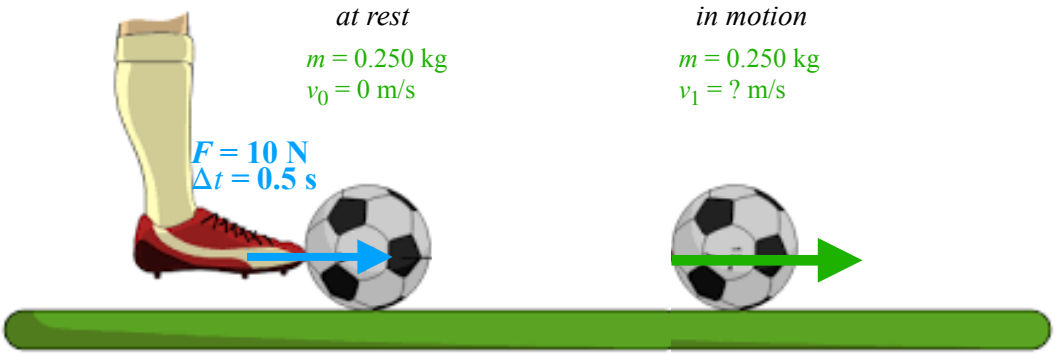
Ch. 6 HW Momentum

Extra Credit Option: Each student may obtain up to +5 points extra credit from this HW set to be added towards Exam II. (see Syllabus "Extra Credit' for details)

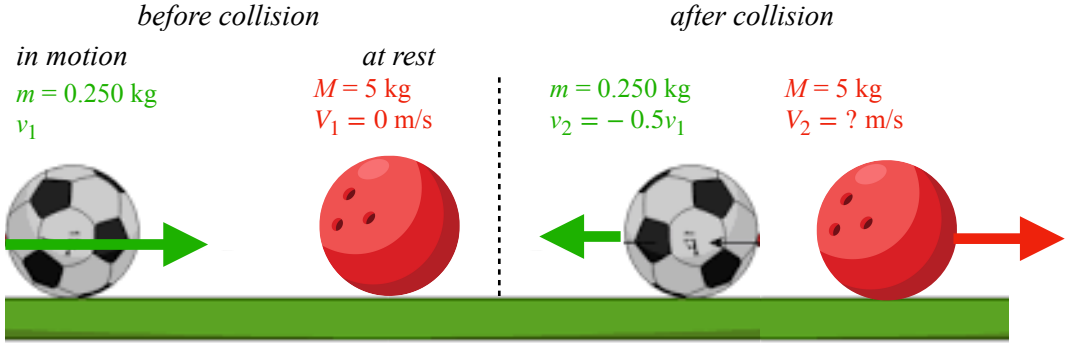
1) **(20 pts)** A soccer ball of mass $m = 0.250$ kg initially at *rest* gets kicked with a force of $F = 10$ N for a brief period of time, $\Delta t = 0.5$ sec.



a) **(5 pts)** calculate the *impulse* of the kick to get the ball from *rest* into *motion*

b) **(5 pts)** calculate the final speed v_1 of the ball *in motion*

c) **(10 pts)** the soccer ball *in motion* with the speed (v_1) determined in the previous part *collides* with a 5-kg bowling ball at *rest* and after the collision the soccer ball bounces back with half as much speed (choose + x to the right), calculate the final speed (V_2) of the bowling ball as it moves forward

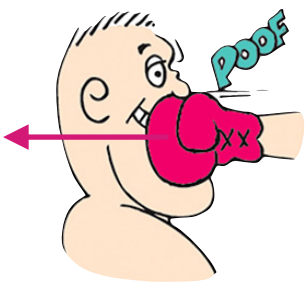


2) **(5 pts)** A boxer gets punched in two different scenarios:
i) he moves backwards, maximizing the time of impact to $\Delta t = 2$ sec.
ii) he leans forward, minimizing the time of impact to $\Delta t = 0.5$ sec.
In both cases, the *change in momentum* of the punch is 20 kg·m/s at the moment of impact. Calculate the *force* of impact of the punch for each case.

i)

$\Delta(mv) = 20$ kg·m/s
$\Delta t = 2$ s

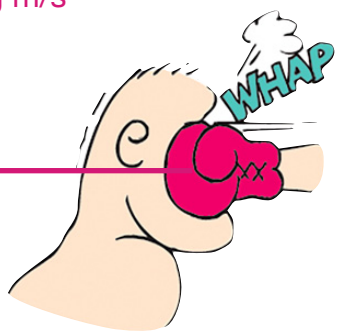
$F_1 = ?$



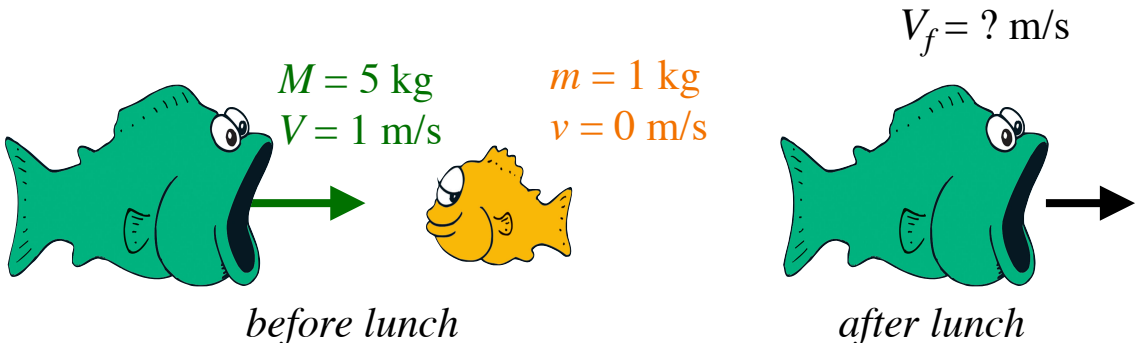
ii)

$\Delta(mv) = 20$·kg m/s
$\Delta t = 0.5$ s

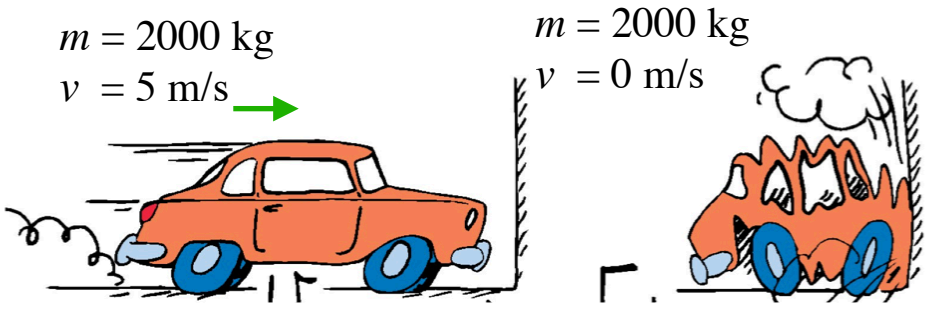
$F_2 = ?$



3) **(5 pts)** A fish swims towards and swallows a smaller fish *at rest*. If the larger fish has a mass of $M = 5$ kg and swims at $V = 1$ m/s toward the smaller 1-kg fish, what is the speed of the larger fish *immediately after lunch*?



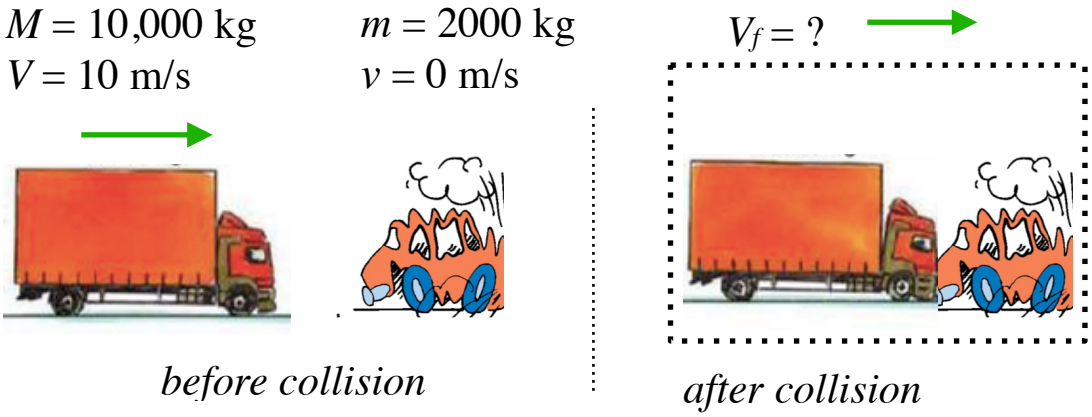
4) **(20 pts)** A vehicle of mass $m = 2000$ kg moving at a speed of $v = 5$ m/s collides with a wall for a brief period of time $\Delta t = 1$ s before coming to a halt



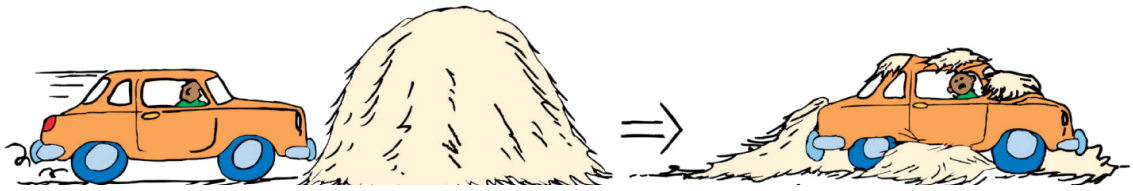
a) **(5 pts)** calculate the *change in momentum* of the vehicle

b) **(5 pts)** calculate the *force* of impact during the collision

c) **(10 pts)** if an incoming truck of mass $M = 10{,}000$ kg moving at speed $V = 10$ m/s collides with the *stationary* car and both continue to move together, calculate the final speed of the (*car+truck*) system



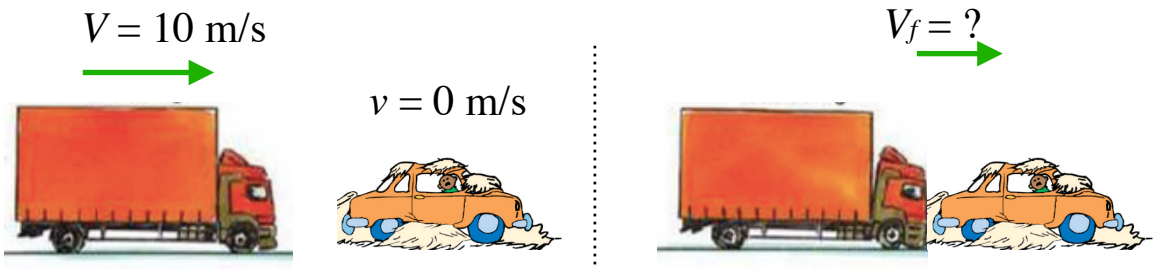
5) **(20 pts)** A vehicle of mass $m = 2000$ kg moving at a speed of $v = 5$ m/s collides with a haystack for a period of time $t = 20$ s before coming to a halt



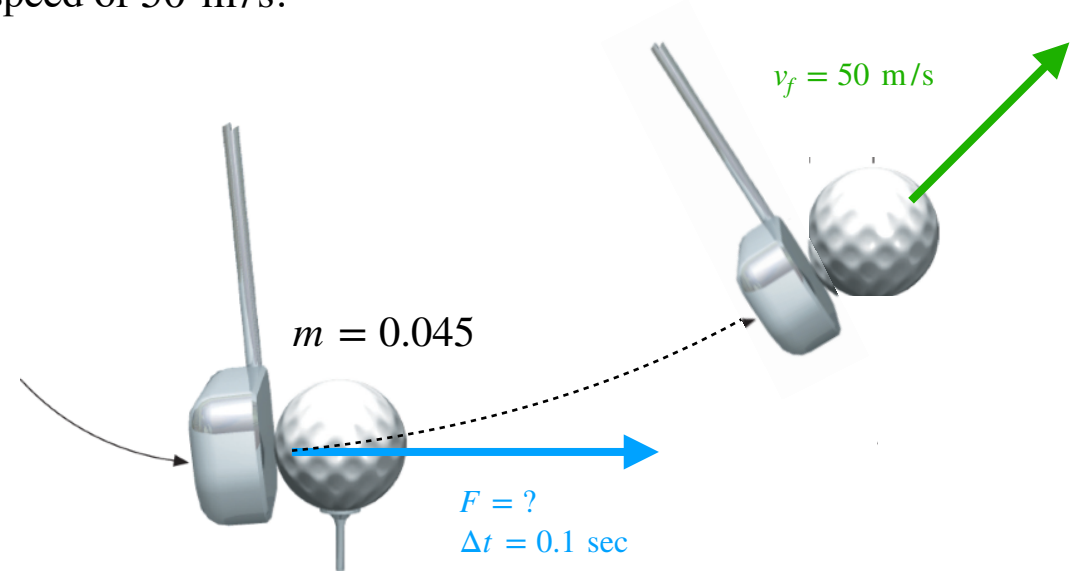
a) **(5 pts)** calculate the *change in momentum* of the vehicle

b) **(5 pts)** calculate the *force* of impact during the collision

c) **(10 pts)** if an incoming truck of mass $M = 10{,}000$ kg moving at speed $V = 10$ m/s collides with the *stationary* car and both continue to move together, find the final speed of the (car+truck) system



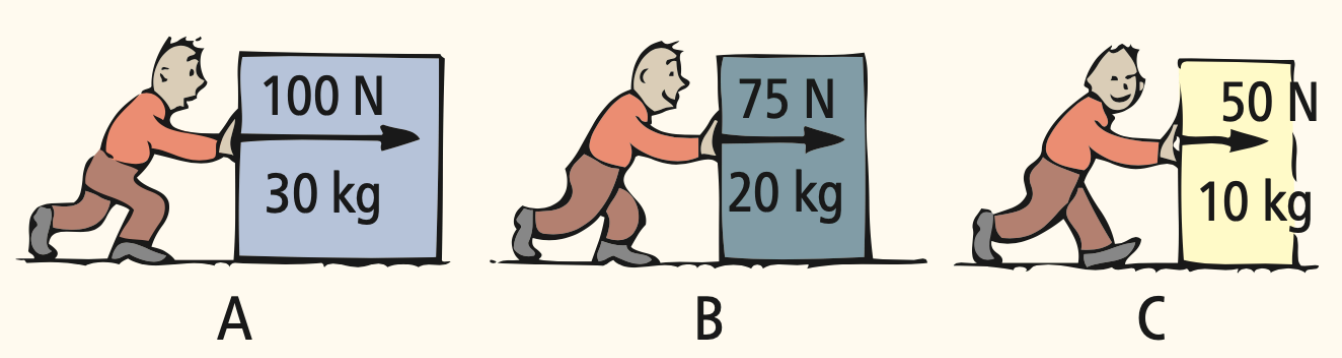
6) **(10 pts)** A golf ball of mass $m = 0.05$ kg initially at *rest* gets hit with a force of F for a brief period of time, $\Delta t = 0.1$ sec, and causes the golf ball to gain a speed of 50 m/s.



a) **(5 pts)** Calculate the *change in momentum* of the golf ball

b) **(5 pts)** Calculate what the *force of impact* applied to the golf ball

7) **(20 pts)** Jake pushes crates starting from *rest* across his classroom floor for 3 seconds with a net force as shown. For each crate (A, B and C), calculate the following and rank the following from greatest to least



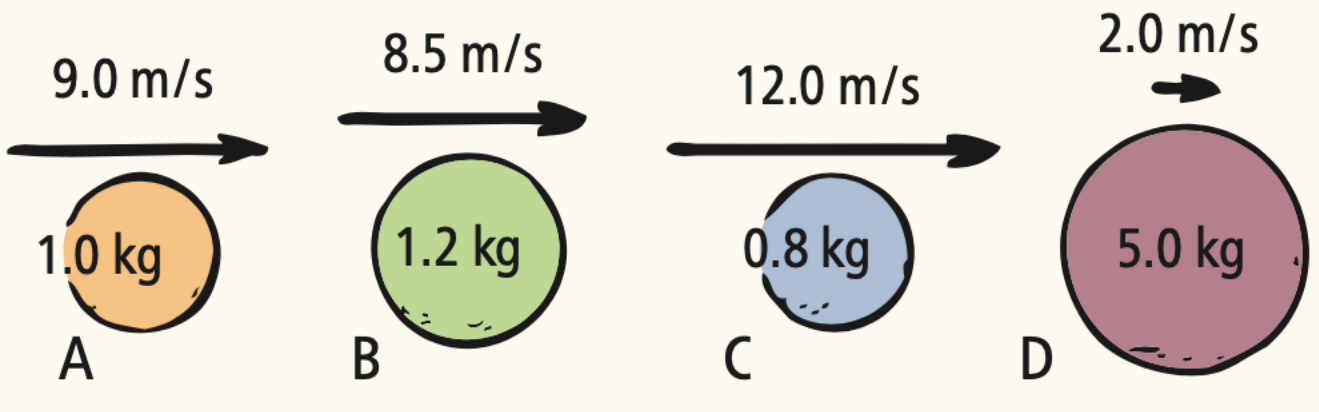
(a) **(5 pts)** *Impulse* delivered

(b) **(5 pts)** *change* in momentum

(c) **(5 pts)** Final speed

(d) **(5 pts)** Momentum in 3 seconds

8) **(10 pts)** Each ball has different masses and speeds. Calculate the following and rank them from greatest to least.



(a) **(5 pts)** Momentum

(b) **(5 pts)** The impulses needed to *stop* the balls (*Hint*: think of change in speed)