



Mikhail M Agrest

Physics Department,
The CITADEL
Charleston, SC

Abstract

When Sir Isaac Newton was sitting under the Apple Tree thinking about the Universe an apple fell on his head and he invented The First Newton's Law... Was it Newton's acceptance of Rene Descartes' "Cogito ergo sum"? Why in the world Sir Isaac Newton was still sitting under the apple tree thinking about the Universe instead of doing something useful to feed his family.

Wasn't Newton himself giving credit for his First Law to Galileo for seeing that the zero net force leads to rest, or uniform motion?

It is essential that in teaching Physics we bring to the students' attention that Newton's approach brought physics to the level of understanding of similarity of events that look very different and differences of events looking very much similar. Sir Isaac Newton didn't "invent Calculus to solve mathematical problems", but to make concepts of Physics be visible through similarity and differences.

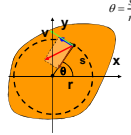
Translational

$$\vec{v} = \frac{\Delta \vec{x}}{\Delta t}$$

$$v = \lim_{\Delta t \rightarrow 0} \frac{\Delta \vec{x}}{\Delta t}$$

$$\vec{v} = \frac{\vec{x}_2 - \vec{x}_1}{t_2 - t_1} = \frac{\Delta \vec{x}}{\Delta t}$$

$$a = \lim_{\Delta t \rightarrow 0} \frac{\Delta \vec{v}}{\Delta t}$$



Rotational

$$\vec{\omega} = \frac{\Delta \theta}{\Delta t}$$

$$\omega = \lim_{\Delta t \rightarrow 0} \frac{\Delta \theta}{\Delta t}$$

$$\vec{\omega} = \frac{\theta_2 - \theta_1}{t_2 - t_1} = \frac{\Delta \theta}{\Delta t}$$

$$\alpha = \lim_{\Delta t \rightarrow 0} \frac{\Delta \omega}{\Delta t}$$

$$v = v_0 + a_0 t$$

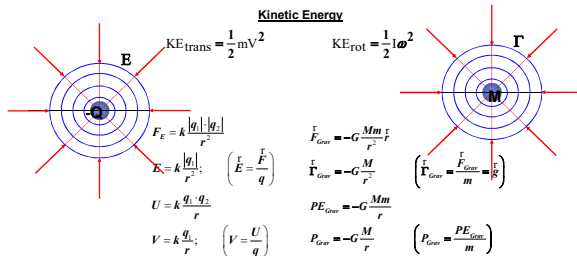
$$x = x_0 + v_0 t + \frac{1}{2} a_0 t^2$$

$$v^2 = v_0^2 + 2a(x - x_0)$$

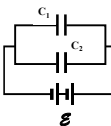
Kinetic Energy

$$KE_{trans} = \frac{1}{2} m v^2$$

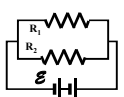
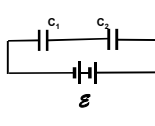
$$KE_{rot} = \frac{1}{2} I \omega^2$$



Parallel Circuit

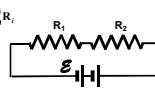


Series Circuit



$$\frac{1}{R} = \sum_{i=1}^n \frac{1}{R_i}$$

$$R = \sum_{i=1}^n R_i$$



American Association of Physics Teachers

Why Sir Isaac Newton was sitting under the Apple Tree...



Sir Isaac Newton Crossed the Road, because...

The Apple tree was there

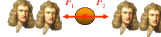
...from the Books of M.M.Agrest ...

When Sir Isaac Newton was sitting under the Apple Tree, thinking about the Universe, an Apple fell on his head and he invented what we call today "First Newton's Law".



$$\vec{v} = \text{const.} = \begin{cases} 0 \\ \neq 0 \end{cases}$$

$$\text{unless } \vec{F}_{net} \neq 0$$



$$\vec{F}_1 = -\vec{F}_2 \Leftrightarrow \begin{cases} |\vec{F}_1| = |\vec{F}_2| \\ \vec{F}_1 \uparrow \vec{F}_2 \end{cases}$$

... and again Sir Isaac Newton was sitting under the same Apple Tree, thinking about the Universe when the second Apple fell on his head and he invented what we call today "Second Newton's Law".



... and again Sir Isaac Newton was sitting under the same Apple Tree, thinking about the Universe when the third Apple fell on his head and he invented what we call today "Third Newton's Law".



$$\vec{F}_{BA} = -\vec{F}_{AB} \Leftrightarrow \begin{cases} |\vec{F}_{BA}| = |\vec{F}_{AB}| \\ \vec{F}_{BA} \uparrow \vec{F}_{AB} \end{cases}$$

But sir Isaac Newton was sitting under the same Apple Tree, again thinking about the Universe when the forth Apple fell on his head and he invented what we call today "Forth Newton's Law", Law of Universal Gravitation.



$$F = G \frac{m_A m_B}{R^2}$$

If the question "Why?" came to your mind, this is exactly the right reason for you to continue your study, because the old proverb says: "If you know HOW – you always have a job; If you know WHY – you are "The Boss".

Why in the World, Sir Isaac Newton was sitting under the same Apple Tree, thinking about the Universe again and again... Didn't he have a job? Didn't he have a family to provide for? Didn't he have other useful and pleasant things to do?

Sir Isaac Newton was sitting under the Apple Tree, thinking about the Universe, because this IS what we Physicists do! We think about the Universe, as Descartes taught: "I think, therefore I AM"

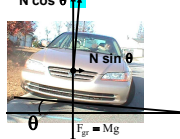
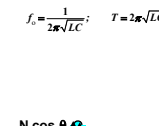
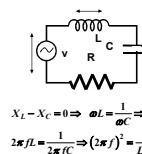
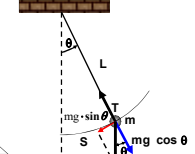
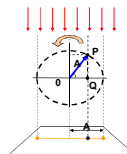
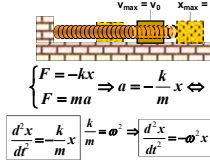


we observe it, as Galileo Galilei was doing, and as he said - "Where the senses fail us, reason must step in. Mathematics is the key and door to the sciences", as it provides possibility for reasoning and emphasize similar in difference and difference in similar

Reasoning and Mathematics



as Sir Isaac Newton taught, we try to understand how it operates; we formulate Hypothesis, then we check it, correct it, if necessary, and finally, it becomes a Theory that others may use to make predictions.



Cogito, ergo sum.



Probandi,...

The Electron Microscope and a hammer



Invoice
One hit with a hammer \$1.00
Knowing how to do it \$ 999.99

Forget everything they taught you at the College.
Here learn "knowledge of Real Life". ?????

Education vs. Training



Those who know HOW – always have a JOB
Those who know WHY – are their BOSSES,
Education is not learning HOW !
Education is learning to understand WHY!
CONCEPTUAL thinking is establishing relationship among events,
understanding SIMILAR IN DIFFERENT and DIFFERENCE IN SIMILAR.
LANGUAGE OF MATHEMATICS IS THE BEST FOR THIS PURPOSE