Homework #2: Additional Exercises for Honor’s Students to be done in addition to the regular course

For this exercise, you will determine the mass of the Sun using \( P_1^2 = \frac{4\pi^2 a_1^3}{G(M_{\text{Sun}}+M_1)} \) for the Earth. You can assume that \( M_{\text{Sun}} \gg M_{\text{Earth}} \). Convert all units to MKS (meters, kgs, seconds) and use these values: \( G = 6.67 \times 10^{-11} \text{Nm}^2/\text{kg}^2 \), \( P_{\text{Earth}} = 1 \text{ year} \) (convert to seconds), and \( a_{\text{Earth}} = 1.50 \times 10^8 \text{ km} \) (convert to meters). The Sun’s mass will be in kg if you convert things properly. Please show your work below and on the back of the sheet if you need more space.

Set \( M_1 = 0 \) since the earth’s mass is insignificant compared to the Sun’s

\[
P_1^2 = \frac{4\pi^2 a_1^3}{G(M_{\text{Sun}})}
\]

\[
M_{\text{Sun}} = \frac{4\pi^2 a_1^3}{GP_1^2}
\]

\( P_1 = 1 \text{ year} = 3.156 \times 10^7 \text{ secs} \quad a_1 = 1 \text{ A.U.} = 1.50 \times 10^8 \text{ km} = 1.50 \times 10^{11} \text{ m} \)

\( G = 6.67 \times 10^{-11} \text{Nm}^2/\text{kg}^2 \) Note that \( 1 \text{ N} = 1 \text{ kg m/sec}^2 \)

\[
M_{\text{Sun}} = \frac{4\pi^2 (1.50 \times 10^{11} \text{ m})^3}{6.67 \times 10^{-11} \text{ m}^2 (3.156 \times 10^7 \text{ sec})^2}
\]

so \( M_{\text{Sun}} = 2.0 \times 10^{30} \text{ kg} \)

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