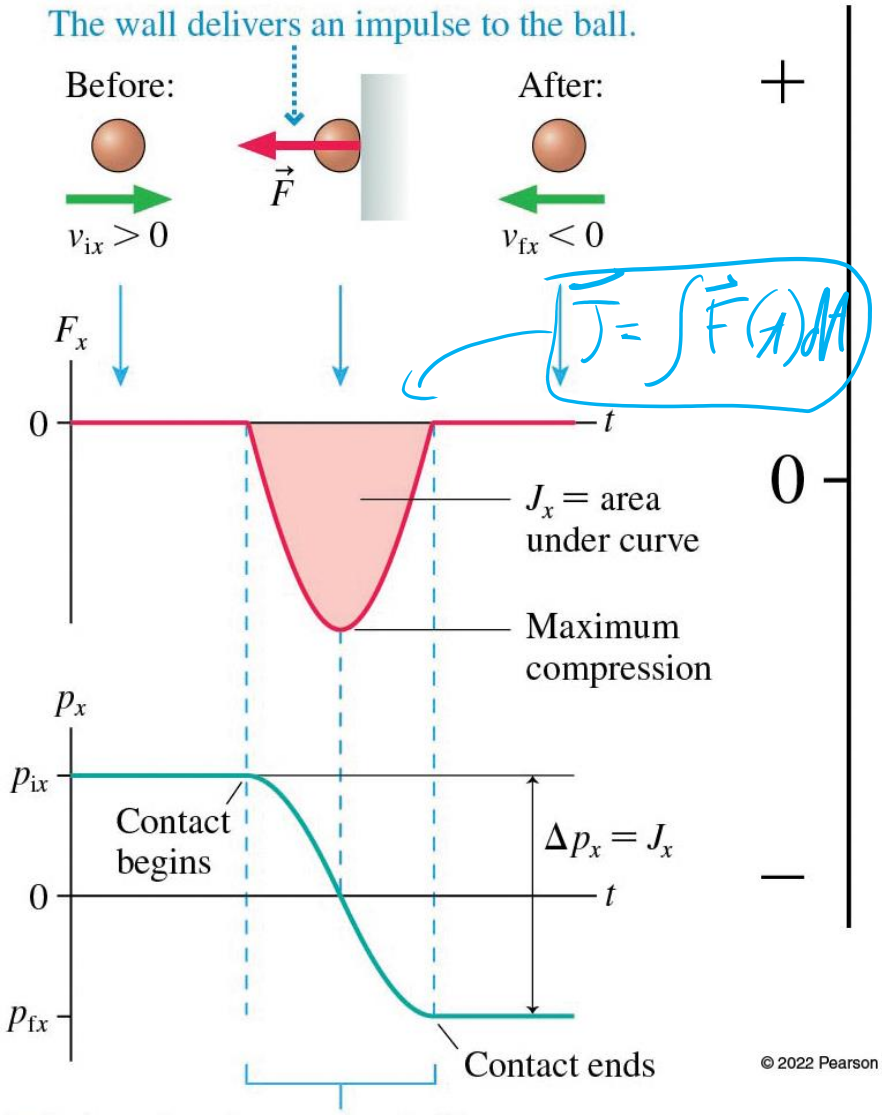
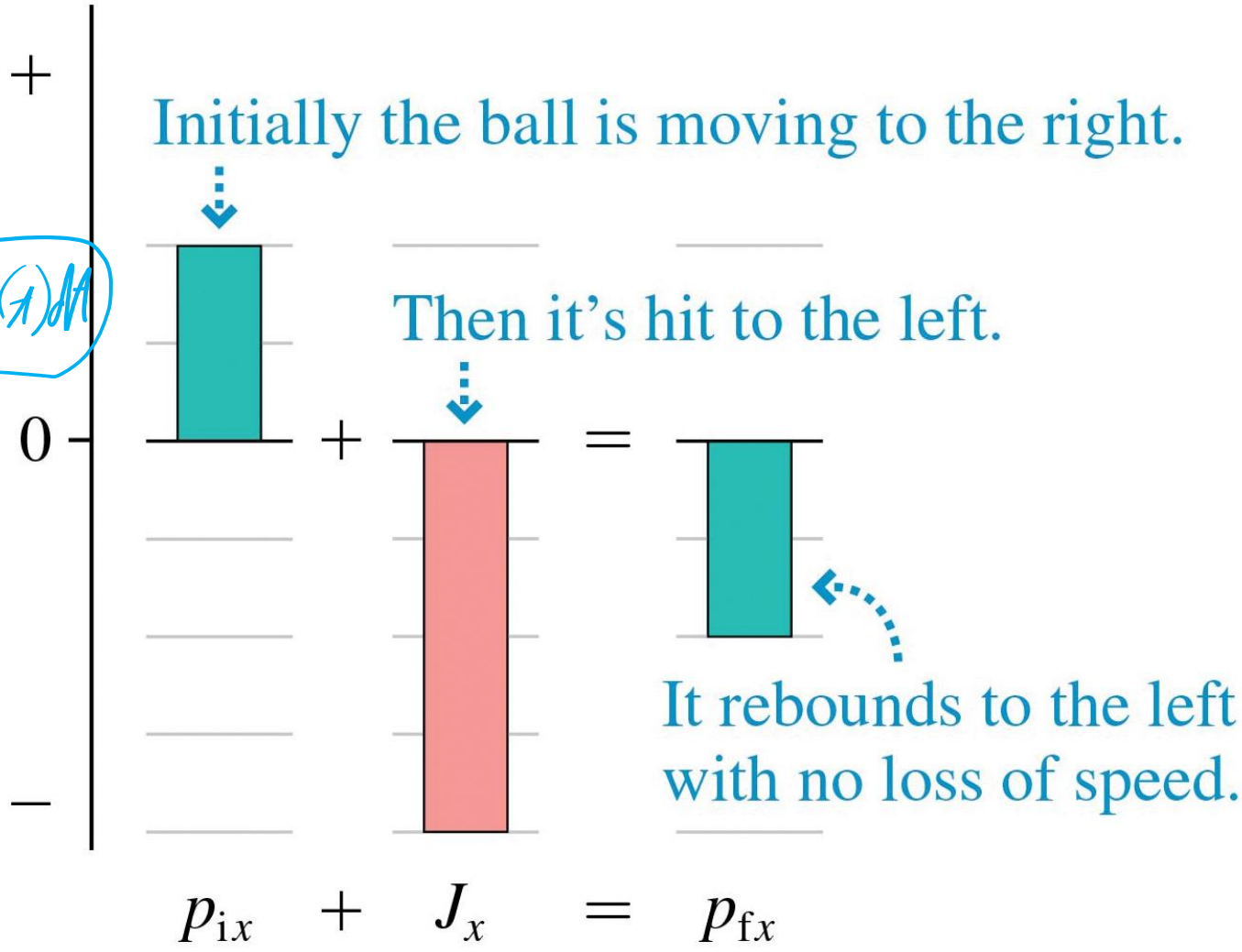
Why are seat belts firm instead of stretchy?

Chapter 11 – Impulse and Momentum

- Momentum, impulse $\vec{p} = m\vec{v}$ $\vec{J} = \Delta\vec{p}$
- When is momentum conserved?
- Collisions and explosions
- Rockets



$\vec{J} = \int \vec{F}(t)\,dt$



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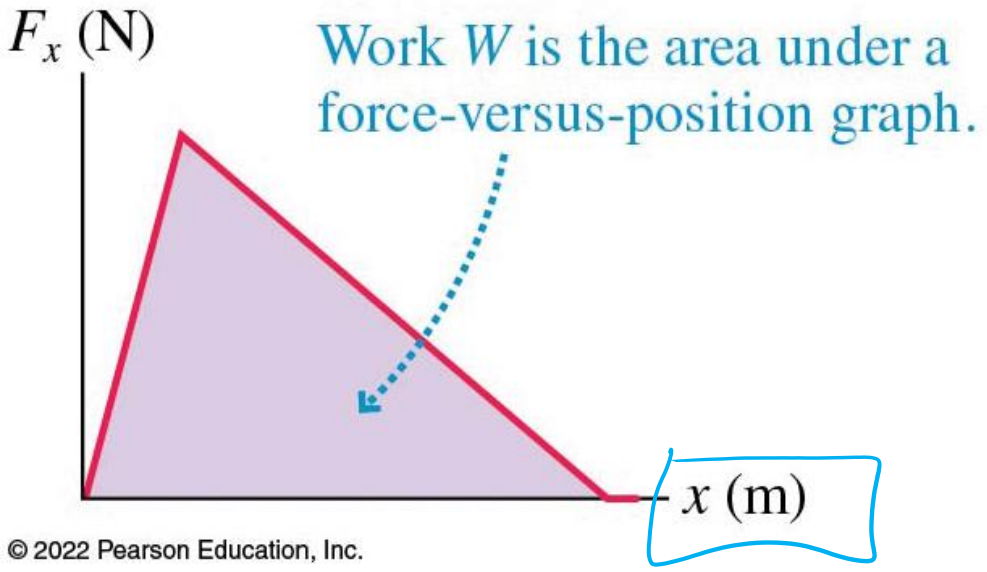
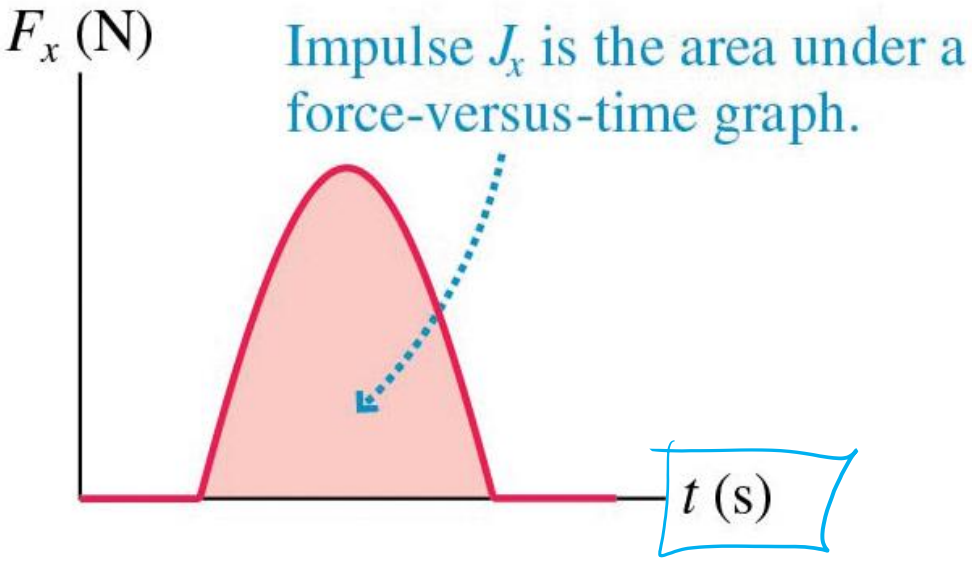
Work versus Impulse



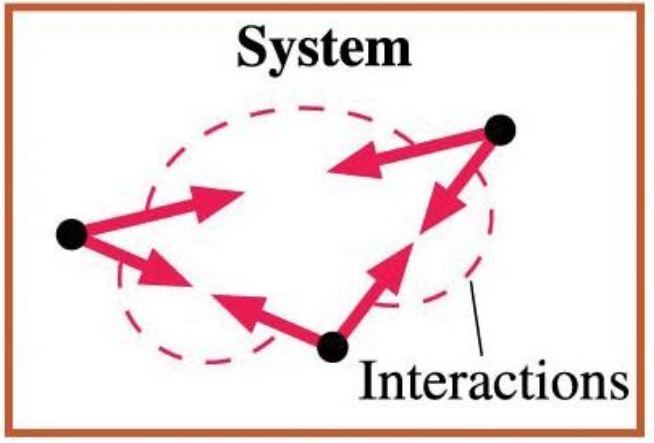
$$W = \int \vec{F}_{ext} \cdot d\vec{x}$$



$$\vec{J} = \int \vec{F}_{ext}\, dt = \Delta \vec{p}$$

Is momentum conserved?

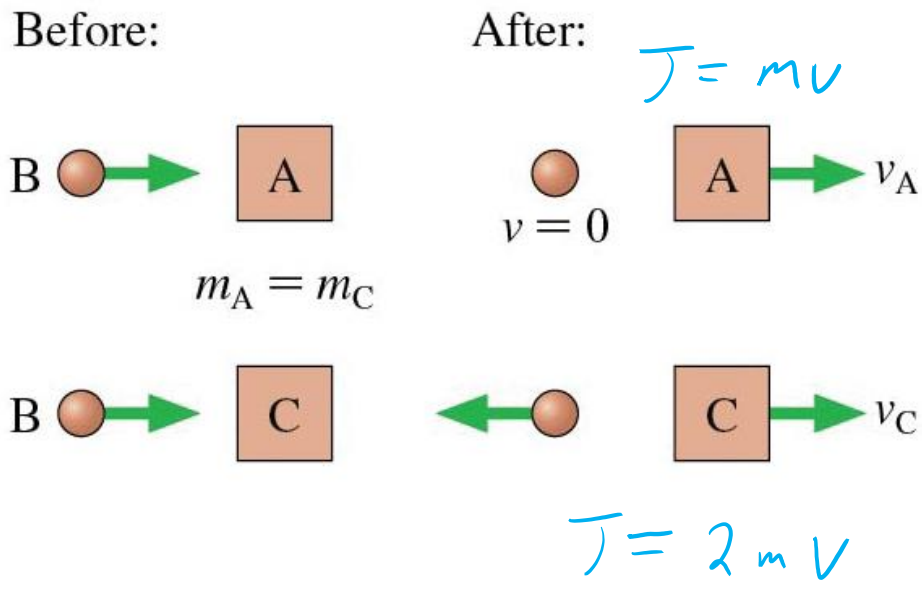
The total momentum of an **isolated system** is conserved. The particles of an isolated system interact with each other but not with the environment. Regardless of how intense the interactions are, **the final momentum equals the initial momentum**.



« **LOOKING BACK** Section 10.4 Energy conservation

Team Up Questions

STOP TO THINK 11.3 Objects A and C are made of different materials, with different "springiness," but they have the same mass and are initially at rest. When ball B collides with object A, the ball ends up at rest. When ball B is thrown with the same speed and collides with object C, the ball rebounds to the left. Compare the speeds of A and C after the collisions. Is v_A greater than, equal to, or less than v_C?



$J = mv$

$J = 2mv$

C: $J = \Delta p = p_f - p_i$

$= \leftarrow - \rightarrow$

$= \leftarrow$

Team Up Questions

Wood cart (1 kg) versus metal cart (4 kg)

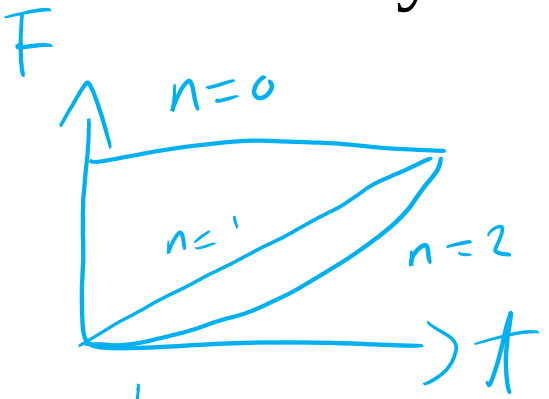
② $\int F\,dt$ = same

③ $\int F\,dx$ = same

$$K = \frac{1}{2}mv^2 = \frac{p^2}{2m}$$

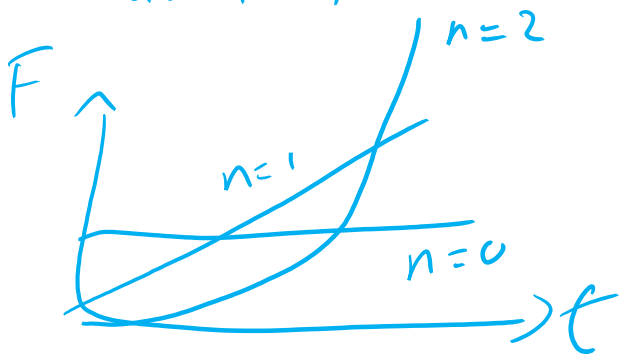
We want minimum F_{max}

Why are seat belts firm instead of stretchy?



bad

areas ≠ each other



$\vec{F}(t) = \vec{A}t^n$ A is unknown (so eliminate)

$\vec{J} = \text{constant} = 0 - \vec{p}_i = -m\vec{v}_i$

$\vec{J} = \int \vec{F}(t)\,dt = \int_0^T \vec{A}t^n\,dt = \vec{A}\frac{1}{n+1}T^{n+1}$

$\vec{J} = (\vec{A}T^n)\frac{T}{n+1} = (\vec{F}_{max})\frac{T}{n+1}$

$F(T) = F_{max}$

$\vec{F}_{max} = \frac{-m\vec{v}_i}{T}(n+1)$

n=0 is best!