

At what velocity and altitude must a satellite need to be in order to be geostationary (geosynchronous) around the Earth? (Hint: Period of orbit must be 24 hrs)

$U = \frac{2\pi R_0}{T}$

Earth  $R_p$   $A$   $R_0$   $U$   $T = 24h \times 60 \times 60$   
 $T = 86400s$

$R_0 = R_p + A$

$F_c = F_g$   
 $\frac{mv^2}{R} = \frac{GMm}{R^2}$   
 $\left(\frac{2\pi R}{T}\right)^2 = \frac{GM}{R^2}$   
 $\frac{4\pi^2 R^2}{T^2} = \frac{GM}{R^2}$   
 $\frac{4\pi^2 R^4}{T^2} = GM$   
 $\frac{4\pi^2 R^3}{T^2} = GM$

$R^3 = \frac{GMT^2}{4\pi^2}$   
 $R^3 = \frac{(6.67 \times 10^{-11})(5.98 \times 10^{24})(86400)^2}{4\pi^2}$   
 $R = 4.23 \times 10^7 m$

$R_0 = R_p + A$   
 $A = R_0 - R_p$   
 $= 4.23 \times 10^7 - 6.38 \times 10^6$   
 $= 3.59 \times 10^7 m$

$v = \frac{2\pi R_0}{T} = \frac{2\pi(4.23 \times 10^7)}{86400}$   
 $v = 3074.6 m/s$

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