

Chapter 8 Problem 15 †

Given

$$m_m = 3.30 \times 10^{23} \text{ kg}$$

$$r_m = 2.44 \times 10^6 \text{ m}$$

$$m_t = 1.35 \times 10^{23} \text{ kg}$$

$$r_t = 2.58 \times 10^6 \text{ m}$$

Solution

a) Find the acceleration on the surface of Mercury.

The acceleration at the surface of Mercury is derived from Newton's 2nd law. The only force acting on the object is gravity; therefore,

$$\vec{F}_g = m\vec{a}$$

where $F_g = G\frac{Mm}{r^2}$ and is directed toward the center of the moon. Then

$$G\frac{Mm}{r^2} = ma$$

The acceleration is then

$$a = \frac{GM}{r^2}$$

Substituting in the values for Mercury gives

$$a_m = \frac{(6.672 \times 10^{-11} \text{ Nm}^2/\text{kg}^2)(3.30 \times 10^{23} \text{ kg})}{(2.44 \times 10^6 \text{ m})^2}$$

$$a_m = 3.70 \text{ m/s}^2$$

b) Find the gravitational acceleration of Titan.

Substituting in the values for Titan gives

$$a_t = \frac{(6.672 \times 10^{-11} \text{ Nm}^2/\text{kg}^2)(1.35 \times 10^{23} \text{ kg})}{(2.58 \times 10^6 \text{ m})^2}$$

$$a_t = 1.35 \text{ m/s}^2$$

†Problem from Essential University Physics, Wolfson