

$$R_e := 6387.14 \cdot \text{km} \quad \mu := 398600 \cdot \frac{\text{km}^3}{\text{sec}^2}$$

Book Homework

$$3.1 \quad r_p := 400 \cdot \text{km} + R_e \quad e := .6 \quad a := \frac{r_p}{1 - e}$$

a perigee velocity

$$V_p := \sqrt{\frac{2\mu}{r_p} - \frac{\mu}{a}} \quad V_p = 9.694 \times 10^3 \frac{\text{m}}{\text{s}}$$

b apogee radius

$$r_a := a \cdot (1 + e) \quad r_a = 2.715 \times 10^7 \text{ m}$$

c apogee velocity

$$V_a := \sqrt{\frac{2\mu}{r_a} - \frac{\mu}{a}} \quad V_a = 2.423 \times 10^3 \frac{\text{m}}{\text{s}}$$

d Orbit period

$$P := \frac{2 \cdot \pi}{\sqrt{\frac{\mu}{a^3}}} \quad P = 6.11 \text{ hr}$$

e Satellite velocity when A=3622 km

$$r_A := 3622 \cdot \text{km} + R_e$$

$$V_x := \sqrt{\frac{2\mu}{r_A} - \frac{\mu}{a}} \quad V_x = 7.494 \times 10^3 \frac{\text{m}}{\text{s}}$$

f True anomaly

$$\theta := \text{acos} \left[r_p \cdot \frac{(1 + e)}{r_A \cdot e} - \frac{1}{e} \right] \quad \theta = 81.86 \text{ deg}$$

g flight path angle

$$\gamma := \text{atan} \left(\frac{e \cdot \sin(\theta)}{1 + e \cdot \cos(\theta)} \right) \quad \gamma = 28.698 \text{ deg}$$

3.9

Hohmann transfer

Apogee radius

$$r_a := 36200 \cdot \text{km} + R_e \quad r_a = 2.715 \times 10^4 \text{ km}$$

Perigee Radius

$$r_p := 500 \cdot \text{km} + R_e$$

Initial circular orbit velocity

$$V_i := \sqrt{\frac{\mu}{r_p}} \quad V_i = 7.608 \times 10^3 \frac{\text{m}}{\text{s}}$$

Final circular orbit velocity

$$V_f := \sqrt{\frac{\mu}{r_a}} \quad V_f = 3.059 \times 10^3 \frac{\text{m}}{\text{s}}$$

$$a := \frac{r_a + r_p}{2} \quad a = 2.474 \times 10^4 \text{ km}$$

perigee velocity

$$V_p := \sqrt{\frac{2\mu}{r_p} - \frac{\mu}{a}} \quad V_p = 9.982 \times 10^3 \frac{\text{m}}{\text{s}}$$

apogee velocity

$$V_a := \sqrt{\frac{2\mu}{r_a} - \frac{\mu}{a}} \quad V_a = 1.614 \times 10^3 \frac{\text{m}}{\text{s}}$$

Deltavee1

$$V_p - V_i = 2.374 \times 10^3 \frac{\text{m}}{\text{s}}$$

Deltavee2

$$V_f - V_a = 1.445 \times 10^3 \frac{\text{m}}{\text{s}}$$

3.14 Same as above, with plane change

Plesetsk inclination $\alpha := 63\text{-deg}$

$$R_{\text{geo}} := 42164 \cdot \text{km}$$

Hohmann transfer

Apogee radius

$$r_a := R_{\text{geo}} \qquad r_a = 4.216 \times 10^4 \text{ km}$$

Perigee Radius

$$r_p := 500 \cdot \text{km} + R_e$$

Initial circular orbit velocity

$$V_i := \sqrt{\frac{\mu}{r_p}} \qquad V_i = 7.608 \times 10^3 \frac{\text{m}}{\text{s}}$$

Final circular orbit velocity

$$V_f := \sqrt{\frac{\mu}{r_a}} \qquad V_f = 3.075 \times 10^3 \frac{\text{m}}{\text{s}}$$

$$a := \frac{r_a + r_p}{2} \qquad a = 2.453 \times 10^4 \text{ km}$$

perigee velocity

$$V_p := \sqrt{\frac{2\mu}{r_p} - \frac{\mu}{a}} \qquad V_p = 9.975 \times 10^3 \frac{\text{m}}{\text{s}}$$

apogee velocity

$$V_a := \sqrt{\frac{2\mu}{r_a} - \frac{\mu}{a}} \quad V_a = 1.629 \times 10^3 \frac{\text{m}}{\text{s}}$$

Deltavee1

$$V_p - V_i = 2.367 \times 10^3 \frac{\text{m}}{\text{s}}$$

Deltavee2

$$V_f - V_a = 1.445 \times 10^3 \frac{\text{m}}{\text{s}} \quad \Delta V_2 := V_f - V_a$$

Plane Change

$$V_{\text{plane}} := 2 \cdot V_a \cdot \sin\left(\frac{\alpha}{2}\right) \quad V_{\text{plane}} = 1.703 \times 10^3 \frac{\text{m}}{\text{s}}$$

Combined maneuvers

Vector sum of

$$V_{f2} := \sqrt{V_{\text{plane}}^2 + \Delta V_2^2 - 2 \cdot \Delta V_2 \cdot V_{\text{plane}} \cdot \cos(\alpha)}$$

$$V_{f2} = 1.659 \times 10^3 \frac{\text{m}}{\text{s}}$$

