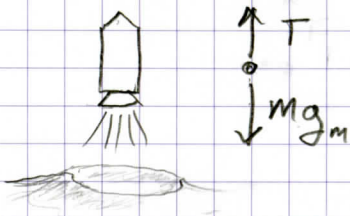


TM5 Pr 9.62

To perform a rescue, a lunar landing craft needs to hover just above the surface of the moon which has $g_m = \frac{1}{6}g_E$. The exhaust velocity is 2000 m/s, but fuel amounting to 0.2 m_0 may be used. How long can the landing craft hover?

USE NSL



$$\sum F = ma \rightarrow 0 \text{ to hover}$$

$$T - mg_m = 0$$

$$T = mg_m$$

Thrust is given by $T = -u \frac{dm}{dt}$

Thus, for u downward,

$$-u \frac{dm}{dt} = mg_m$$

SEPARATING VARIABLES

$$\frac{dm}{m} = -\frac{g_m}{u} dt$$

$$\int_{m_0}^{0.8m_0} \frac{dm}{m} = -\frac{g_m}{u} \int_0^{t_{max}} dt$$

$$\ln(m) \Big|_{m_0}^{0.8m_0} = -\frac{g_m}{u} t_{max}$$

$$\ln\left(\frac{0.8m_0}{m_0}\right) = -\frac{g_m}{u} t_{max}$$

$$t_{max} = -\frac{u}{g_m} \ln(0.8)$$

EVALUATING

$$t_{max} = -\frac{2000}{\left(\frac{1}{6}\right)(9.8)} \ln(0.8) = \boxed{273 \text{ SEC} = t_{max}} \\ = 4^m 33.2$$