# Newton's equation for the force between two masses

(a) Given a Cartesian coordinate system with standard unit vectors $\boldsymbol{i}, \boldsymbol{j}$, and $\boldsymbol{k}$, let the mass $m_1$ be at position $\boldsymbol{r}_1 = x_1\boldsymbol{i} + y_1\boldsymbol{j} + z_1\boldsymbol{k}$ and the mass $m_2$ be at position $\boldsymbol{r}_2 = x_2\boldsymbol{i} + y_2\boldsymbol{j} + z_2\boldsymbol{k}$. In terms of the standard unit vectors, determine the unit vector that points from $m_1$ to $m_2$.

(b) Newton's law of universal gravitation states that two point masses attract each other along the line connecting them, with a force proportional to the product of their masses and inversely proportional to the square of the distance between them. The magnitude of the force acting on each mass is therefore

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

where $m_1$ and $m_2$ are the two masses, $r$ is the distance between them, and $G$ is the gravitational constant. Let the masses $m_1$ and $m_2$ be located at the position vectors $\boldsymbol{r}_1$ and $\boldsymbol{r}_2$. Write down the vector form for the force acting on $m_1$ due to its gravitational attraction to $m_2$.

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