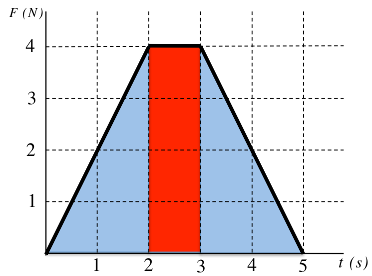
Problem 9.15

A 2.50 kg mass feels a force in the *x-direction* modeled by the graphed to the right.



a.) What is the *impulse* over the 5.00 seconds interval?

As stated in the previous problem, the impulse is just the area under the *Force versus time* graph. That quantity in this case is:

$$\vec{I} = \left[\frac{1}{2}(2.00\text{ s})(4.00\text{ N}) + (1.00\text{ s})(4.00\text{ N}) + \frac{1}{2}(2.00\text{ s})(4.00\text{ N})\right]\hat{i}$$

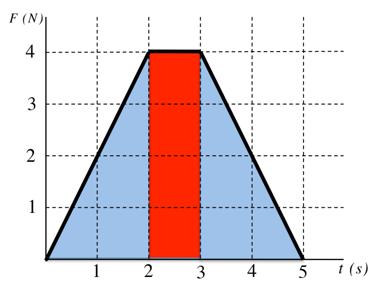
$$= (12.0\text{ N}\bullet\text{s})\hat{i}$$

b.) Assuming it starts from rest, what is the mass's final velocity?

This is the only thing about this problem that is interesting (you did all of the other operations in the previous problem).

1.)

Using the *impulse relationship,* we can write:



$$I_x = F_{avg,x}\Delta t = \Delta p_x$$

$$\Rightarrow \quad I = mv_{2,x} - \cancelto{0}{mv_{1,x}}$$

$$\Rightarrow \quad (12.0\text{ N}\bullet\text{s}) = (2.50\text{ kg})v_{2,x}$$

$$\Rightarrow \quad v_{2,x} = 4.80\text{ m/s}$$

c.) Assuming the mass starts with velocity $\vec{v}_{1,x} = (-2.00\text{ m/s})\hat{i}$, what is its final velocity?

From above, in the x-direction (eliminating the need to reproducing the $\hat{i}$):

$$I_x = F_{avg,x}\Delta t = \Delta p_x$$

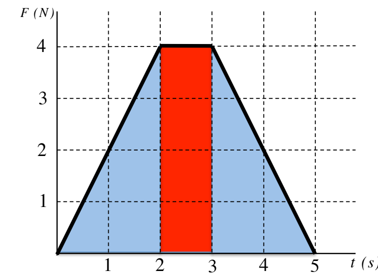
$$\Rightarrow \quad I = mv_{2,x} - mv_{1,x}$$

$$\Rightarrow \quad (12.0\text{ N}\bullet\text{s}) = (2.50\text{ kg})v_{2,x} - (2.50\text{ kg})(-2.00\text{ m/s})$$

$$\Rightarrow \quad v_{2,x} = 2.80\text{ m/s}$$

2.)

d.) Determine the average force acting over the 5.00 second period.



$$I_x = F_{avg,x}\Delta t$$

$$\Rightarrow \quad F_{avg,x} = \frac{I_x}{\Delta t}$$

$$\Rightarrow \quad F_{avg,x} = \frac{(12.0\text{ N}\bullet\text{s})}{(5.00\text{ s})}$$

$$= 2.40\text{ N} \qquad \text{(this is in the } \hat{i} \text{ direction)}$$

3.)