-- Two-Dimensional Motion --

Scalar: quantity composed of only magnitude (distance, volume, speed, mass, energy, power)

Vector: quantity composed of both magnitude and direction (scalar with direction; displacement, velocity, acceleration, force, weight)

V_i = initial velocity
V_f = final velocity
Δx = change in position
a = acceleration
t = time

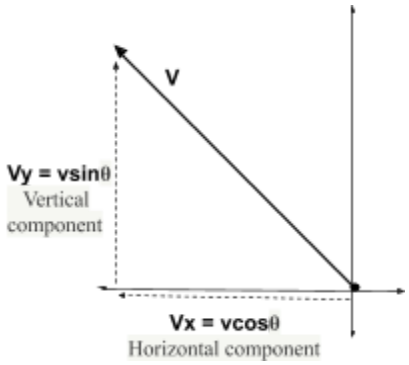
No V_i: $\Delta x = V_f t - \frac{1}{2} a t^2$
No V_f: $\Delta x = V_i t + \frac{1}{2} a t^2$
No Δx: $V_f = V_i + at$
No a: $\Delta x = (\frac{V_1 + V_f}{2})t$
No t: $V_f^2 = V_i^2 + 2a\Delta x$

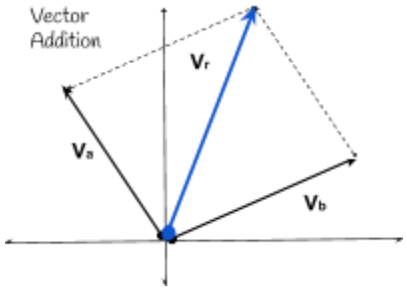
Ball travelling 885 m/s

Ball travelling 500m/s

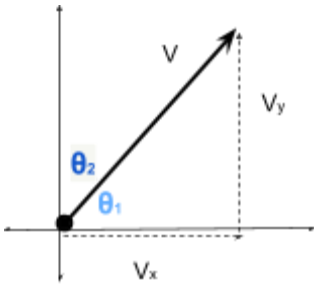
=

Ball travelling 385 m/s



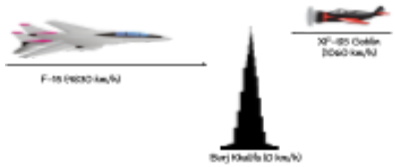


$Vr = \sqrt{V_a{}^2 + V_b{}^2}$



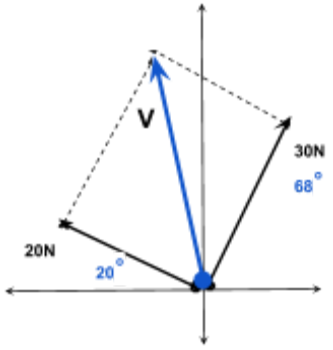
$\theta 1 = tan^{-1}(\frac{Vy}{Vx})$ $\theta 2 = tan^{-1}(\frac{Vx}{Vy})$

Relative Velocity



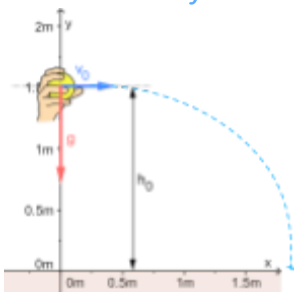
Ref. Frames	F-15 (km/h)	XF-85 (km/h)	Burj K (km/h)
F-15	0	4830+1060 = 5890	4830
XF-85	1060+4830 = 5890	0	1060
Burj K	4830	1060	0

☆ there is no air resistance in an ideal world
☆ horizontal & vertical components act separately of each other

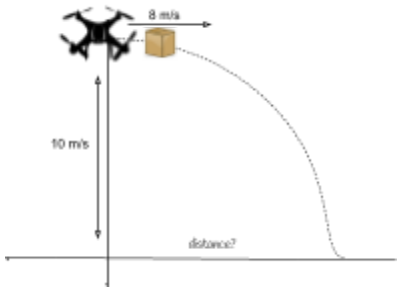


Find resultant vector:
$Vx = 30\cos 68^\circ - 20\cos 20^\circ = -7.56$
$Vy = 30\sin 68^\circ + 20\sin 20^\circ = 34.66$

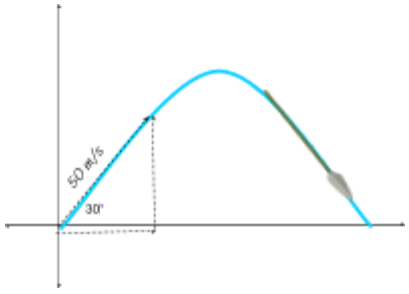
Horizontal Projectile:



☆ gravity is the only force pushing the object downwards **(Vy initial is 0, a=-g, y=h)**
☆ V0 is x comp. of velocity (stays the same)
☆ initial velocity doesn't determine time in air, but height does, which also affects Δx
☆ $t = \sqrt{\frac{2h}{g}}$ ☆ $\Delta x = v_i\sqrt{\frac{2h}{g}}$

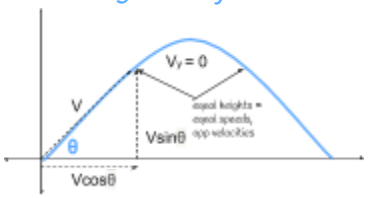


$\Delta x = ?$
☆ $t = \sqrt{\frac{2(10)}{9.8}} = 1.43$
$\Delta x = v_i t = (8)(1.43) = 11.43$



Max height?
☆ $Vx = 50\cos 32^\circ$ ☆ $Vy = 50\sin 32^\circ$
☆ $0 = 26.5 - gt$; $t = 2.7$
☆ $\Delta y = (26.5)(2.7) = 71.66$ m

Angular Projectile



☆ no horizontal acceleration
☆ $Vx = v\cos\theta$ ☆ $Vy = v\sin\theta - gt$
☆ inc θ inc time, dec horizontal speed & distance
☆ greatest horizontal Δx is at 45°