Ch. 3

Rocket Example

V_2 rocket – 1st liquid propelled rocket.

total mass = 12,500 kg

$m_{propellant}$ = 8720 kg

m_{body} = 3780 kg

$V_{exhaust}$ = 2000 $\frac{m}{s}$

thrust = 265 kN

$$V_x = V_{x_0} + V_{exhaust} \ln\left(\frac{m_0}{m}\right)$$

$$\Delta V_{x_{max}} = \left(2000 \tfrac{m}{s}\right) \ln\left(\frac{12500\ kg}{3780\ kg}\right)$$

$$\boxed{\Delta V_{x_{max}} = 2390 \tfrac{m}{s}}$$

After burnout, $V_x = V_{x_0} + 2740 \frac{m}{s}$

$thrust = -\dot{m} V_{ex}$ so $\dot{m} = \frac{-thrust}{V_{ex}} = \frac{-265 \times 10^3\ N}{2000 \frac{m}{s}}$

$\dot{m} = -133 \frac{kg}{s} = \frac{\Delta m}{\Delta t}$

$m = m_0 + \dot{m} t$

$$t_{burnout} = \frac{-\Delta m}{\dot{m}} = \frac{-(8720\ kg)}{-133\ kg/s} = \boxed{65.6\ s}$$