Chapter 8 Problem 39 [†]

Given
$h = 130\ km = 1.30 \times 10^5\ m$
$m_m = 7.35 \times 10^{22}\ kg$
$r_m = 1.74 \times 10^6\ m$

Solution
Find the time the astronaut is without communications during an orbit.

The orbital period for the astronaut is derived from Kepler's 3^{rd} law

$$T = \sqrt{\frac{4\pi^2 r^3}{G m_m}}$$

The distance given in the problem is the altitude the astronaut is above the moon's surface. Therefore, we need to add this altitude to the radius of the moon to find the value of r for this problem.

$$T = \sqrt{\frac{4\pi^2 (1.74 \times 10^6\ m + 1.30 \times 10^5\ m)^3}{(6.672 \times 10^{-11}\ Nm^2/kg^2)(7.35 \times 10^{22}\ kg)}}$$

$$T = 7.26 \times 10^3\ s$$

If communications are lost during half of this orbit, then time without communications is

$$t = \frac{T}{2} = \frac{7260\ s}{2} = 3630\ s = 1.01\ hr$$

[†]Problem from Essential University Physics, Wolfson