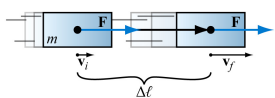
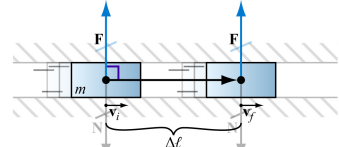
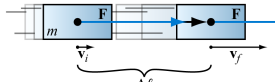
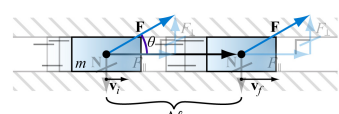
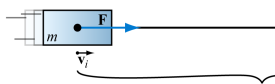
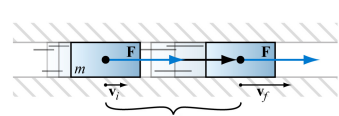
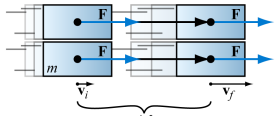


# A net force can perform work that contributes to a change in $\frac{1}{2}mv^2$

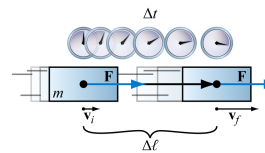
How much can I change the  $v^2$  of an object of mass  $m$  by applying a constant force while the object moves through a path length?

 <p style="text-align: center;"><math>\Delta(v^2) \neq 0</math></p>	 <p style="text-align: center;"><math>\perp \Rightarrow \Delta(v^2) = 0</math></p>
 <p style="text-align: center;"><math>\uparrow  \vec{F}  \Rightarrow \uparrow  \Delta(v^2) </math></p>	 <p style="text-align: center;">oblique <math>\Rightarrow</math> some <math> \Delta(v^2) </math></p>
 <p style="text-align: center;"><math>\uparrow \Delta\ell \Rightarrow \uparrow  \Delta(v^2) </math></p>	 <p style="text-align: center;"><math>\parallel \Rightarrow \max  \Delta(v^2) </math></p>
 <p style="text-align: center;"><math>\uparrow  \Sigma \vec{F}  \Leftarrow \uparrow m</math></p>	

Deduced **relationship**

$$\begin{aligned}
 \underbrace{(\Sigma F \cos \theta)}_{\Sigma F_{\parallel}} \Delta\ell &= \frac{1}{2} m \Delta(v^2) \\
 &= \frac{1}{2} m (v_f^2 - v_i^2) \\
 &= \frac{1}{2} m v_f^2 - \frac{1}{2} m v_i^2 \\
 &= \Delta \left( \frac{1}{2} m v^2 \right)
 \end{aligned}$$

**Vocabulary**



Kinetic energy

$$K := \frac{1}{2} m v^2$$

Work delivered by a force

$$\Delta W_F := \underbrace{(F \cos \theta)}_{F_{\parallel}} \Delta\ell$$

Power delivered by a force

$$P_{F,AVG} := \frac{\Delta W_F}{\Delta t}$$

**Work-energy theorem**

$$K_i + \overbrace{\sum_F \Delta W_F}^{\Delta W_{\Sigma \vec{F}}} = K_f$$

(for an object having no accessible internal degrees of freedom)

# A net force can perform work that contributes to a change in $\frac{1}{2}mv^2$

## Work done by a varying force

Consider the work performed by a force of varying strength. Allow increments of path length to be small enough so that, for each increment, the force is roughly constant.

$$\Delta W_{F,i} \approx F_{\parallel,i} \Delta \ell$$

The total work done along a path of finite length

$$\Delta W_F \approx \sum_i F_{\parallel,i} \Delta \ell$$

is the signed area “under” the plot of  $F_{\parallel}$  vs.  $\ell$

