

[mex43] Kepler's second and third laws

Derive Kepler's second and third laws of planetary motion from the results established in class for central force motion. Use the case of an elliptic orbit ($0 < e < 1$). Specifically: (a) Show that the rate at which area is swept by the position vector of the planet, dA/dt , is a constant. Determine that constant. (b) Integrate the result for dA/dt over one period of revolution τ to show that the following relation holds between τ and the semi-major axis a : $\tau^2 = 4\pi^2(m/\kappa)a^3$, where $\kappa = GMm$, $M = m_S + m_P$, $m = m_S m_P / (m_S + m_P)$.

Solution: