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Projekt: Grunderna för Newtons mekanik

Newton postulated that the *gravitational force* between two particles of mass m_1 and m_2 that are separated by a distance r is

$$F = G\frac{m_1 m_2}{r^2} \quad . \quad (1)$$

1. G is called the universal gravitational constant which is considered independent of time and space. It was first measured by Henry Cavendish 1798. Discuss how the hypothesis about the constancy of G has been questioned.

2. The *acceleration due to gravity* at sea level is denoted by g. If the radius of the earth is R and its mass is M, then $g = G\frac{M}{R^2}$. Is this g equally constant as G?

3. What is the accuracy of the exponent 2 in (1)? Why is it not 3 or 2,001?

4. Newton postulated also three laws. Some claim that the first law is merely a consequence of the second and then should be unnecessary. Others claim that the second law requires the existence of the first law. Find what will support your opinion.

5. A particle with mass m_1 follows Newton's second law: $\mathbf{F} = m_1\mathbf{a}$, where $\mathbf{a}$ is the acceleration. But the same m_1 appears in the gravitational force. This equivalence between the inertial mass and the gravitational mass was used by Einstein to postulate *The Principle of Equivalence* and is fundamental in his *General theory of Relativity*. Present this principle and discuss it more deeply.

6. Newton's second law is valid only in an *inertial frame of reference*. Discuss the difference and consequences between an *inertial* and a *non-inertial frame of reference*.

(Idea: Ian Cohen, Mechanics, KTH)