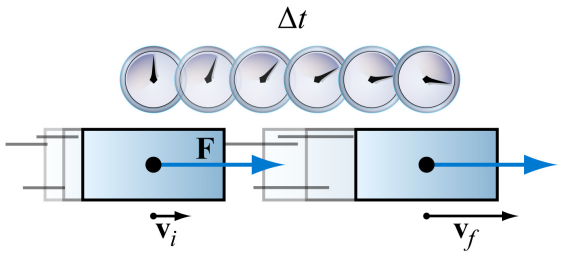
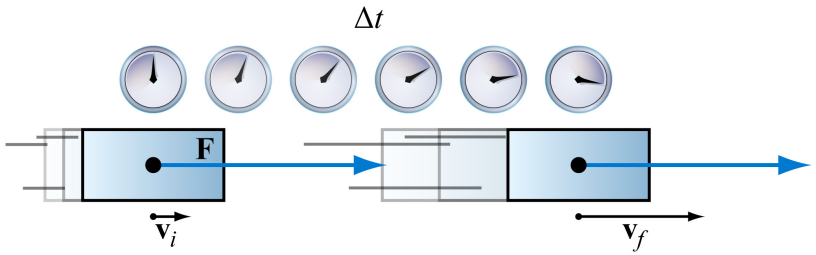
A force can deliver an impulse that contributes to a change in $m\vec{\mathbf{v}}$

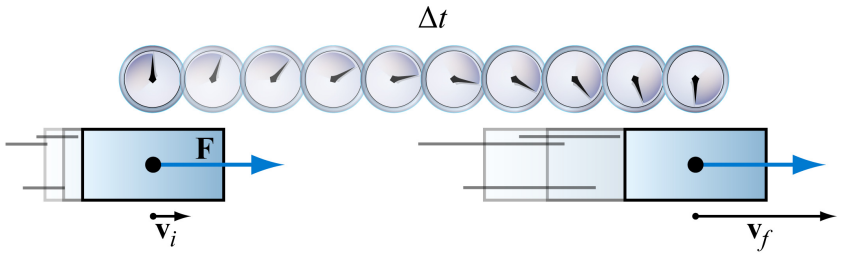
How much can I change the $m\vec{\mathbf{v}}$ of an object by applying a constant force during some interval of time?



change in $m\vec{\mathbf{v}}$



$\uparrow F \Rightarrow \uparrow$ change in $m\vec{\mathbf{v}}$



$\uparrow \Delta t \Rightarrow \uparrow$ change in $m\vec{\mathbf{v}}$

$$\text{Momentum} = \vec{\mathbf{p}} := m\vec{\mathbf{v}}$$

$$\text{Impulse delivered} = (\text{forcefulness})(\text{duration of contact}) = \text{change in momentum}$$

$$\text{Impulse delivered by a force} = \Delta\vec{\mathbf{J}}_{\mathrm{F}} := \vec{\mathbf{F}}\Delta t = \Delta\vec{\mathbf{p}}$$

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Impulse delivered by a varying force

Consider the impulse delivered by a one-dimensional force of varying strength. Allow increments of time to be short enough so that, for each increment, the force is roughly constant.

$$\Delta J_{\mathrm{F},i} \approx F_i \Delta t$$

The total impulse delivered during a finite interval of time

$$\Delta J_{\mathrm{F}} \approx \sum_i F_i \Delta t$$

is the signed area “under” the plot of F vs. t.