

# 1 Physics: What the heck am I learning?

$\int \frac{df}{dx} dx = f$	<div> <div>Math</div> <div>Qualitative</div> </div> <p>Position change over time linearly with no acceleration</p>	<div>Quantitative</div> $\sum \vec{F} = m\vec{a}$ $\vec{a} = \frac{d\vec{v}}{dt}$ $\vec{x} = \frac{d\vec{v}}{dt}$
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## 2 4 Fields of Physics

There 4 kinds of physics:

classical mechanics	quantum mechanics
relativity	QFT

All related to E&M.

## 3 The 4 Basic Forces

1. Strong force:
  - (a) Bring neutron, proton, electron away, together
2. Electromagnetic force:
  - (a) Drive electric motor, magnets, give us friction, air resistance, normal forces
3. Weak:
  - (a) Nuclear decay. beta and gamma.
4. Gravity
  - (a) Weaker than all of them. Behave like E&M so use almost the same equation

## 4 Scalars and Vectors

1. Scalars
  - (a) unit-less
  - (b) magnitude

- (c) mass
- (d) time
- (e) count

## 2. Vectors

- (a) Length(magnitude) and direction
- (b) Know the representation of a Vectors
- (c) Addition and multiplication is the typical operator
- (d) You can add Vectors, scalar product
  - i. dot product and cross product does scalar computation
- (e) Displacement

## 3. vector addition/subtraction

## 4. dot product and cross product to manipulate vectors

# 5 Dot Product and Cross Product

<u>Dot Product</u>	<u>Cross Product</u>
$\vec{a} \cdot \vec{b} = c$ (scalar)	$\vec{a} \times \vec{b} = \vec{c}$ (vector)
$= ab \cos \theta$	$= ab \sin \theta \hat{n}$
$\vec{a} \cdot \vec{a} = a^2$	$\hat{n} \perp \vec{a}$
$\vec{a} \cdot \vec{a} = a^2$	$\hat{n} \perp \vec{b}$
<i>order of operation don't matter</i>	<i>order of operation matter.</i>
	$\vec{a} \times \vec{a} = 0$

1. If  $a$  double in size, then dot product double in size.
2. If you  $a$  double in size, then cross product double in size.
3. For cosine term, 0 degree give 1, 90 degree give 0, 180 degree give -1, and so on.
  - (a) Therefore, the dot product is maximized when the 2 vector point to the same direction (or how parallel they are)
4. For sine term, 0 degree give 0, 90 degree give 1, 180 degree give 0.
  - (a) Therefore, the cross product is maximized when the 2 vectos are perpendiculr to each other

## 5.1 The Dirac Delta Function

The divergence of  $\frac{\vec{r}}{r^2}$

$$\Delta \cdot \vec{v} = \frac{1}{r^2} \frac{\partial}{\partial r} (r^2 * \frac{1}{r^2}) = 0 \quad \text{The divergence is 0}$$

$$\int_{volume} \Delta \cdot \vec{v} \, dV = \oint_{surface} v \, d\vec{a}$$

Gauss's theorem (1)