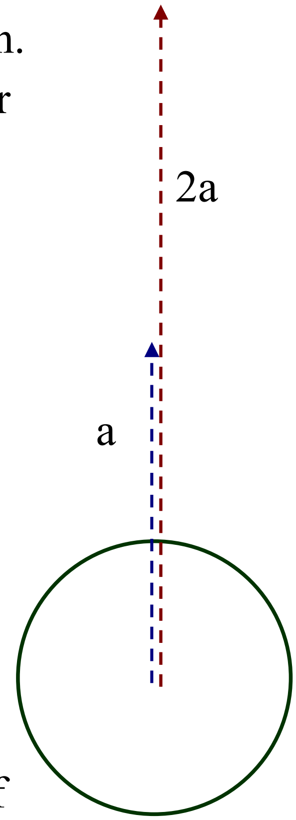
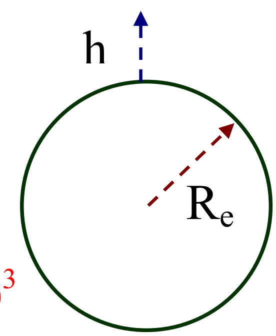
- A synchronous satellite is orbiting the Earth. Find its period if its distance from the center of the Earth is doubled.



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

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



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

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

$$T^2 = (4\times\pi^2 / G\times M_e) \times a^3 \;\rightarrow\; a = (G\times M_e\times T^2 / 4\times\pi^2)^{1/3}$$
$$a = (6.67\times10^{-11} \times 6\times10^{24} \times 24\times24\times3600\times3600 / 4\times\pi^2)^{1/3}$$
$$a = (7.567\times10^{22})^{1/3} = 4.23\times10^7 \text{ m} = 42300 \text{ km}$$
$$T_2^2 / T_1^2 = a_2^3 / a_1^3$$
$$a_2 = a_1\,(T_2 / T_1)^{2/3} = a_1\,(30{*}24/24)^{2/3}$$
$$= 9.655\, a_1 = 408400 \text{ km}$$

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