

MECHANICS - GRAVITY

10. Suppose a comet has a highly elliptical orbit about the Sun with an orbital period of 86 yr. The orbital eccentricity is $\epsilon = 0.8$. Find the distance of closest approach r_p to the Sun (also called the perihelion) and the farthest distance r_a the comet lies from the Sun. Express your answers in Astronomical Units (where $1 \text{ AU} = 1.5 \times 10^{13} \text{ cm}$).

First find the semi-major axis a .

$$\text{Kepler} \Rightarrow a^3 \sim T^2$$

$$\text{Scale to Earth orbit} \Rightarrow a \sim T^{2/3}$$

$$a = (86)^{2/3} \text{ AU}, \quad \boxed{a \approx 19.5 \text{ AU}}$$

$$r_p = a(1 - \epsilon) = 0.2a = a/5$$

$$\boxed{r_p \approx 3.9 \text{ AU}}$$

$$r_a = a(1 + \epsilon) = 1.8a$$

$$\boxed{r_a \approx 35.1 \text{ AU}}$$