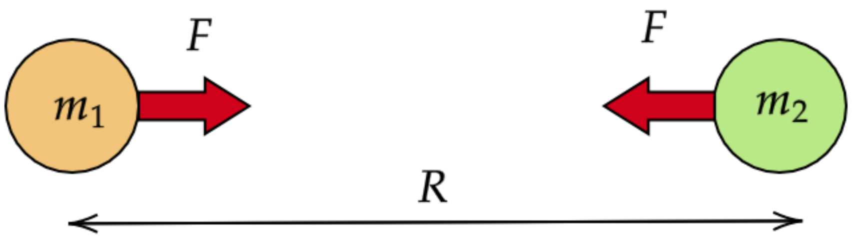
Universal Law of Gravity

Newton's universal law of gravity:



$$F = \frac{G\, m_1 m_2}{R^2}$$

Gravitational constant:

$$G = 6.67 \cdot 10^{-11} \frac{N \cdot m^2}{kg^2}$$

Free fall acceleration on Earth:

$$g = \frac{G\, M_E}{R_E^2}$$

Homework 12

Problem 1.
Find the gravitational force between two humans of mass $70\ kg$ if the distance between them is $10\ m$.

Problem 2.
Imagine you are a NASA engineer in the early days of a Mars exploration program and tasked with designing the first Martian rover. For this project, knowing the free fall acceleration on Mars is critical, but no one has been there yet to measure it. Luckily, from astronomical measurements, you know the mass and radius of Mars. Mass of Mars is $M_M = 6.4 \cdot 10^{23}\ kg$ and radius of Mars is $R_M = 3400\ km$. Use this information to calculate the free fall acceleration on Mars for the success of the rover project.

Problem 3* (bonus problem).
Find the mass of the Earth knowing its' radius $R_E = 6400\ km$.

Problem 4* (bonus problem).
On the next page!

Homework 12

Problem 4* (bonus problem).

In systems with several springs, a notion of an effective spring constant is useful. Suppose we can replace several springs with one spring and get the same total deformation under the same force. The spring constant of this one spring is called the effective spring constant of a system. Find the effective spring constant for the "series" (left figure) and "parallel" (right figure) connection of two springs with spring constants $k_1 = 5\ \frac{N}{cm}$ and $k_2 = 10\ \frac{N}{cm}$.