

Homefun 7

A Subject of Gravity

MATH 150
20 points

Directions: Work in groups of 2 to 4 in class and then finish outside of class as necessary. Each group should submit **ONE** solution page for the group. (Be sure everyone's name is on it!)

The gravitational attraction between two bodies is inversely proportional to the square of their distance: $F = G \frac{m_1 m_2}{r^2}$, where m_1 and m_2 are the masses of the objects, r is the distance between their centers of mass, and G is a constant known as the universal gravitation constant. This is Newton's Gravitational Equation (NGE).

1. Look up the value of G , the mass and radius R_0 of Earth, the mass of the moon, and the distance between Earth and the moon. (Use kilograms and meters.)
2. Calculate the force F between Earth and the moon.
3. With m_2 as the mass of Earth and R_0 as its radius, compute $g = G \frac{m_2}{R_0^2}$ (so that $F = mg$). Does this number look familiar?
4. Compute the weight (in N) of a 100kg tarantula at sea level and at the top of Sagarmatha (known in Tibet as Chomolungma and in the west as Mt. Everest) using NGE.
5. Now assume $m_1 = 100$ (tarantula) and m_2 is the mass of the Earth. Compute $\frac{dF}{dr}$ and use it to find the linearization of F at $r = R_0$.
6. Now use your linearization to compute the weight of a 100kg tarantula at the top of Sagarmatha. Compare your result to what you found using NGE. Does the linearization give a good approximation at that altitude? (You may want to convert to pounds; see below.)
7. Look up the conversion factor for Newtons to pounds and convert the sea-level weight and a top-of-the-mountain weight into pounds. How much lighter would the tarantula feel at the top of Sagarmatha compared to sea-level?