

Chapter 3 Problem 43 †

Given

$$r = 385,000 \text{ km} = 3.85 \times 10^8 \text{ m}$$

$$t = 27 \text{ days}$$

Solution

Find the acceleration of the moon.

First convert the time into seconds.

$$t = (27 \text{ d}) \left(\frac{24 \text{ hr}}{1 \text{ d}} \right) \left(\frac{3600 \text{ s}}{1 \text{ h}} \right) = 2.33 \times 10^6 \text{ s}$$

Since the moon is traveling in a nearly circular orbit at constant speed, the acceleration will be centripetal acceleration. The velocity of the moon is the circumference of the orbit divided by the time.

$$v = \frac{d}{t} = \frac{2\pi r}{t} = \frac{2\pi(3.85 \times 10^8 \text{ m})}{2.33 \times 10^6 \text{ s}}$$

$$v = 1038 \text{ m/s}$$

The centripetal acceleration is then

$$a = \frac{v^2}{r} = \frac{(1038 \text{ m/s})^2}{3.85 \times 10^8 \text{ s}} = 2.8 \times 10^{-3} \text{ m/s}^2$$

†Problem from Essential University Physics, Wolfson