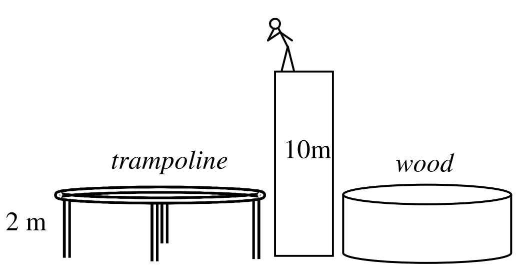
M. $p_{1B} + p_{2B} = p_{1A} + p_{2A}$
N. $p_B - I = p_A$
O. $p_{1+2B} = p_{1A} + p_{2A}$
P. $0 = p_{1A} + p_{2A}$
Q. $p_B - I = 0$
R. $p_B + I = p_A$
S. $p_{1B} + p_{2B} = p_{1+2A}$
T. $0 + I = p_A$
U. $p_{1B} + p_{2B} = 0$

10. Slim Jim and Kim go ice skating. Standing amorously on the ice, they push off from each other. Jim is 60 kg and Kim is 40 kg. If Kim ends up moving to the right at 2 m/s. How fast is Jim moving?

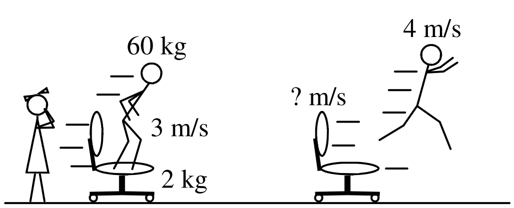




11. A 4 kg object moving 25 m/s slows down for 8 seconds to 3 m/s. * Calculate the force.



12. Slim Jim is choosing to jump onto a trampoline or a wood block.
    A. In which case will he have the most momentum before hitting?
    B. In which case will feel the most force?
    C. In which case will he take more time to stop?
    D. In which case will he feel the greatest impulse?
    E. Jim jumps from 10 m. How fast is Jim moving when he lands on the 2 m tall trampoline? (*Good choice, Jim!)*



13. Much to Kim's horror, Slim Jim tries to impress her. Since she knows he is a very poor skate boarder, he chooses to jump from a 2 kg rolling chair, instead. Calculate the final velocity of the chair.

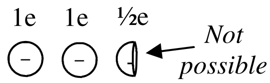
Electric Charge The unit of charge is a fundamental quantity.

Electron Charge

$1\,electron = -1.602\times10^{-19}\,C$

The charge of a proton is the same as an electron, only positive:
1 proton = +1.602×10^{-19}C.

The smallest units of charge are the proton and the electron. You cannot have part of an electron, because it would lose its negative charge. Therefore, you cannot have less than -1.602×10^{-19}C of charge and any amount of charge must be multiples of this number. You can have 12 or 13 electrons, but not 12.2 or 12.5 electrons!



Electric charge is quantized, meaning the amount of charge must always be in multiples of e. You can never have part of an electron.

Ex: What is the charge of an object that gains 1.2 x 10^{8} electrons?

Do a conversion:

$$\left(\frac{1.2\times10^{8}\,e}{1}\right)\left(\frac{-1.602\times10^{-19}\,C}{1e}\right)=-1.92\times10^{-11}\,C$$

Ex: How many electrons are gained or lost if an object has a charge of 4.6μC (microcoloumbs)?

$$\left(\frac{4.6\times10^{-6}\,C}{1}\right)\left(\frac{1e}{-1.602\times10^{-19}\,C}\right)=-2.87\times10^{-13}\,e$$

The negative means it lost e's (+ object).

Getting ahead…

14. * What is the charge of 15 electrons?

15. * Given the charge of 1.12×10^{-18} coulombs. How many electrons were gained or lost?

16. What is the charge of 8 electrons?

17. An object has a charge of -1.92×10^{-18}C. How many electrons are gained or lost?

18. Why can't you have the charge of 1.5 electrons?

Q1A: −3 m/s Q1H: Hint: damage has to come from energy.
Q2A: p_{net} can be neg, but not KE: the objects are moving, since KE ≠ 0. p_{net} = 0, they are moving opp. directions and p's cancel
Q3E: again, sound comes from energy. Lots of sound = lost KE, so inelastic.
Q4H: Calculate the area from 3—12 seconds = 8 N(9sec) = 72 Nsec = 72 kgm/s
Q5FII: −2V
Q6: A. −8 m/s. 6B: 8 m/s 6C: 16 m/s (or 2V) The point (and big hint for Q7): This is relative motion: beforehand the distance between the objects gets smaller at a speed of V. Afterwards the distance between them expands at a speed of V. So the difference is 2V. This is the same as in Q5 when the right cart is infinitely bigger than the left cart.
Q8A: MV Q11: F = −11N (this is why it is best to just put +I and not −I or you'll have to add the neg yourself)

Q14: -2.403×10^{-18} C remember to use the "EE" key.

Q15: 7 electrons lost. Remember objects are + because the LOST electrons.

