Astronomy 105 Laboratory

LAB 03
NIGHT LAB: SIGN UP!
Lab 03

MERCURY'S ORBIT
Kepler and the Physics of Planetary Motion

Laws of Planetary Motion

- Law 1 - Law of Ellipses
- Law 2 - Law of Equal Areas
- Law 3 - Harmonic Law -- $P^2 = ka^3$

Kepler’s laws provide a concise and simple description of the motions of the planets.
Mercury’s Orbit

Major Axis

Equal Time Intervals

70 X 10^6 km

7.0 X 10^7 km
Lab Exercise

- Make all measurements accurately
- Show all calculations and units
- Use proper number of significant figures
- Answer all questions in complete sentences!
  Support your conclusions.
Unit Conversion

Convert 25 \( \frac{\text{km}}{\text{hr}} \) to \( \frac{\text{m}}{\text{s}} \)

Conversions

\[
1000 \, \text{m} = 1 \, \text{km} \quad 1 \, \text{hr} = 3600 \, \text{s}
\]

\[
\frac{1000 \, \text{m}}{1 \, \text{km}} = \frac{1 \, \text{km}}{1 \, \text{km}} \quad \frac{1 \, \text{hr}}{3600 \, \text{s}} = \frac{3600 \, \text{s}}{3600 \, \text{s}}
\]

\[
\frac{1000 \, \text{m}}{1 \, \text{km}} = 1 \quad \frac{1 \, \text{hr}}{3600 \, \text{s}} = 1
\]

\[
\left(25 \frac{\text{km}}{\text{hr}}\right) \cdot \left(\frac{1000 \, \text{m}}{1 \, \text{km}}\right) \cdot \left(\frac{1}{3600 \, \text{s}} \cdot \frac{\text{hr}}{\text{s}}\right) = 6.9 \frac{\text{m}}{\text{s}}
\]
Kepler’s 3rd Law

Example: Find the period of an asteroid that is 3 AU from the sun?

\[ P^2 = k \cdot a^3 \]

\[ k = 1 \frac{yr^2}{AU^3} \]

\[ a = 3 \text{ AU} \]

\[ P = \sqrt{k \cdot a^3} \]

\[ P = \sqrt{1 \frac{yr^2}{AU^3} \cdot (3 \text{ AU})^3} \]

\[ P = \sqrt{1 \frac{yr^2}{AU^3} \cdot 27 \text{ AU}^3} \]

\[ P = \sqrt{27 \text{ yr}^2} \]
Lab Exercise

Road Trip:

distance = 100 km  time = 2.0 hr

What is the average velocity?

\[ \text{velocity} = \frac{\text{distance}}{\text{time}} \]

\[ 1000 \frac{\text{m}}{\text{km}} \]

velocity