Summary of Prelim Period:

Rectilinear Motion with constant/ uniform acceleration:

$S = Vt$

$V = Vo \pm at$

$V2 = Vo2 \pm 2aS$

$S = Vo\ t \pm 1/2at2$

Free Falling Bodies:

$V = Vo - gt$

$V2 = Vo2 - 2gh$

$h = Vo\ t - 1/2gt2$

Where: $g = 9.81 m/s2 = 32.2\ ft/s2$

Rectilinear Motion with variable acceleration:

$V = dS/dt$ **(velocity)**

$a = dV/dt = d^2S / dt^2$ **(acceleration)**

$a \cdot dS = V \cdot dV$

Motion Diagrams:

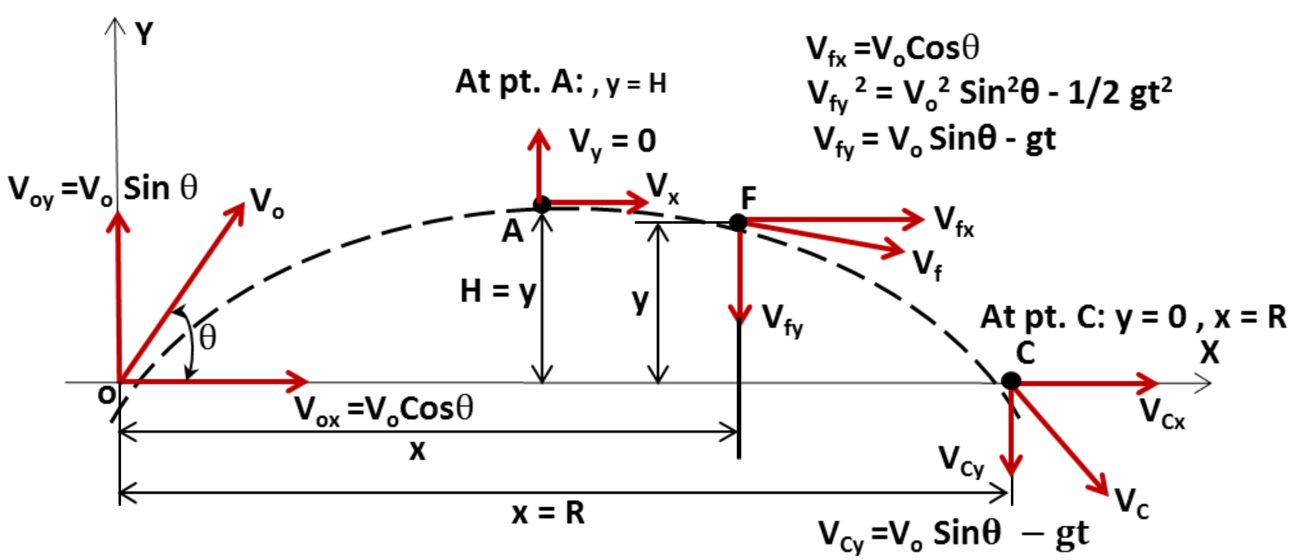
a. The increase in velocity during a given time interval is equal to the area of the ***a-t diagram*** for that time interval. **V_1 = Vo + Area of Acceleration**

b. The increase in velocity during a given time interval is equal to the area of the ***v-t diagram*** for that time interval. **S_1= So+ Area of Velocity**

Projectile Motion: Curvilinear Translation (where Air resistance neglected)

Projectile – is any body that is given an initial velocity and then follows a path determined entirely by the effects of gravitational acceleration.

Trajectory – The path followed by a projectile and is always parabola.



At Any Point:

Along Horizontal: ($a_x = 0$, $V_{ox} = V_o \cos\theta$)

- $x = V_o \cos\theta\, t$
- $V_x = V_o \cos\theta$

Along Vertical: ($a_y = -g$, $V_{oy} = V_o \sin\theta$)

- $V_y^2 = V_o^2 \sin^2\theta - 2gH$
- $V_y = V_o \sin\theta - gt$
- $y = V_o \sin\theta\, t - ½ gt^2$

- **at maximum height ($V_y = 0$, $y=H$)**
  - $H = V_o^2 \sin^2\theta / 2g$
  - $t = V_o \sin\theta / g$

  (t= time from moment of release to the highest point of its flight)
- **At maximum range or maximum horizontal distance ($x = R$, $y = 0$)**
  - $R = V_o^2 \sin 2\theta / g$
  - $t = V_o \cos\theta / R$

  (t = time from the moment of release to the point at which it hits the ground)

General Equation: At any point in the projectile path

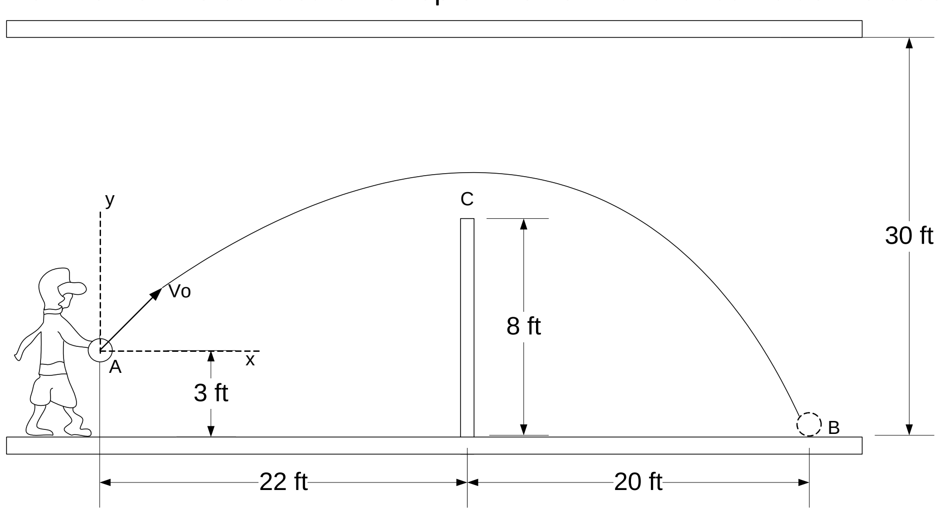
$$y = x\tan\theta - ½ (gx^2/V_o^2 \cos^2\theta)$$

Practice Problems:

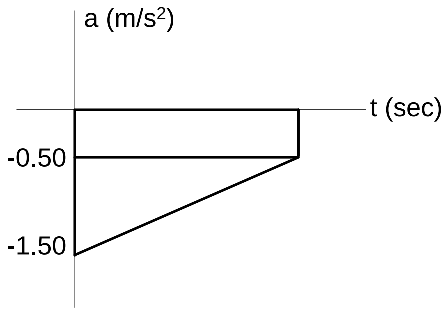
1. A ball is thrown from a tower 30m high above the ground with a velocity of 300 m/s directed at 20 from the horizontal. How long will the ball hit the ground?
2. A stuntman is to drve a car across the water-filled gap shown. Determine the car's minimum take velocity and the angle θ of the landing ramp.
3. A stone is thrown upward at an angle of 30 with the horizontal it lands 60m measured horizontally and 2m below measured vertically from its point of release. Determine the initial velocity of the stone.
4. A ball is thrown so that it just clears a 3m fence 18m away. If it left the hand 1.5m above the ground and at an angle of 60° with the horizontal, what was the initial velocity of the ball?
5. The volleyball player serves the ball from point A with the speed V_o =40 ft/sec at the angle θ=30°.

(a) Derive the equation of the trajectory (y as function of x) of the ball.

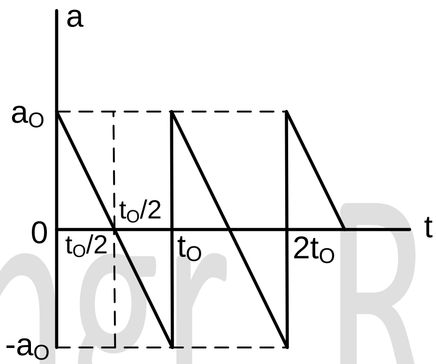
(b) Determine whether the ball clears the top of the net C and lands inside the baseline B



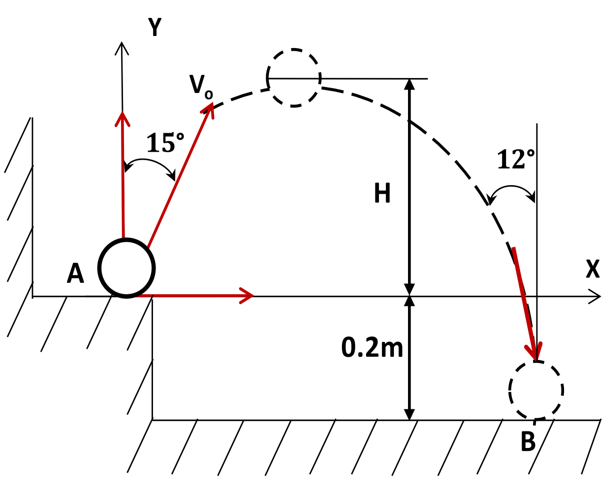
6. A train is brought to an emergency stop in 16 seconds; the decelerations are being shown in the diagram. Compute (a) the speed of the train before the brakes were applied; and (b) the stopping distance.



7. A particle, at rest when t=0, undergoes the periodic acceleration as shown in the figure. Determine the velocity and distance traveled when (a) $t= 3t_O$; and (b) $t= 3.5t_O$



8. A ball is dropped onto a step at point A and rebound with a velocity Vo at an angle of 15 with the vertical. Determine the value Vo knowing that just before the ball bounces at point B, its velocity VB forms an angle of 12 with the vertical, determine also the velocity at point B and the maximum height



that the ball could reach from B.