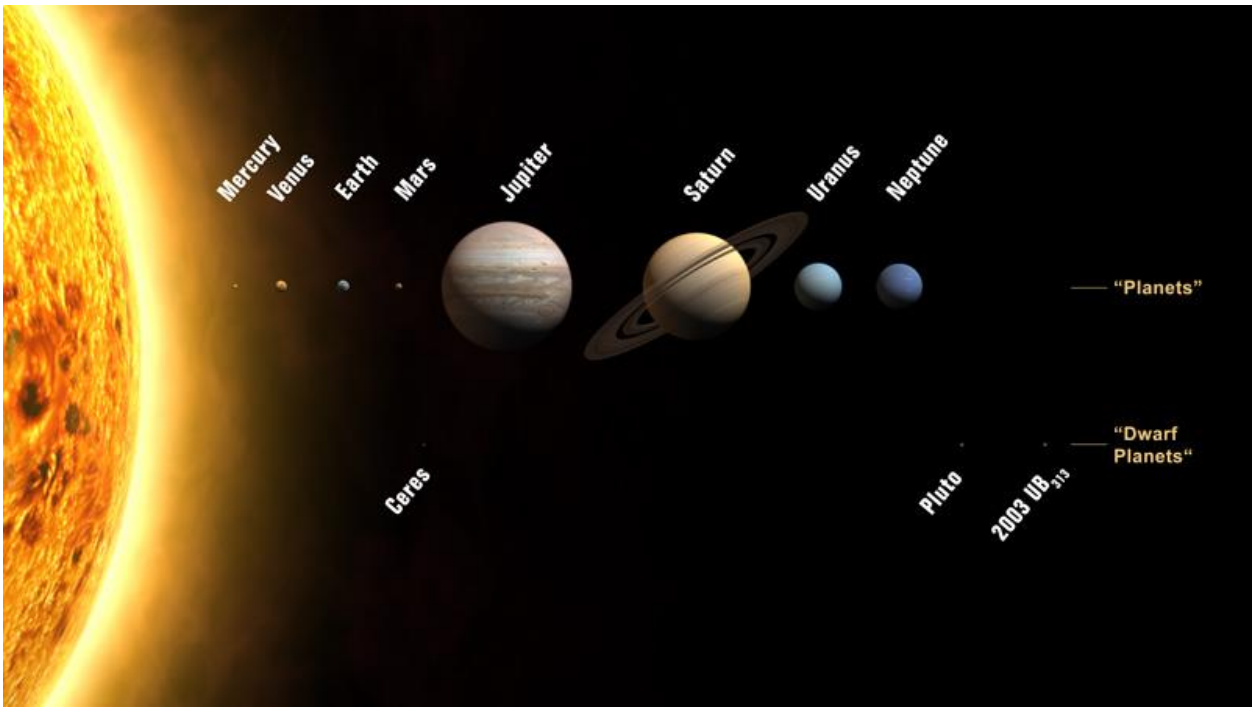
**Answer on Question#37205 – Physics – Mechanics | Kinematics | Dynamics**

Explain how Neptune really is a planet. Titius-bode law and the structure of Neptune




Solution:

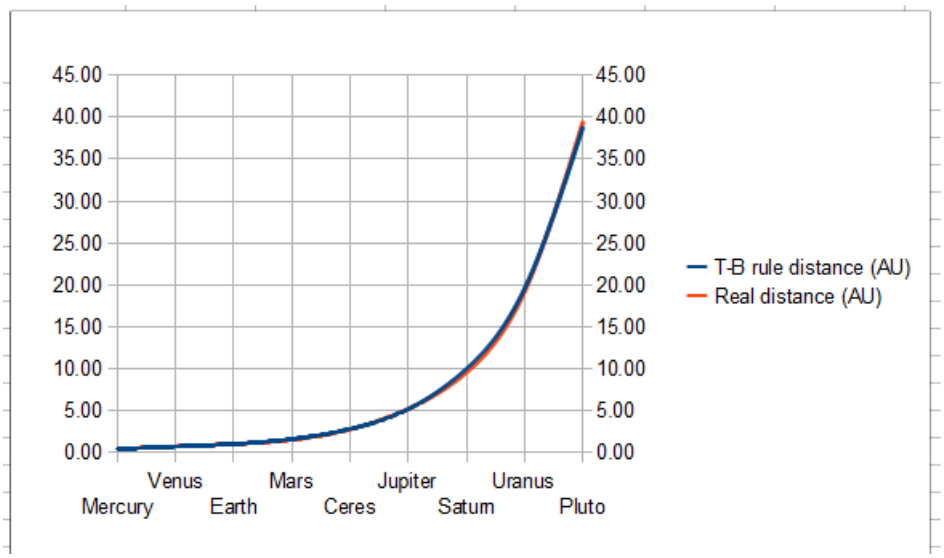
Rule giving the approximate distances of planets from the Sun. First announced in 1766 by the German Johann Daniel Titius (b. 1729d. 1796), it was popularized, from 1772, by his countryman Johann Elert Bode (b. 1747d. 1826).

### Formulation

The law relates the semi-major axis $a$ of each planet outward from the Sun in units such that the Earth's semi-major axis is equal to 10:
$a = 4 + n$
where n = 0, 3, 6, 12, 24, 48 …, each value of n > 3 twice the previous value. The resulting values can be divided by 10 to convert them into astronomical units (AU), which would result in the expression
$a = 0.4 + 0.3 \cdot 2^m$
for m = -∞, 0, 1, 2 …
For the outer planets, each planet is predicted to be roughly twice as far from the Sun as the previous object.

After its discovery, this ratio successfully predicted the location of both Uranus and Ceres. In fact, of all the planets in our system *only* Neptune fails to conform to this precise mathematical spacing. As an example of modern scientific absurdity, when Neptune was discovered to not fit with this spacing, the scientific community discarded any recognition of the Titus-Bode Law and you'll find very few scientists that even know this ratio exists, despite their study of the planets.

| k | Planet | T-B rule distance (AU) | Real distance (AU) | % error (using real distance as the accepted value) |
|---|---|---|---|---|
| 0 | Mercury | 0.40 | 0.39 | 2.56% |
| 1 | Venus | 0.70 | 0.72 | -2.78% |
| 2 | Earth | 1.00 | 1.00 | 0.00% |
| 4 | Mars | 1.60 | 1.52 | 5.26% |
| 8 | Ceres | 2.80 | 2.77 | 1.08% |
| 16 | Jupiter | 5.20 | 5.20 | 0.00% |
| 32 | Saturn | 10.00 | 9.54 | 4.82% |
| 64 | Uranus | 19.60 | 19.20 | 2.08% |
| 128 | Pluto | 38.80 | 39.44 | -1.62% |
| | | | | |
| | Neptune | | 30.06 | |




***Properties of the Solar System's Planets, Expressed in Earth Ratios***

| | Mercury | Venus | Earth | Mars | Jupiter | Saturn | Uranus | Neptune |
|---|---|---|---|---|---|---|---|---|
| Average Distance from Sun (AU) | 0.4 | 0.7 | 1 | 1.5 | 5.2 | 9.5 | 19.2 | 30.1 |
| Average Diameter at Equator* | 0.38 | 0.95 | 1 | 0.53 | 11.21* | 9.45* | 4.01* | 3.88* |
| Mass | 0.055 | 0.82 | 1 | 0.11 | 320 | 95 | 14.5 | 17 |
| Average Density | 0.98 | 0.95 | 1 | 0.71 | 0.24 | 0.13 | 0.23 | 0.30 |
| Average Surface Gravity* | 0.38 | 0.88 | 1 | 0.38 | 2.36* | 0.91* | 0.89* | 1.14* |
| Average Surface Pressure | ~$10^{-15}$ | 95 | 1 | 0.006 | — | — | — | — |
| Rotation Period (Sidereal) | 58.6 | 243 | 1 | 1.03 | 0.41 | 0.45 | 0.72 | 0.67 |
| Orbital Period (Year on Planet) | 0.24 | 0.62 | 1 | 1.88 | 11.86 | 29.44 | 84.01 | 163.72 |

*For the outer planets (Jupiter, Saturn, Uranus, and Neptune), which have no solid surfaces, these values are calculated for the altitude at which 1 bar of atmospheric pressure (the pressure of Earth's atmosphere at sea level) is exerted.

Planet of solar system size sharply divided into two groups. The first group is relatively small planet closest to the Sun: Mercury, Venus, Earth and Mars. This group is often called the group Earth. The second group includes the largest planet of the solar system: Jupiter, Saturn, Uranus and Neptune. This group is called the group of Jupiter. Both groups are belt minor planets or asteroids. Stands alone byway, a small planet Pluto. Considering other physical characteristics of the planets, we see that many of them sharply divided the planet into the same two groups. For example, the average density of the planets of the solar system of the first group is 4.5 g/cm3, and the average density of 1.21 g/cm3 Jovian . Judging by the density, we can say that the planet Earth groups are solids. The density of the Jovian planets, which is close to the density of the sun, does not allow this conclusion.

So Neptune really is a planet.