

Home Work #2

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1 Question 1

The space shuttle weighs approximately 12.5 tons, whose thrusters can simultaneously produce a total thrust of 53400 Newtons for orbital maneuvers. Assuming that the shuttle is initially in a 300 Km (altitude) circular Earth orbit, it is desired to use a single impulse to transfer the shuttle to a 250x300 Km elliptical orbit.

1.1 part a

$$h = \sqrt{2\mu} \sqrt{\frac{r_a r_p}{r_a + r_p}}$$
$$v = \frac{h}{r}$$

First orbit (circular):

$$r = 6678$$

For first circular orbit $r_a = r_p$.

$$h = 51593 \rightarrow v = 7.7258_{km/sec}$$

Second orbit (elliptical):

$$r_p = 6628, \quad r_a = 6678$$

$$h = 51496 \rightarrow v_a = 7.7113_{km/sec}$$

$$\Delta v = v_a - v = 0.0145_{km/sec}$$

1.2 part b

$$T = \frac{m\Delta v}{\Delta t} \rightarrow \Delta t = \frac{m\Delta v}{T} = 0.0034_{sec}$$

1.3 part c

Assuming the velocity is the mean velocity of circular and elliptical velocity.

$$v_{mean} = \frac{v_{circular} + v_{elliptical}}{2} = 7.7186_{km/sec}$$

$$\begin{aligned} \text{distance} &= v_{mean} \times \Delta t \pm \Delta v \Delta t = 7.7186_{km/sec} \times 0.0034_{sec} \pm 0.0145_{km/sec} \times 0.0034_{sec} \\ &= 0.0268_{km} \pm 4.9415 \times 10^{-5}_{km} \end{aligned}$$

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