PROB. 12-79

SHOW THAT $r_m = f(r_p, g_p, T)$

$D = 2\pi r_m \Rightarrow r_m = \frac{D}{2\pi}$

$v = \frac{D}{T}, \quad D = vT$

$r_m = \frac{vT}{2\pi}$

$g_p r_p^2 = GM_p = r_m v^2$

$v = \sqrt{\frac{g_p r_p^2}{r_m}}$

$r_m = \frac{T}{2\pi}\sqrt{\frac{g_p r_p^2}{r_m}}$

$r_m^{\frac{3}{2}} = \frac{T}{2\pi}\sqrt{g_p r_p^2}$

$r_m = \sqrt[3]{\frac{T^2 r_p^2 g_p}{(2\pi)^2}} = \sqrt[3]{\frac{T^2 r_p^2 g_p}{4\pi^2}}$

$g_p = \frac{4\pi^2 r_m^3}{T^2 r_p^2}$

$g_p = \frac{4\pi^2\left[(670.9\times10^3\ \text{km})\left(\frac{1000\ \text{m}}{\text{km}}\right)\right]^3}{\left[(3.551\ \text{DAY})\left(\frac{24\ \text{HR}}{\text{DAY}}\right)\left(\frac{3600\ \text{s}}{\text{HR}}\right)\right]^2 \cdot \left[(71{,}492\ \text{km})\left(\frac{1000\ \text{m}}{\text{km}}\right)\right]^2}$

$g_p = 24.78\ \frac{\text{m}}{\text{s}^2}$