2. Review of vector and scalar fields.

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Scalar field: A scalar function of one or more variables:

eg. The distribution of locally averaged family incomes over the United States,

or the electric charge distribution on the surface of a piece of metal.

Vector field: A vector function of one or more variables:

eg. the velocity of a projectile fired from a cannon as a function of time,

or the electric field as a function of time and space.

Why vectors?

Some quantities of PHYSICAL interest CANNOT be characterized by a SINGLE number.

In order to fully characterize a vector field, $\vec{F}$, which represents, say force, you must

(1) Tell the point in space and time at which you are interested in determining F.

(2) Tell the DIRECTION in which F acts.

(3) Tell how MUCH force is being applied ($|\vec{F}|$).

How is a vector represented?

(1) Graphically. This type of representation is useful for illustrative purposes for vector fields and can be useful computationally for two-dimensional vector fields.

(2) Resolution into components. This is most commonly how we represent a vector.

For example, in RECTANGULAR COMPONENTS, we represent a vector by specifying its PROJECTIONS along the x, y, and z axes.

The BASE vectors for rectangular components are vectors with UNIT magnitude and with a direction along the x, y, and z axes.

The most common notations are

NOTATION	BASE VECTOR DIRECTION		
	x	y	z
	$\mathbf{i}$	$\mathbf{j}$	$\mathbf{k}$
	$\mathbf{e}_1$	$\mathbf{e}_2$	$\mathbf{e}_3$
	$\hat{x}$	$\hat{y}$	$\hat{z}$

In this course, we will use the last notation because it clearly indicates to which coordinate axes the vector is parallel.

In general, a circumflex, "^," over a symbol will be used to indicate that that symbol represents a UNIT vector.

Thus, in our notation, a vector, $\vec{F}$, would be written as

$$\vec{F} = F_x \hat{x} + F_y \hat{y} + F_z \hat{z},$$

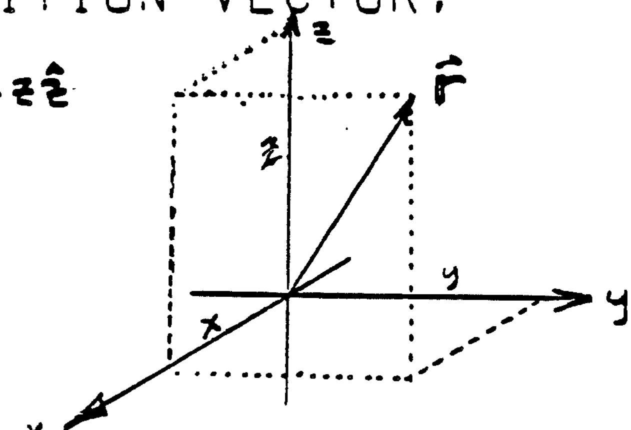
in rectangular coordinates.

Later on in the course, we will find that it is NECESSARY to use OTHER coordinate systems than rectangular to solve problems.

Now $\vec{F} = \vec{F}(x, y, z, t)$ in most problems of physical interest.

Rather than writing out "x, y, z" every time, it is preferable to define the POSITION VECTOR,

$$\vec{r} = x\hat{x} + y\hat{y} + z\hat{z}$$



Thus, we write

$$\vec{F} = \vec{F}(\vec{r}, t).$$