Problem 40

The average distance between Earth and the Sun is 1.5×10^{11} m. (a) Calculate the average speed of Earth in its orbit (assumed to be circular) in meters per second. (b) What is this speed in miles per hour?

Solution

Part (a)

Calculate the average speed of the Earth in its circular orbit around the Sun.

$$\text{Average Speed} = \frac{\text{Average Distance}}{\text{Time}} = \frac{2\pi R}{T} = \frac{2\pi(1.5 \times 10^{11}\ \text{m})}{1\ \text{yr}} = 3.0\pi \times 10^{11}\ \frac{\text{m}}{\text{yr}}$$

Convert this speed to meters per second by multiplying by the appropriate conversion factors.

$$3.0\pi \times 10^{11}\ \frac{\text{m}}{\text{yr}} = 3.0\pi \times 10^{11}\ \frac{\text{m}}{\cancel{\text{yr}}} \times \frac{1\ \cancel{\text{yr}}}{365\ \cancel{\text{days}}} \times \frac{1\ \cancel{\text{day}}}{24\ \cancel{\text{h}}} \times \frac{1\ \cancel{\text{h}}}{60\ \cancel{\text{min}}} \times \frac{1\ \cancel{\text{min}}}{60\ \text{s}} \approx 3.0 \times 10^{4}\ \frac{\text{m}}{\text{s}}$$

Part (b)

Convert this speed to miles per hour by multiplying by the appropriate conversion factors.

$$3.0\pi \times 10^{11}\ \frac{\text{m}}{\text{yr}} = 3.0\pi \times 10^{11}\ \frac{\cancel{\text{m}}}{\cancel{\text{yr}}} \times \frac{1\ \cancel{\text{yr}}}{365\ \cancel{\text{days}}} \times \frac{1\ \cancel{\text{day}}}{24\ \text{h}} \times \frac{1250\ \cancel{\text{ft}}}{381\ \cancel{\text{m}}} \times \frac{1\ \text{mi}}{5280\ \cancel{\text{ft}}} \approx 6.7 \times 10^{4}\ \frac{\text{m}}{\text{s}}$$