Derive Kepler's 3^d from Newton's 2^d

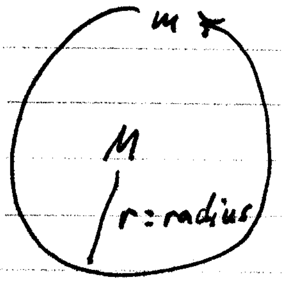
(G = constant) $\quad F = ma \quad$ Newton's 2^d law

$F = \frac{GmM}{r^2}$ $\quad a = \frac{v^2}{r}$ for circular orbit at constant speed v

Combine:

① simplify: $\quad v^2 =$ ______

Notice that m is irrelevant! (if M ≫ m)



speed of m = $\frac{\text{distance}}{\text{time}}$ = $\frac{\text{circumference}}{\text{period}}$ $\quad$ T = period

② $$v = \frac{2\pi r}{T}$$

$$v^2 = v^2$$ Combine ① & ②

Kepler's 3^d Law:

If $M = M_\odot$ then $T \to P$, $r \to a$, $\quad P^2 (yr) = a^3 (AU)$

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Kepler's 3d Law: $GMT^2 = 4\pi^2 r^3$

$G = \frac{20}{3} \times 10^{-11} \frac{m^3}{kg \cdot s^2}$

Algebraically Solve for M = ________

Period of Earth's orbit T = ________

Radius of Earth's orbit r = ________

Sun's mass M =