

$$\begin{aligned}
\int_a^b \frac{du}{dx}(x) \frac{dv}{dx}(x) \, dx &= \left[\frac{du}{dx}(x) v(x) \right]_a^b - \int_a^b \frac{d^2u}{dx^2}(x) v(x) \, dx \\
&= \underbrace{\frac{du}{dx}(b)v(b) - \frac{du}{dx}(a)v(a)}_{=0 \text{ because } v(a)=v(b)=0} - \int_a^b \frac{d^2u}{dx^2}(x) v(x) \, dx \\
&= - \int_a^b \frac{d^2u}{dx^2}(x) v(x) \, dx.
\end{aligned}$$