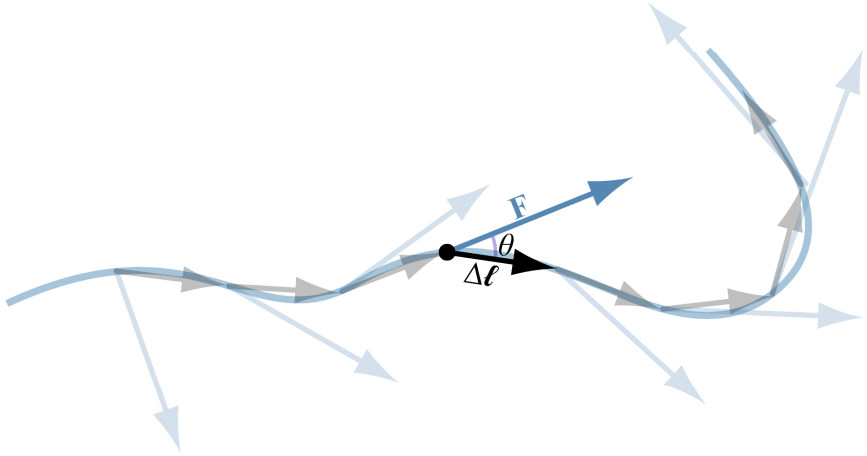
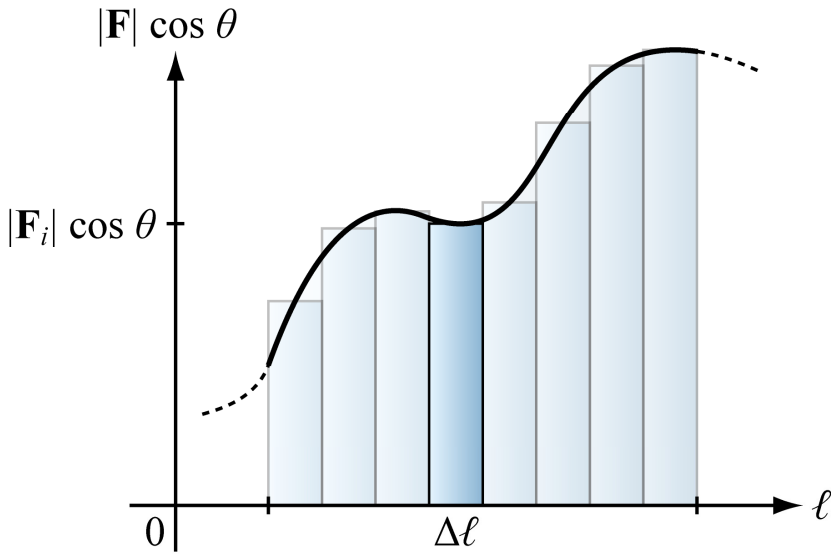
Work performed along a path





$$\Delta W = \vec{\mathbf{F}} \cdot \Delta\vec{\boldsymbol{\ell}}$$

$$\Delta W = \left(\left|\vec{\mathbf{F}}\right| \cos\theta\right) \Delta\ell$$

$$\Delta W_i = \left(\left|\vec{\mathbf{F}}_i\right| \cos\theta\right) \Delta\ell$$

$$\Delta W = \sum_{i=1}^{N} \left(\left|\vec{\mathbf{F}}_i\right| \cos\theta\right) \Delta\ell$$

$$\Delta W = \int_{\vec{\mathbf{r}}=\vec{\mathbf{r}}_i}^{\vec{\mathbf{r}}=\vec{\mathbf{r}}_f} \left(\left|\vec{\mathbf{F}}\right| \cos\theta\right) \mathrm{d}\ell$$

$$\Delta W = \int_{\vec{\mathbf{r}}=\vec{\mathbf{r}}_i}^{\vec{\mathbf{r}}=\vec{\mathbf{r}}_f} \vec{\mathbf{F}} \cdot \mathrm{d}\vec{\boldsymbol{\ell}}$$

Steps for calculating work done on paths

1. Draw path
2. Indicate a representative position.
3. Draw a representative small displacement from that position.
4. Draw force vector applied at the representative position.
5. Obtain an expression for $\vec{\mathbf{F}}$
6. Obtain an expression for $\mathrm{d}\vec{\boldsymbol{\ell}}$
7. Calculate $\vec{\mathbf{F}} \cdot \mathrm{d}\vec{\boldsymbol{\ell}}$
8. Integrate the resulting expression.