Measuring the Mass of Jupiter Lab
Newton’s General form of Kepler’s Third Law

\[
(M_1 + M_2) P^2 = a^3
\]

In this case,

- \( M_1 \) = Mass of Jupiter = \( M_J \)
- \( M_2 \) = Mass of a moon (small compared to \( M_J \))

\( M \) in Solar Units (mass of Sun)

\( P \) in Years

\( a \) in Astronomical Units (AU)
Simplifying Things

But, the mass of the moon is much less than the mass of Jupiter so we can say it is very close to zero so….

\[(M_J + 0) P^2 = a^3\]

or

\[M_J = \frac{a^3}{P^2}\]
Observations

• We need to measure the period $P$ and the semi-major axis $a$ of the orbit of the moons.
  – Watch the moons over the course of several days.

• We can only observe from the Earth
Reading the Chart

Apparent Position (J.D.)

Time (days)

P

a

P

P