$$\vec{F} = m\vec{a}$$

$$\int_{t_1}^{t_2} \vec{F}\,dt = \int_{t_1}^{t_2} m\vec{a}\,dt$$

$$\int_{t_1}^{t_2} \vec{F}\,dt = m\int_{t_1}^{t_2} \vec{a}\,dt$$

$$\int_{t_1}^{t_2} \vec{F}\,dt = m(\vec{v}_2 - \vec{v}_1)$$

$$\int_{t_1}^{t_2} \vec{F}\,dt = (m\vec{v}_2) - (m\vec{v}_1)$$

$$\int_{t_1}^{t_2} \vec{F}\,dt = \vec{p}_2 - \vec{p}_1$$

$$\frac{d\vec{p}}{dt} = \sum \vec{F}_{ext}$$

$$\frac{d\vec{p}_{tot}}{dt} = 0 \quad \Rightarrow \quad \vec{p}_{tot} = \text{constant}$$

$$\vec{p}_B - \vec{p}_A = \int_A^B F_{ext}\,dt$$

$$\text{final} \;\; p_x = \text{initial} \;\; p_x$$
$$\text{final} \;\; p_y = \text{initial} \;\; p_y$$
$$\text{final} \;\; p_z = \text{initial} \;\; p_z$$

$$\vec{p}_{final} = \vec{p}_{initial}$$

$$\int_{t_1}^{t_2} \vec{F}\,dt \quad = \quad \vec{F}_{\text{avg}}\int_{t_1}^{t_2} dt \quad = \quad \vec{F}_{\text{avg}}\,(t_2 - t_1)$$