Physics 2001 Introduction:

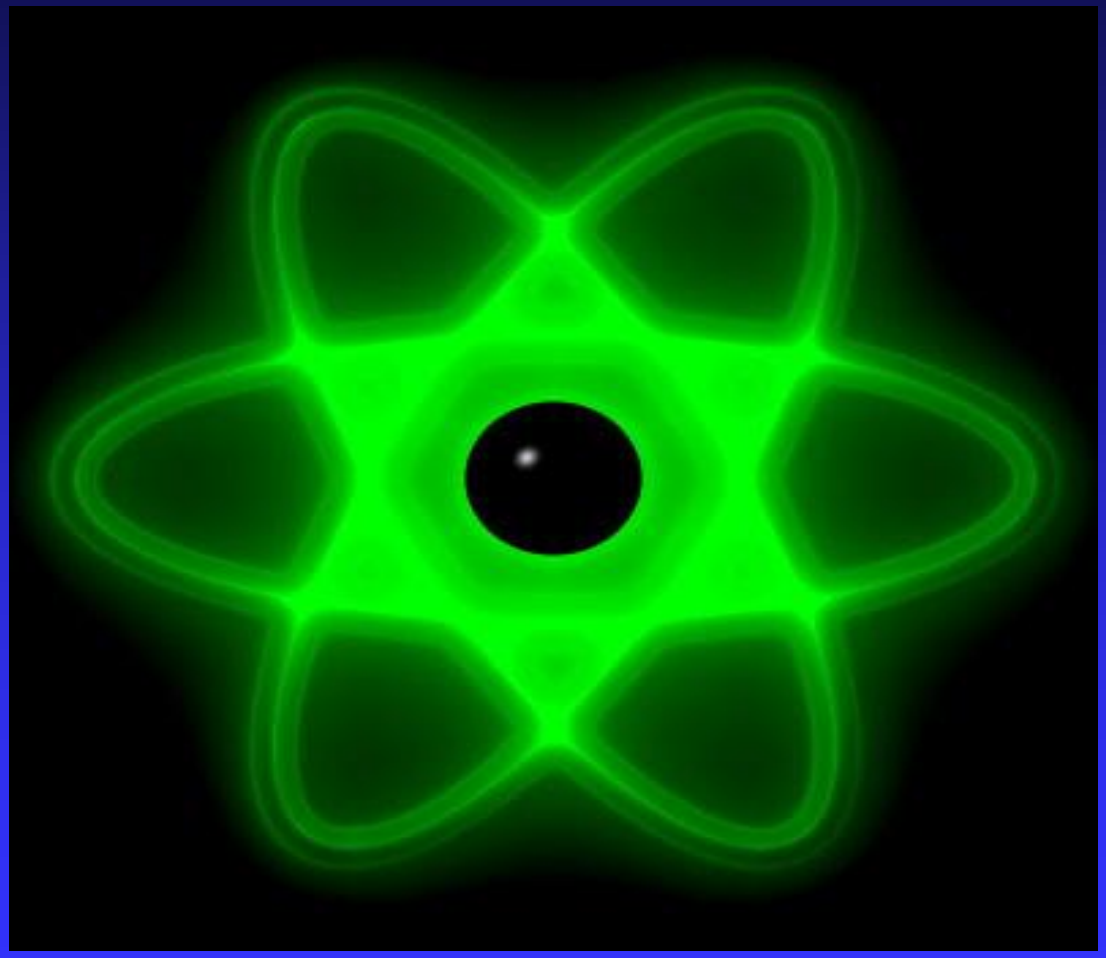
- What is Physics
  - The scientific study of the basic properties of matter and energy

The Galaxies, The Large View

The Cosmos


CYBER ESPACE
http://www.cyberespace.ca
The Hubble Heritage Project
http://heritage.stsci.edu/

The Atom- The small view

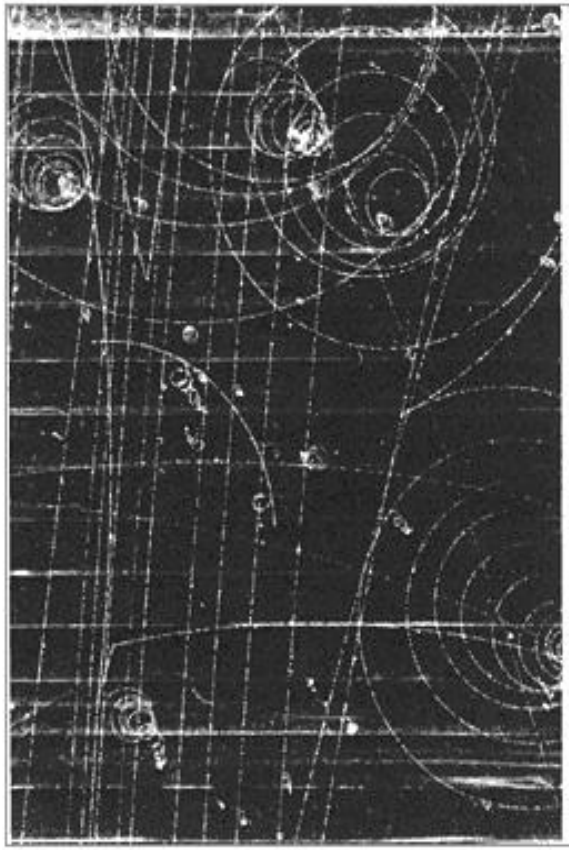


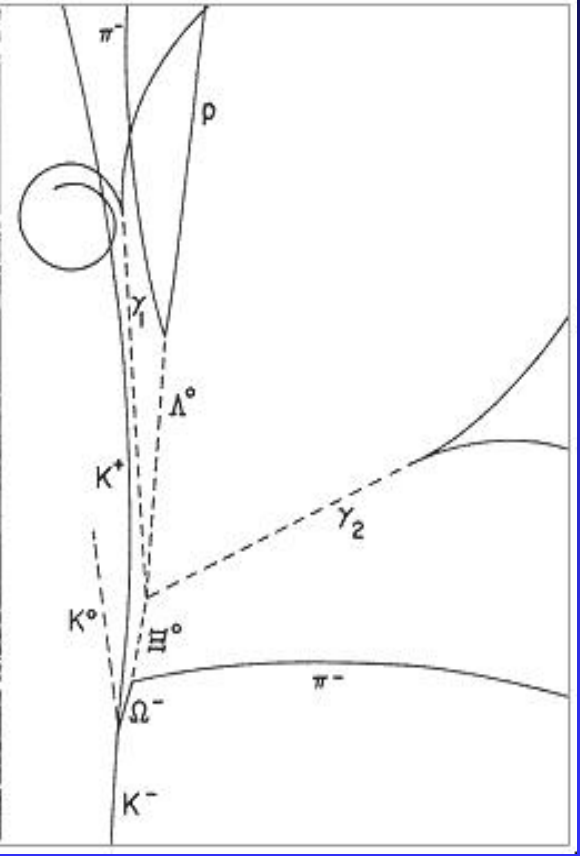
The small-Fundamental Particles

Discovery of the strange quark

Image: This image shows the first Omega-minus particle to be discovered. An incoming K- meson collides with a proton in a liquid hydrogen bubble chamber producing the Omega-minus, a K+ meson, and a K0 meson. Neutral particles leave no tracks in the chamber and are denoted by dashed lines. The positions of the neutral particles are inferred from the visible decay products and by the use of the laws of conservation of energy and momentum.

One of the most important





Science

- An organized method of study using the scientific method:
  - Observation
  - Hypothesis
  - Experiment
  - Modification of Hypothesis

Parts of Science

- Consists of Physical Sciences, Life Sciences, Social Sciences

Physical, Social and Life Sciences

- **Life Sciences**
  - **Biology, Anatomy,Physiology,…**
- **Physical Sciences**
  - **Physics, Geology, Chemistry,…**
- **Social Sciences:**
  - **Psychology, Sociology..**

Physics 2001

Chapter 1

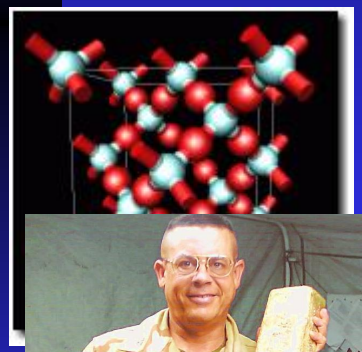
Motion

Drag Racing-an example of the importance of acceleration and average speed

- In drag racing the first car to the end of the course wins.
- This usually means the one with the fastest acceleration
- However one car can accelerate faster at the beginning and the other might still win if it accelerates more at the end.

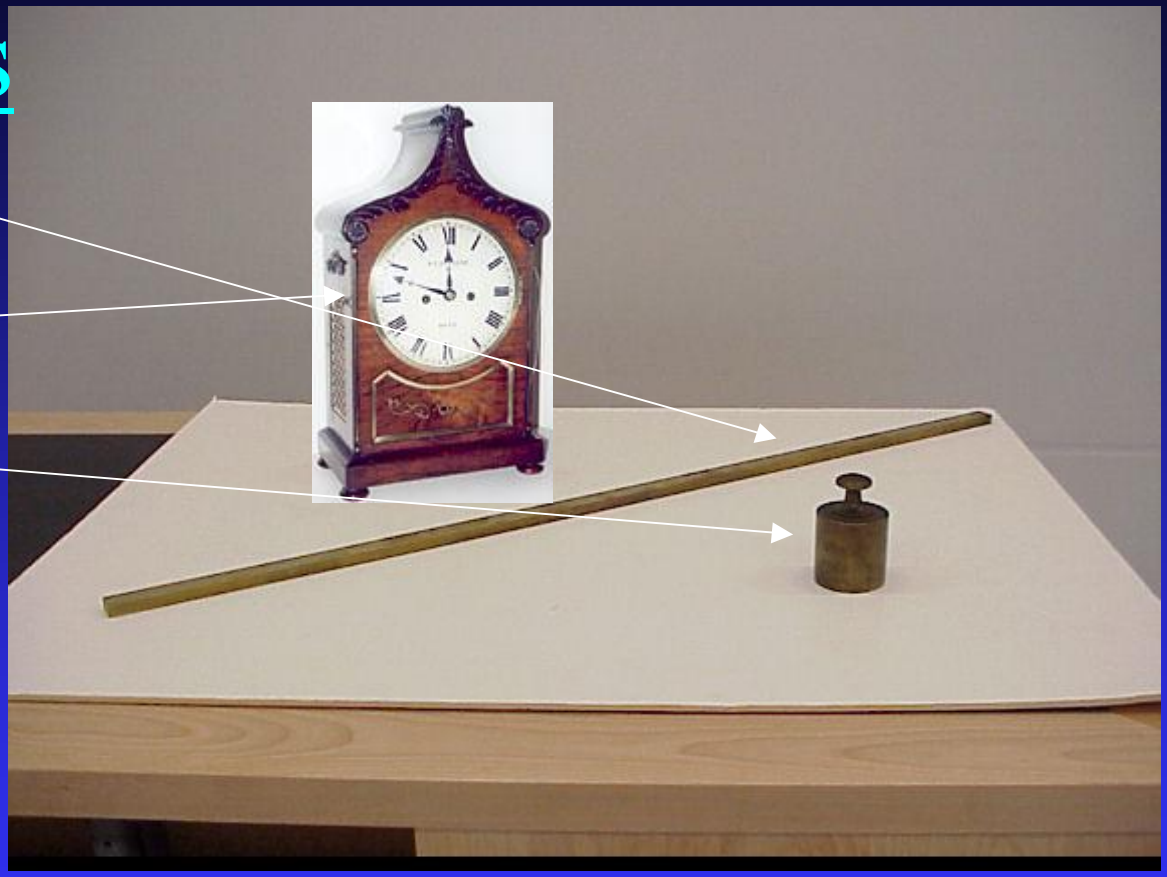
3 Basic Aspects of Nature

- Space
- Time
- Matter



3 Fundamental Physical Quantities

- Distance
- Time
- Mass



Units

- Size or amount used in measuring something (physical quantity)
- Based on standard,
- Standard: something of known size, e.g. Length of Kings Foot = “Ruler”, or foot.

Aspect vs Quantity

- Space vs Distance…Distance=how space is measured feet, meters, miles, etc.
- Time vs. Time in seconds, min.,etc
- Matter vs mass, mass=how matter is measured kilogram, gram, slug, etc.

Exponents

- An exponent is a number telling us the other number is multiplied by itself this many time.
- $10^2 = 10 \times 10 = 100$
- $10^4 = 10 \times 10 \times 10 \times 10$
- Negative exponents are 1 divided by the number
- $10^{-2} = 1/10 \times 1/10$ or .01 (2 decimal places)
- $10^{-4} = 1/(10 \times 10 \times 10 \times 10) = .0001$ (4 dec. places)

Prefixes

- A word put in front of another word to alter the meaning of the word.
- Example word: boat,
- Prefix: life
- New word: lifeboat
- In physics we use prefixes frequently, especially in units.

Metric System

- **A special system of units, consisting of units for all the known physical quantities and concepts used by science.**
- **Example length: meter**
- **Mass: Gram**
- **Time: second**
- **Prefix: kilo = 1 thousand, kilometer = 1000 meters; kilogram = 1000 grams.**

Common Prefixes in the Metric System

- **Deci = $1/10^{th}$**
- **Deca = 10 times**
- **Centi = $1/100^{th} = 10^{-2}$**
- **Milli = $1/1000^{th} = 10^{-3}$**
- **Micro = $1/1000{,}000^{th} = 10^{-6}$**
- **Mega = 1,000,000 times = 10^{+6}**
- **Giga = 1,000,000,000 times = 10^{+9}**

Physical Objects

Measurement

Length, Time

The Breath Experiment

Metric vs. British System

Conversions

- To convert from one unit to another
  - Get the conversion factor
  - Multiply it by the number of units
  - E.g. 1 m = 3.28 ft
  - 12 m = 12 x 3.28 = 39.36 ft

Cycle and Period:

- A cycle is one complete phase of something
- **Period** (T) The time for one complete cycle of a periodic process.

Frequency (f)

- The number of cycles of a periodic process that occur per unit time.
- The unit of measure of frequency is the hertz (Hz). (s^{-1} =1/sec)
- To get frequency from period, divide 1 by period. T=12(s), f = 1/12(Hz)

Mass (m) .

- A measure of an object's resistance to acceleration. A measure of the quantity of matter in an object
- Measured in grams, kg (SI units), slugs (British Units)

Speed (v)

- **Rate of movement. Rate of change of distance from a reference point. The distance that something travels divided by the time elapsed.**
- V= Δd/Δt (Δ = greek letter delta, = change in something).
- Δd/Δt = change in distance/change in time (time for the change to happen)

Calculating Speed

- An object is 8 ft from the door, 3 seconds later it is 23 feet from the door,
- Δd=final-original=23-8=15 ft
- The object moves 15 feet in 3 seconds
- $V = \Delta d/\Delta t = 15/3 = 5$ ft/sec

Velocity

- Velocity is Speed with direction.
- E.G. 90 meters/second North
- 30 meters/second South West
- 80 mph South, etc.

Vectors vs Scalars

- Vectors have size and direction, e.g. 90 meters North
- Scalars have only size, e.g. 90 meters.
- Vector 120 miles per hour (mph) East (E).
- Scalar 120 miles per hour
- We draw vectors on paper to represent them.

Drawing Vectors

- **When representing a vector we must use a grid, the grid shows direction, like North, South, East, and West, and size.**
- **For example the size of 1 inch on the grid may stand for 10 miles per hour of velocity. This is the "scale"**
- **Something 2 inches long would be 20 miles per hour.**

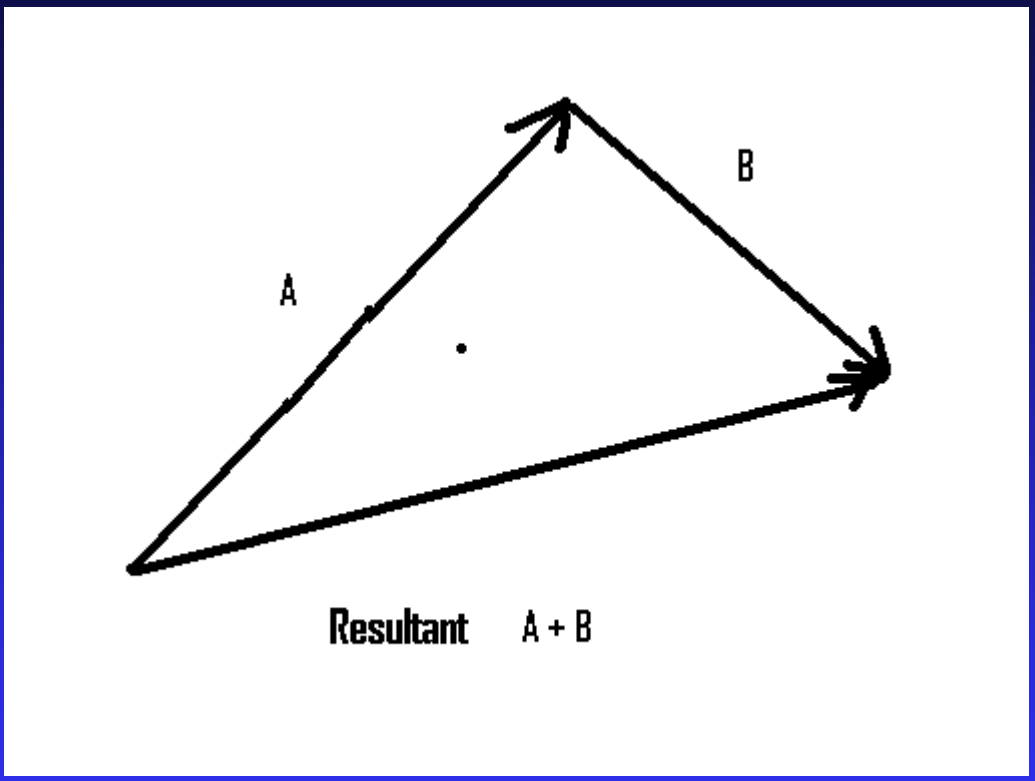
One Dimensional Vector Addition

- Back and forth in the same direction.

Two Dimensional Vector Addition,

- To add vectors:
  - Draw the first vector, A
  - Draw the second vector,B, with it's tail starting at the head of the first vector
  - The answer, or resultant is drawn from the tail of the first to the head of the last.

Vector Addition Example



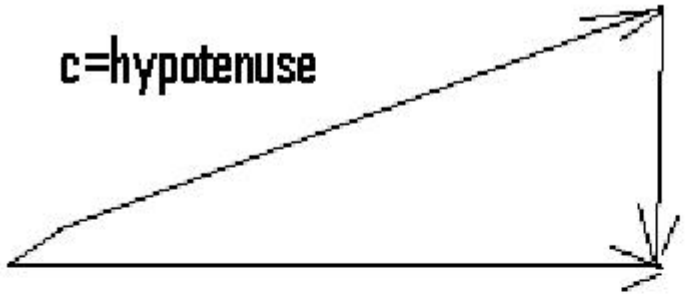
Average Speed Vs Instantaneous Speed, Velocity,

- Average speed is speed over some time or distance, but it may be changing, to know it exactly we need to know it at a very short "instant" in time. This is the instantaneous speed or velocity.

Trigonometry,

Pythagorean Theorem, Right Triangles,

- $c^2 = a^2 + b^2$
- Hypotenuse squared = sum of the squares of the sides in a right triangle



$c2 = a2 + b2$

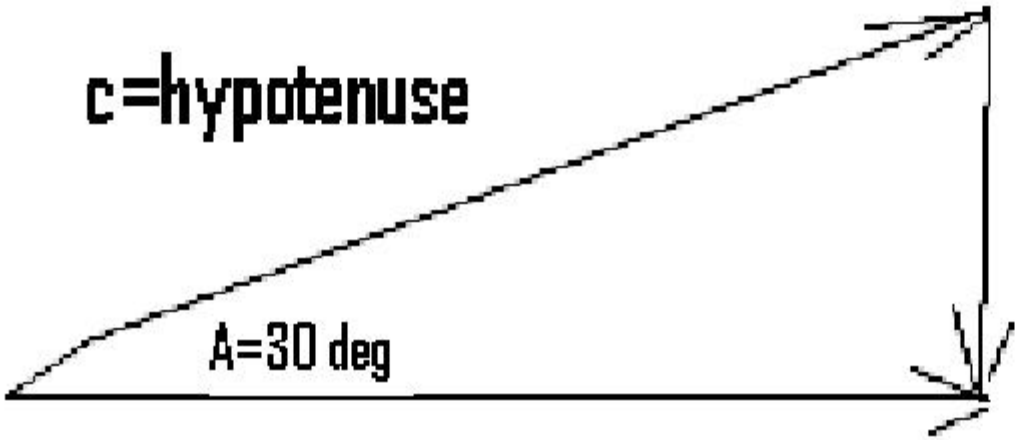
Ex. c=9, b =5 a=?

9 x 9 = a x a + 5 x 5

81 = axa + 25

81-25 = 56 = a xa

a = sq.rt of 56 = 7.5



Pyth. Theorem always holds, but special case 30 deg. angle.

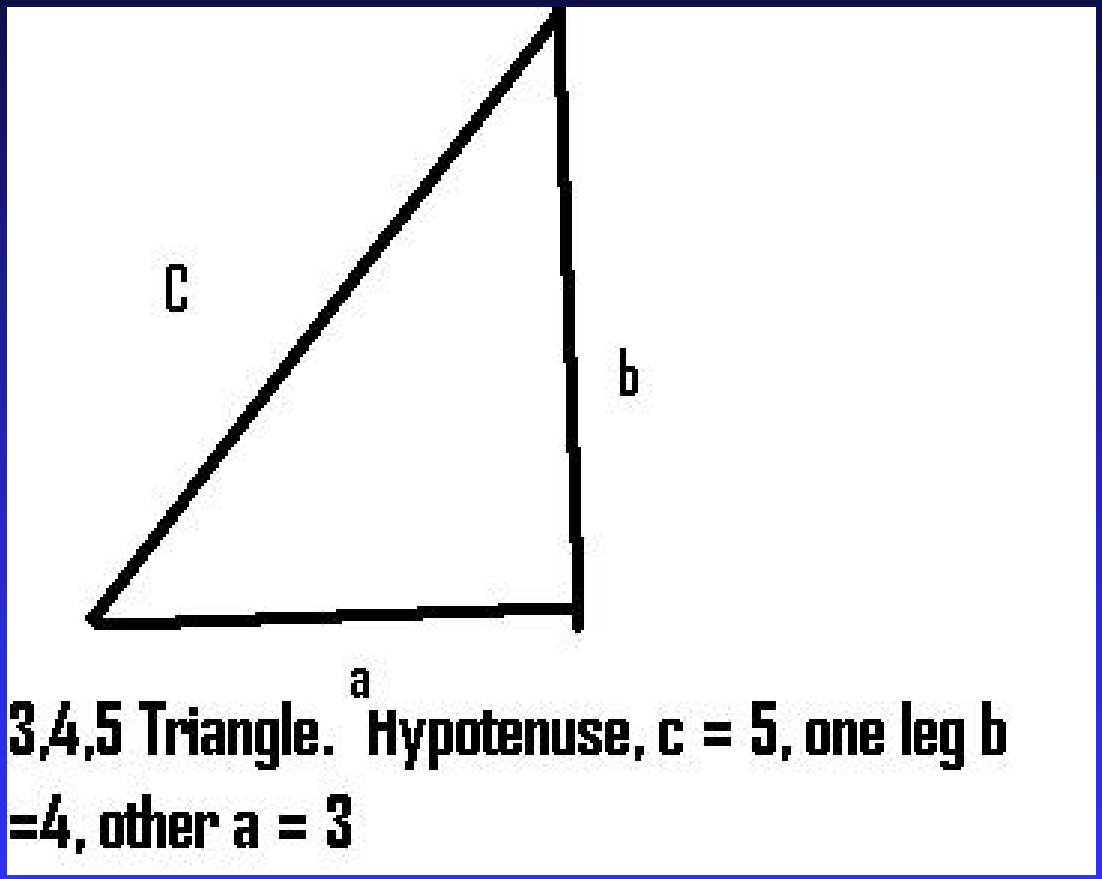
When a = 30 deg. b = 1/2 x c or 1/2 x hypotenuse.

e.g. c = 12, b = 12/2 or 6

$$c2 = a2 + b2$$

3-4-5 Right Triangle

- 3-4-5 Right Triangle. Sides a ratio of 3 to 4 to 5. E.G. a = 9 (3x3), b = 12 (3x4) and c=15 (3 x 5)



Acceleration

- Rate of change of velocity.
- The change in velocity divided by the time elapsed.
- $\Delta v/\Delta t$ = change in velocity/change in time (time for the change to happen)

Example of Acceleration Problem

- Velocity 9 m/s E
- After 2 sec. v= 15 m/s E
- Change in v=(final-original)15-9 or 6 m/s E
- $a=\Delta v/\Delta t$
- a = 6m/s/2sec = 3 m/s/s(m/s^2) E

Determining v from a and t

- When a is constant, $v = a \times t$
- $a = 5\ m/s^2$ $t = 20\ s$
- $v = 5\ m/s^2 \times 20\ s = 100\ m/s$

Centripetal Acceleration

- Acceleration of an object moving along a circular path.
- It is directed toward the center of the circle.
- $a = v^2/r$ = square of velocity divided by the radius of the circle.

Example Cent. Acc.

- Particle moves in a circle of radius 5 m
- Speed is 12 m/s. What is Cent. Acc.?
- Cent. Acc. = $v^2/r = (12\ m/s)^2 / 5\ m$
- = $144\ m^2/s^2 / 5m = 28.8\ m/s^2$

Simple Types of Motion:

- Zero Velocity, Constant Velocity
- d = v x t when v=constant
- E.g. v = 10 m/s; t = 5 s
- d = 10 m/s x 5 s = 50 m

Distance vs. Time Graphs,

- Slope of the distance vs time graph = velocity

Constant Speed Graphs

- Speed vs. time, plots a straight line.

Accelerated motion,

- When velocity is changing we have accelerated motion.
- The simplest case is when acceleration is constant, such as the acceleration of gravity near the earth's surface.

Speed vs. Time Graphs.

- When speed is constant the graph is a straight horizontal line.
- When speed is accelerated uniformly (constant acceleration) the graph is a straight line at an angle.
- The slope is the acceleration. See fig. 1.26

Constant Acceleration,

- Acceleration of Gravity
- g = acceleration of gravity = 9.8 m/sec/sec.
- $d = \frac{1}{2} at^2$ ($\frac{1}{2}$ x a x t x t)

$D = \frac{1}{2} at^2$ Problem

- $a = 9.8\ m/s^2$
- $t = 5$ sec. What is d?
- $\frac{1}{2} at^2 = \frac{1}{2} \times 9.8\ m/s^2 \times 5\ s \times 5\ s$
- $= 4.9 \times 25\ m/s^2 \times s^2 = 122.5\ m$

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