

## Propulsion Force Summary Sheet.



### Momentum

$$m_1 \cdot \vec{v} = m_{exh} \cdot \vec{v}_{exh}$$

$$m_1 \cdot \frac{dv}{dt} = \frac{dm_p}{dt} \cdot v_p \quad > \quad dm_1 = dm_p = dm_{exh} \quad > \quad dv = -v_p \cdot \frac{dm_1}{m_1}$$

### Thrust Force

$$\vec{F} = \frac{d\vec{I}}{dt} \quad > \quad \vec{F} = \frac{d}{dt} \cdot m_p \cdot \vec{v}_p \quad > \quad \vec{F} = \dot{m}_p \cdot \vec{v}_p$$

### Impulse

Specific Impulse  $I_{sp}$  in seconds

$$I_{sp} = \frac{F_{th}}{\dot{m}_p \cdot g}$$

### Tsiolkovski Formula

$$v_2 - v_1 = v_p \cdot \text{Log}_e \frac{m_1}{m_2} \quad \Delta v = v_p \cdot \text{LN} \cdot \frac{m_1}{m_2}$$

$$\frac{m_1}{m_2} = e^{\frac{\Delta v}{v_p}} \quad > \quad m_p = m_1 - m_2 \quad > \quad m_p = m_1 - m_1 \cdot e^{-\frac{\Delta v}{v_p}}$$

$$m_p = m_1 \cdot \left[ 1 - e^{-\frac{\Delta v}{v_p}} \right]$$