

47. (a) The greatest distance between the satellite and Earth's center (the apogee distance) is $R_a = 6.37 \times 10^6 \text{ m} + 360 \times 10^3 \text{ m} = 6.73 \times 10^6 \text{ m}$. The least distance (perigee distance) is $R_p = 6.37 \times 10^6 \text{ m} + 180 \times 10^3 \text{ m} = 6.55 \times 10^6 \text{ m}$. Here $6.37 \times 10^6 \text{ m}$ is the radius of Earth. From Fig. 14-13, we see that the semimajor axis is

$$a = \frac{R_a + R_p}{2} = \frac{6.73 \times 10^6 \text{ m} + 6.55 \times 10^6 \text{ m}}{2} = 6.64 \times 10^6 \text{ m} .$$

- (b) The apogee and perigee distances are related to the eccentricity e by $R_a = a(1+e)$ and $R_p = a(1-e)$. Add to obtain $R_a + R_p = 2a$ and $a = (R_a + R_p)/2$. Subtract to obtain $R_a - R_p = 2ae$. Thus,

$$e = \frac{R_a - R_p}{2a} = \frac{R_a - R_p}{R_a + R_p} = \frac{6.73 \times 10^6 \text{ m} - 6.55 \times 10^6 \text{ m}}{6.73 \times 10^6 \text{ m} + 6.55 \times 10^6 \text{ m}} = 0.0136 .$$