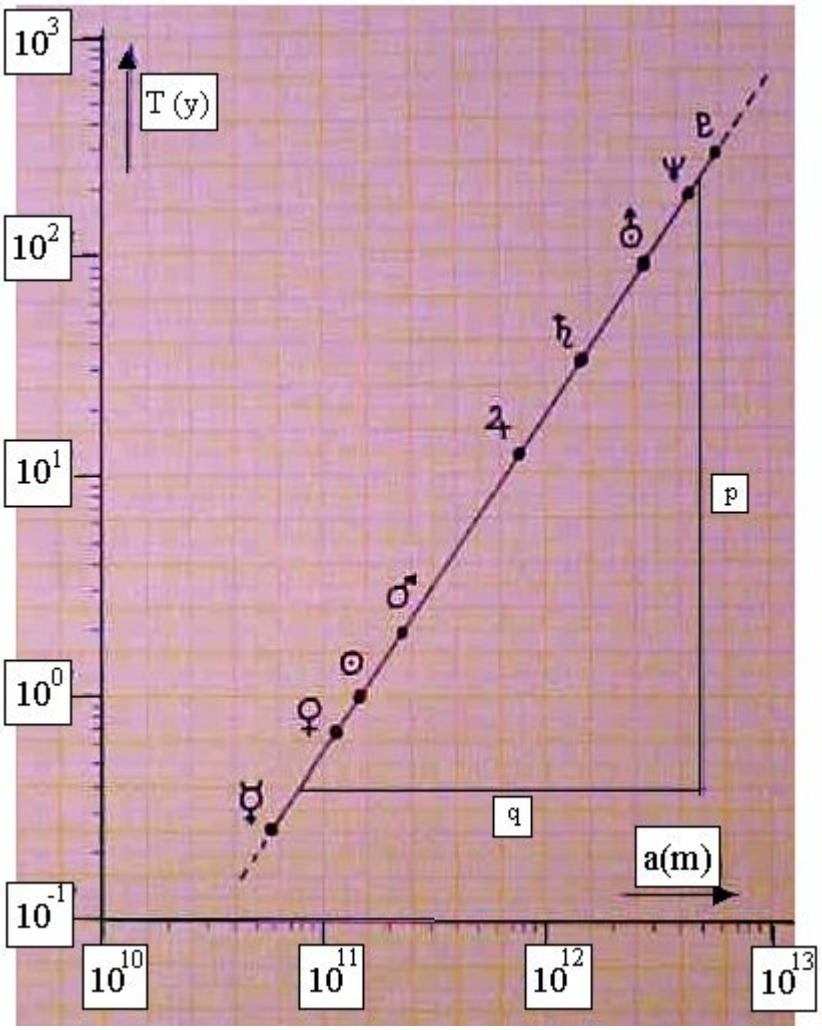
# Kepler's third law

**Aim:** To show empirically that Kepler's third law is true.

**Subjects:** 1L20 (Orbits)
8A10 (Solar System Mechanics)

**Diagram:**




**Equipment:**

- Graph on overhead sheet, *T=f(a), T* and *a* both scaled logarithmically.
- Table with data of the planetary system (see Sources).

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**Presentation:** The graph is projected by means of an overhead sheet. The relationship with the table of planetary data is elucidated. Clearly can be observed that the data fit on a straight line in such a double logarithmic graph. The slope of this line *(p/q)* equals 1.5. This is the relationship of the powers in Kepler's third law: $T^2 \propto a^3$.

**Explanation:** Kepler's third law states $T^2 = const.a^3$. Taking logarithms on both sides, we can also write: $2\log T = \log const. + 3\log a$ and: $\log T = \frac{1}{2}\log const. + \frac{3}{2}\log a$. So when $T$ and $a$ are graphed logarithmically (with $x$– and $y$-decades equally spaced), we see a line whose slope ($\frac{3}{2}$) is the power-relationship in the original function.

**Simulations:** On the internet you can find many simulations that are appropriate. For instance on: www.walter-fendt.de , www.physics.sjsu.edu/Tomley/demos.htm and www.astro.unl.edu/naap/pos/animations/kepler.swf .

**Sources:**


- Mansfield, M and O'Sullivan, C., Understanding physics, edition 1998, pag. 106-107 and 741 (planetary data).
- BINAS tabellenboek, vijfde druk, tabel 31.
- McComb, W.D., Dynamics and Relativity, edition 1999, pag. 72-74.
- Roest, R., Inleiding Mechanica, vijfde druk, pag. 257-258.
- Stewart, J, Calculus, edition 1999, pag. 867.