Exploring Physics 01

The last two sections of the page "Physics Equations 01" titled "Einstein's Field Equations are a Piece of Cake" and "*Paths not Taken*" can assuredly be ignored. They serve the unsubstantiated rambling of a Mad-Man, disconnected from the flow of these pages, and pay far to much attention to a fictitious audience. Though the rambles hold some seeds of truth for the Mad-Man, who is after all me, they do not belong in my own reasonable path of exploration. Those self indulgent musings which I have put on page serve only to stall my effort to learn something of value for the sake of beauty which is the World of my own existence.

Back to the Matter at Hand

Physics Mathematics Chemistry
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Back to the Matter at Hand

Physics is about where something is, where it will be and where it was. In **Classical** Physics these three things are completely deterministic and predictable. The physics of Newton is Classical and the basic principles derived from these Laws:

Newton's First Law: $\mathbf{p} = m\mathbf{v}$

> Every object will remain at rest or in uniform motion in a straight line unless compelled to change its state by the action of an external force.

Newton's Second Law: $\mathbf{F} = m\mathbf{a}$

> The rate of change of momentum, acceleration, produced by a particular force acting on a body is directly proportional to the magnitude of the force, inversely proportional to the mass of the body and in the same direction of the particular force.

Newton's Third Law: $\mathbf{F}_{12} = -\mathbf{F}_{21}$

> To every action there is always opposed an equal reaction; or, the mutual actions of two bodies upon each other are always equal, and directed to contrary parts. *"For every action there is an equal and opposite reaction."*

can be applied to systems which "on the surface" look quite different, but in fact operate in the same manner.

$F_{12} = -F_{21}$

$\Sigma F = ma$

$p_x = mv_x$

$F_s \leq \mu_s N$

$F_k = \mu_k N$

Α α	alpha	Ν ν	nu
Β β	beta	Ξ ξ	ksi
Γ γ	gamma	Ο ο	omicron
Δ δ	deta	Π π	pi
Ε ε	epsilon	Ρ ρ	rho
Ζ ζ	zeta	Σ σ	sigma
Η η	eta	Τ τ	tau
Θ θ	theta	Υ υ	upsilon
Ι ι	iota	Φ φ	phi
Κ κ	kappa	Χ χ	chi
Λ λ	lambda	Ψ ψ	psi
Μ μ	mu	Ω ω	omega

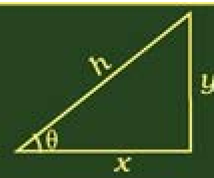
$$\frac{d}{dx} a = 0$$

$$\frac{d}{dx}(au) = a\frac{du}{dx}$$

$$\frac{d}{dx}(u + v) = \frac{du}{dx} + \frac{dv}{dx}$$

$$\frac{d}{dx}\sin u = \cos u \frac{du}{dx}$$

$$\frac{d}{dx}\cos u = -\sin u \frac{du}{dx}$$



$$\sin\theta = \frac{y}{h}$$

$$\cos\theta = \frac{x}{h}$$

$$\tan\theta = \frac{y}{x}$$

$$\tan\theta = \frac{\sin\theta}{\cos\theta}$$

$$h^2 = x^2 + y^2$$

The Fundamental Principles of Motion are Vectors independent of Coordinates

position $x(t) = a + bt + ct^2$

velocity $v = \frac{dx}{dt} = \dot{x} = b + 2ct$

acceleration $a = \frac{dv}{dt} = \frac{d^2x}{dt^2} = \ddot{x} = 2c$

position (r, θ) polar

$(r\cos\theta, r\sin\theta)$ cartesian

position written in terms of time and simplified by using a unit circle where radius, $|r| = 1$

$x(t) = \cos\omega t$ $y(t) = \sin\omega t$

velocity

$\dot{x} = -\omega\sin\omega t$ $\dot{y} = \omega\cos\omega t$

From the Dot Product the velocity is found to perpendicular to the radius, $|r| = 1$ and from the Pythagorean Theorem is of magnitude $|\omega|$.

acceleration

$\ddot{x} = -\omega^2\cos\omega t$ $\ddot{y} = -\omega^2\sin\omega t$

From the Dot Product and the Pythagoren Theorem the acceleration is found to be anti-parallel to the radius and of magnitude ω^2.

Useful Expressions of Linear Motion

$x_f = x_i + v_{xi}t \quad a = 0$

$x_f = x_i + \frac{1}{2}(v_{xf} + v_{xi})t$

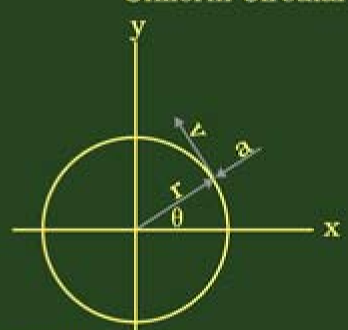
$x_f = x_i + v_{xi}t + \frac{1}{2}a_x t^2$

$v_{xf} = v_{xi} + a_x t = \frac{dx}{dt}$

$v_{xf}^2 = v_{xi}^2 + 2a_x(x_f - x_i)$

$a_{xf} = a_x = \frac{dv_x}{dt} = \frac{d^2x}{dt^2}$

Uniform Circular Motion



position = r

velocity = v = ωr

acceleration = $a = \omega^2 r = \frac{v^2}{r}$

At any given time the the angle θ increases linearly.

$\theta = \omega t$ relates time to the angle.

θ completes a rotation every 2π radians.

The period of rotation is $T = \frac{2\pi}{\omega}$, where ω is the angular frequency.

Classical Mechanics

Classical Mechanics is the study of motion of a particle or a system of particles where each particle is point. By the rules of Classical Physics, where something is at a specific time determines where it will be in the future and where it was in the past.

A coordinate system labels the location and provides a framework to describe motions driven by the principles that cause the motion. It is found through experimentation that the position of a particle can be completely described by:

$$x(t) = a + b(t) + c(t^2)$$

for any where and any when. The first derivative of the position equations gives the velocity. The second derivative of the position equation gives the acceleration.

These quantities can thus be calculated and also measured resulting in a validation of the theoretical principles of motion. The wildest thing about the validation is that it works out for both linear and circular motion. Motion is governed by the same principles even though the cases appear different in the Physical World.

Conservation Laws