

PhyzJob: The Galactic Weigh Station



1. “Weighing” the Earth

A 1.0kg mass is found to have a weight of 9.8N, and the radius of the earth is 6.37×10^6 m; use the law of universal gravitation ($F = GMm/R^2$) to calculate the mass M of the earth (since G is now known, this calculation is possible).

2. “Weighing” the Sun

Knowing G , it was now possible to measure the mass of the sun as well. Follow these steps.

- Write “Kepler’s Rule“ (Kepler’s law of harmony).
- Complete Newton’s substitution $4\pi^2 K =$
- Write an expression for K in terms of G , M , a , and π^2 .
- Notice that you have an expression for K in part a and in part c. Equate them and solve for M .
- If $R = 1.5 \times 10^{11}$ m and $T = 365$ d (how many seconds is that?), what is the mass of the sun?

3. How ’bout “weighing” Jupiter and Saturn while we’re at it?

- Jupiter has a moon named Europa. Europa has an orbital radius 6.88×10^8 m and a period 3.55d. What is the mass of Jupiter?
- Saturn has a moon named Tethys. Tethys has an orbital radius 2.95×10^8 m and a period 1.89d. What is the mass of Saturn?

Is physics cool, or what? Measuring the force of attraction between a couple of hunks of lead made it possible to “weigh” whole planets and stars!

Check your answers with the 2019 Zephyr Information Reference