A synchronous satellite is orbiting the Earth. Find its period if its distance from the center of the Earth is doubled.

\[
\frac{T_2^2}{T_1^2} = \frac{a_2^3}{a_1^3} \\
T_2 = T_1 \sqrt{\frac{a_2^3}{a_1^3}} \\
= T_1 \sqrt{\frac{(2a_1)^3}{a_1^3}} \\
= T_1 \sqrt{8} \frac{a_1^3}{a_1^3} \\
= T_1 \sqrt{8} = 2.83 \ T_1 \\
= 2.83 \times (24) \\
= 67.88 \text{ hr.} \approx 68 \text{ hr.}
\]

The HST is orbiting the Earth at a height of 600 km above its surface. Find its period.

\[
T^2 = \frac{4 \pi^2 / G \text{Me}}{a^3} \\
a = h + R_e = 600 + 6400 \\
= 7000 \text{ km} = 7 \times 10^6 \text{ m} \\
T^2 = \frac{4 \pi^2 / 6.67 \times 10^{-11} \times 6 \times 10^{24}}{(7 \times 10^6)^3} \\
= 3.38 \times 10^7 \text{ s}^2 \\
T = 5816.86 \text{ s} = 96.95 \text{ min.} \approx 97 \text{ min.}
\]

What should be the distance of a synchronous satellite from the center of the Earth if its new period is 30 days.

\[
T^2 = \frac{4\pi^2 / G \text{Me}}{a^3} \Rightarrow a = (G \times \text{Me} \times T^2 / 4 \pi^2)^{1/3} \\
a = (6.67 \times 10^{-11} \times 6 \times 10^{24} \times 24 \times 24 \times 3600 \times 3600 / 4 \pi^2)^{1/3} \\
a = (7.567 \times 10^{22})^{1/3} = 4.23 \times 10^7 \text{ m} = 42300 \text{ km} \\
T^2 / T_1^2 = a_2^3 / a_1^3 \\
a_2 = a_1 (T_2 / T_1)^{2/3} = a_1 (30 \times 24/24)^{2/3} \\
= 9.655 \ a_1 = 408400 \text{ km}
\]