LENGTH – TIME – MOTION

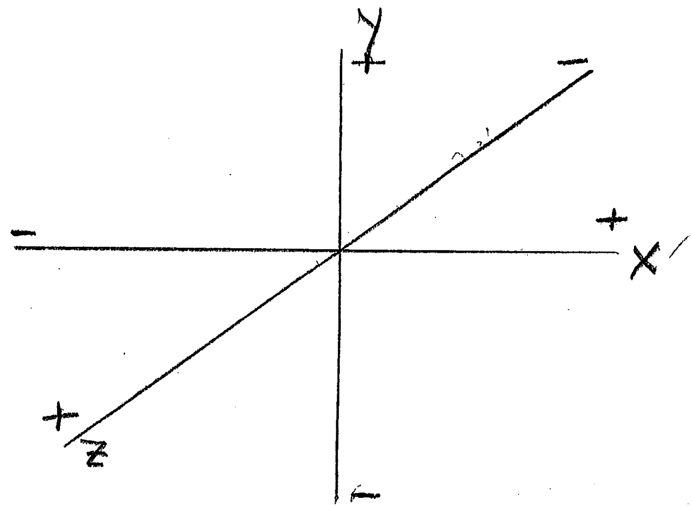
Coordinate Systems

Once we have a way to measure the dimensions of length along three mutually perpendicular directions we can locate the position of any object in the universe. We begin by choosing a point which we call the origin (O) and draw three mutually perpendicular lines which we label x-axis, y-axis and z-axis

x→ left-right

y→ up-down

z→ back and forth



The location of any point is then uniquely determined by the triplet of numbers called "coordinates". For instance, if we write (3m, 4m, 5m) that fixes the point where starting for 0 we go 3m right, 4m up and 5m forward. Alternately (-3m, 4m, -5m) is a point reached by going 3m left, 4m up and 5m back.

So we have a well defined method for fixing the position of any object in our universe. However, if all objects always remained fixed the universe would be very dull. It is far more fun to take the next step: our "point" object is moving. This requires us to introduce the next "player" in our description of the universe.

TIME

All of us are aware of the passage of time, but establishing a succinct definition of time is by no means easy. Indeed, we use concepts of "before" and "after" or alternatively "cause" and "effect" to put a sequence of events in order to mark the flow of TIME. It is therefore not surprising that a meaningful method of measuring time developed long after people had learned to gauge the extent of space; the development of the simple clock owes its existence to the brilliant observation made by Galileo that the time elapsed for the chandeliers, in a cathedral, to swing back and forth was controlled only by their length (incidentally, he made the measurement with reference to his pulse beat). We will discuss the precise reasons for this much later, but once this finding became available the simple pendulum clock followed soon after and measurement of time got a firm footing. As you will learn in the very first experiment the period of a pendulum of length l is

$T = 2\pi(\frac{l}{g})^{1/2}$ where $g = 9.8 m/s^2$.

So, in our master table the next row is

TIME	T^1	second	scalar

and the intervals of every day interest are:

minute	60sec
hour	60min.
Day*	24hrs.
Year**	$365\frac{1}{4}$ days

*Time taken by Earth to turn on its axis once.
**Time taken by earth to complete one revolution around the Sun.

MOTION

Once we have a measure of both position and time we can introduce the simplest parameter to describe motion: speed (S)

$$S = \frac{\text{distance traveled}}{\text{time taken}}$$

S	LT^{-1}	m/sec	scalar

It is useful to look at an everyday speed to relate it to SI units.

$60 mph = 88 ft/\sec = 26.82 m/\sec$