T.G.I.W.


ATLANTIC
NORTH AMERICAN BASIN
SARGASSO SEA
GULF OF MEXICO
CARIBBEAN SEA
WEST
BAHAMAS
Havana
JAMAICA
Kingston
BELIZE
CENTRAL AMERICA
VENEZUELA
GRENADA
DOMINICA
ST. LUCIA
BARBADOS
ST. VINCENT & THE GRENADINES
TRINIDAD AND TOBAGO
ANTIGUA AND BARBUDA
Bermuda
Cape Hatteras
New York
Philadelphia
Boston
Montreal
Detroit
Cleveland
NOVA SCOTIA
NEWFOUNDLAND
LABRADOR
ONTARIO
AZORES
Tropic of Cancer
ANTILLES

Maxwell's equations

Wikipedia article on *Maxwell's Equations*:

General case

[edit]

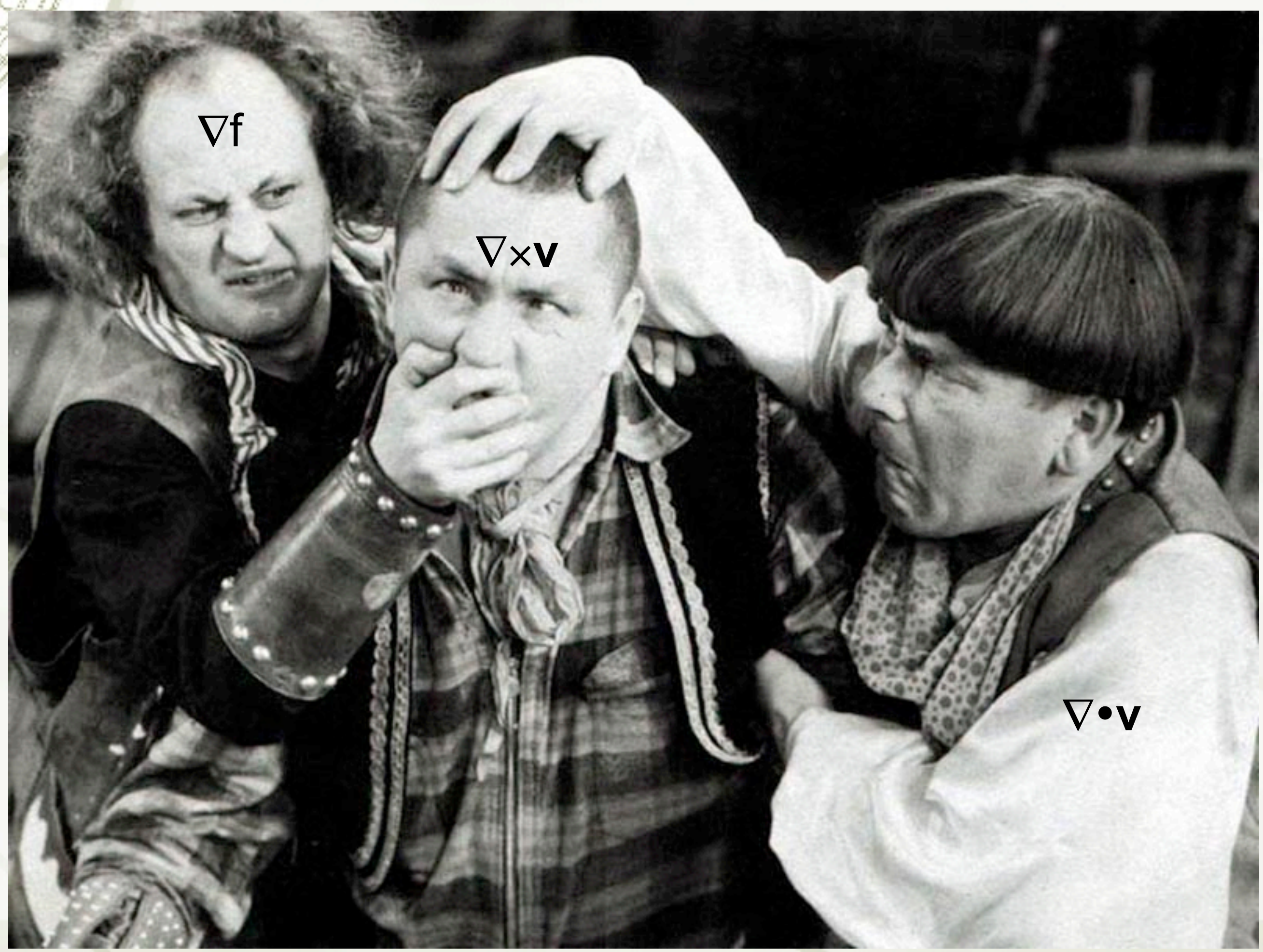
The Equations are given in SI units. See below for CGS units.

Name	Differential form	Integral form
Gauss's law:	$\nabla \cdot \mathbf{E} = \frac{\rho}{\epsilon_0}$	$\oint_S \mathbf{E} \cdot \mathrm{d}\mathbf{A} = \frac{Q_S}{\epsilon_0}$
Gauss' law for magnetism (absence of magnetic monopoles):	$\nabla \cdot \mathbf{B} = 0$	$\oint_S \mathbf{B} \cdot \mathrm{d}\mathbf{A} = 0$
Faraday's law of induction:	$\nabla \times \mathbf{E} = -\frac{\partial \mathbf{B}}{\partial t}$	$\oint_{\partial S} \mathbf{E} \cdot \mathrm{d}\mathbf{l} = -\frac{d\Phi_{B,S}}{dt}$
Ampère's Circuital Law (with Maxwell's correction):	$\nabla \times \mathbf{B} = \mu_0 \mathbf{J} + \mu_0 \epsilon_0 \frac{\partial \mathbf{E}}{\partial t}$	$\oint_{\partial S} \mathbf{B} \cdot \mathrm{d}\mathbf{l} = \mu_0 I_S + \mu_0 \epsilon_0 \frac{d\Phi_{E,S}}{dt}$

The following table provides the meaning of each symbol and the SI unit of measure:

Symbol	Meaning (first term is the most common)	SI Unit of Measure
$\nabla \cdot$	the divergence operator	per meter (factor contributed by applying either operator)
$\nabla \times$	the curl operator	

Grad, Curl, and Div



Grad, Curl, and Div

- Just for fun, think of ∇ as a vector "operator" with components
  - $\partial/\partial x$, $\partial/\partial y$, and $\partial/\partial z$.
- And do with it what you like to do with vectors.

Favorite functions of the day

- Scalar function
  - xy, $|\mathbf{r}|^3$
- Vector fields
  - $x\,\mathbf{i} + y\,\mathbf{j} + z\,\mathbf{k}$, a.k.a. $\mathbf{r}$.
  - $-y\,\mathbf{i} + x\,\mathbf{j} + 0\,\mathbf{k}$.
  - $-\mathbf{r}/|\mathbf{r}|^3$. *Why is this one important?*

From Wolfram MathWorld

(Go to that site to see graphics of vector fields.)

New derivatives

- Derivative in out notation
  - ∇ = grad gradient
  - $\nabla\bullet$ = div divergence
  - $\nabla\times$ = curl curl

a.k.a. rot

New derivatives

Derivative	in	out	notation
∇f = grad f	scalar		gradient
$\nabla \bullet \mathbf{v}$ = div **v**	vector		divergence
$\nabla \times \mathbf{v}$ = curl **v**	vector		curl a.k.a. rot **v**

New derivatives

Derivative	in	out	notation
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$\nabla \bullet \mathbf{v}$ = div **v**	vector	scalar	divergence
$\nabla \times \mathbf{v}$ = curl **v**	vector	vector	curl a.k.a. rot **v**

Grad, curl, and div

- grad. ∇f
  - The direction uphill and the slope
  - Critical points
  - Normal vectors and tangent planes

Grad, curl, and div

- div. $\nabla \bullet \mathbf{v}$
  - Quantifies the tendency of a vector field to spread.
  - Related to flux (stay tuned)

Grad, curl, and div

- curl. $\nabla \times \mathbf{v}$
  - Quantifies the tendency of a vector field to swirl.
  - Related to flux (stay tuned)

New rules

- Linear rules
- Product rules
- Chain rules
- Higher derivatives
  - Laplacian $\nabla^2 = \nabla \bullet \nabla$
  - $\nabla \times \nabla f =$
  - $\nabla \bullet \nabla \times \mathbf{v} =$

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Math videos of the day

- Sarah's choice: I will derive, at
  - http://www.youtube.com/watch?v=P9dpTTpjymE
- Kenneth's choices:
  - The derivative song, at http://www.youtube.com/watch?v=eEhkBmHqGA8
  - Pi (the movie), http://www.pithemovie.com/

This Thanksgiving, don't just eat the turkey and π ….

Remember your Green's!

The End