Gravity

Physics  In 1687, Isaac Newton developed his theory of gravity. This gravitational theory suggested a force between all objects. In addition he determined that this force does not require contact between the two objects and can act from a distance. Newton used his theories to determine that there is such a force between Earth and the moon, which keeps the moon in a circular motion around Earth. At the same time, there is an equal and opposite force which keeps the moon from orbiting any closer to Earth. These same theories can be applied to the motion of the planets (including Earth) around the sun. This classic theory, which is still accurate today, uses the Universal Constant of Gravitation (\(6.67^{-11} \times 10\)). The gravitational force between two objects can be determined using the formula:

\[
\text{Gravitational Force} = \frac{(6.67^{-11} \times 10) \times \text{Mass of 1st Object} \times \text{Mass of 2nd Object}}{(\text{Distance})^2},
\]

where the mass is given in kilograms and the distance is given in meters.

1. The mass of Earth is \(5.9736 \times 10^{24}\) kilograms and the mass of the moon is \(7.35 \times 10^{22}\) kilograms. The moon is 384,400 kilometers from Earth. Find the gravitational force between Earth and the moon.

2. The mass of the sun is \(1.99 \times 10^{30}\) kilograms and the mass of Mercury is \(3.3 \times 10^{23}\) kilograms. Mercury is 57,900,000 kilometers from the sun. Find the gravitational force between Mercury and the sun.

In Exercises 3–5, use the following information.

On December 18, 1999, NASA launched the first of a series of satellites designed to monitor the climate and environmental changes on Earth. The mass of this satellite is 5190 kilograms. It will orbit Earth at an approximate altitude of 25,000 kilometers.

3. Write the function to find the gravitational force of this satellite as it is launched from Earth into the atmosphere.

4. Find the domain and range of your function.

5. Graph your function from Exercise 3 for \(0 < x \leq 25,000\). Describe what happens to the gravitational force as the satellite’s distance from Earth increases.