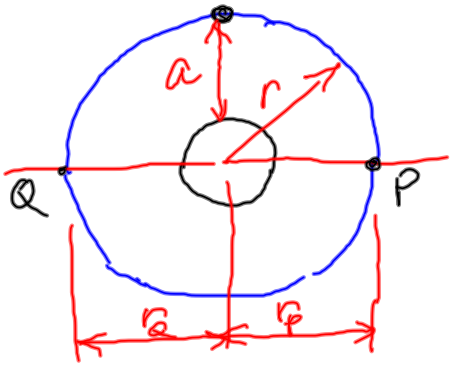
Geostationary satellite: its altitude

$r = a + R \qquad R = 3960 \text{ mi}$



$$\frac{1}{r_P} + \frac{1}{r_Q} = \frac{2GM}{h^2}, \qquad T = \frac{\pi(r_P + r_Q)\sqrt{r_P r_Q}}{h}$$

$$\frac{1}{r} + \frac{1}{r} = \frac{2gR^2}{h^2}, \qquad \frac{\cancel{2}}{r} = \frac{\cancel{2}gR^2}{h^2}$$

$$\boxed{h^2 = gR^2 r} \qquad T = \frac{\pi(2r)r}{h} = \frac{2\pi r^2}{h}$$

$$h = \frac{2\pi r^2}{T}, \qquad \boxed{h^2 = \frac{4\pi^2 r^4}{T^2}} \qquad \text{mi}, \ \text{s}$$

$$gR^2\cancel{r} = \frac{4\pi^2 r^{\cancel{4}3}}{T^2}, \qquad r^3 = \frac{gR^2T^2}{4\pi^2}$$

$$r^3 = \frac{\frac{32.2}{5280}(3960)^2\left[24(60)(60)\right]^2}{4\pi^2}, \qquad r = 26247.8 \text{ mi}$$

$$= a + 3960 \text{ mi}$$

$\therefore\ a = 22{,}287 \text{ mi} \qquad \boxed{a = 22.3 \times 10^3 \text{ mi}}$