PROB. 13-100

$v_i = 26.9 \frac{km}{s} = 26.9 \times 10^3 \frac{m}{s}$

$r_A = 350 \times 10^6 \, m$, $r_B = 100 \times 10^6 \, m$, $M_J = 319 M_E$

FIND Δv FOR ORBITAL INSERTION.

CONSERVATION OF ANGULAR MOMENTUM:

$$r_A m v_A = r_B m v_B \Rightarrow v_B = \left(\frac{r_A}{r_B}\right) v_A$$

CONSERVATION OF ENERGY:

$$T_A + V_A = T_B + V_B$$

$$\frac{1}{2} m v_A^2 - \frac{G M_J m}{r_A} = \frac{1}{2} m v_B^2 - \frac{G M_J m}{r_B}$$

$$\frac{1}{2} v_A^2 - \frac{1}{2}\left[\left(\frac{r_A}{r_B}\right) v_A\right]^2 = G M_J \left(\frac{1}{r_A} - \frac{1}{r_B}\right)$$

$$v_A^2 \left\{\frac{1}{2}\left[1 - \left(\frac{r_A}{r_B}\right)^2\right]\right\} = 319 G M_E \left(\frac{1}{r_A} - \frac{1}{r_B}\right)$$

$$v_A = \sqrt{319 \cdot g R^2 \left(\frac{1}{r_A} - \frac{1}{r_B}\right) \cdot \left\{\frac{1}{2}\left[1 - \left(\frac{r_A}{r_B}\right)^2\right]\right\}^{-1}}$$

$$v_A = \sqrt{319\left(9.81 \frac{m}{s^2}\right)\left(6.37 \times 10^6 m\right)^2 \left[\frac{1}{(350 \times 10^6 m)} - \frac{1}{(100 \times 10^6 m)}\right] \cdot \left\{\frac{1}{2}\left[1 - \left(\frac{350 \times 10^6 m}{100 \times 10^6 m}\right)^2\right]\right\}^{-1}}$$

$$v_A = 1.270 \times 10^4 \frac{m}{s}$$

$$\Delta v = 26.9 \times 10^3 - 1.27 \times 10^4 \frac{m}{s} = 1.42 \times 10^4 \frac{m}{s} = 14.2 \frac{km}{s}$$