**Work** = amount of energy generated by a process.

\[ W = F \cdot \Delta x \]

\[ J = N \cdot m \]

\[ 4 \, N = 1 \, m/s^2 \cdot kg \]

work to lift 100kg elevator

\[ h = 5 \, m \]

\[ m = 100 \, kg \]

\[ F_{\text{gravity}} = -g \cdot m \]

\[ = -9.8 \cdot 100 \]

\[ = -980 \, N \]

\[ W = 980 \cdot 5 = 4900 \, J \]

\[ W_{\text{gravity}} = -4900 \, J \]

**Variable force**

\[ W = \int F(x) \, dx \]

**Hooke's Law**

\[ F_{\text{spring}} = -k \cdot x \]

How much work do you do to compress it by 1m?

\[ W = F \cdot \Delta x \]

Total work:

\[ = \int K \cdot x \, dx \]

\[ = \left[ \frac{1}{2} K \frac{x^2}{2} \right]_{0}^{1} \]

\[ = \frac{1}{2} K \]

\[ F(i) = -5 \, N \]

\[ -5 = -k \cdot 1 \]

\[ k = 5 \, N/m \]

\[ \therefore W = \frac{1}{2} \cdot 5 = 2.5 \, J \]
**Gravity in space**

\[ W = \int_a^b F(x) \, dx \]

\[ F_{\text{gravity}} = -\frac{G M m}{x^2} \]

**Piston with gas**

\[ F_{\text{gas}}(x) = K \cdot x^{-\gamma} \]

\[ W_{\text{piston by gas}} = \int_a^b F(x) \, dx = \int_a^b K \cdot x^{-\gamma} \, dx \]

\[ = \left[ \frac{K}{\gamma + 1} \cdot x^{1-\gamma} \right]_a^b = \frac{K}{\gamma + 1} \left( b^{1-\gamma} - a^{1-\gamma} \right) \]