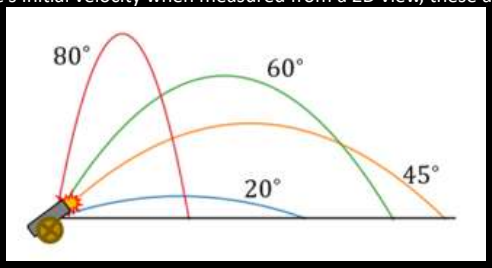
CONCEPTS

- Launch angle
- Projectile motion
- Range

Launch angle

It's the angle of the projectile's initial velocity when measured from a 2D view, these angles are typically 90° or less



Note: the higher the angle, the higher the elevation (maximum height)

Note: the closer the angle to 45, the higher the range (horizontal length), and vise versa

In projectile motion, there are two accelerations

- Downward acceleration due to gravity = **9.8m/s²**
- Horizontal acceleration which in our case = **0m/s²**

Commented [SD1]: The acceleration is 0 because we are ignoring air resistance

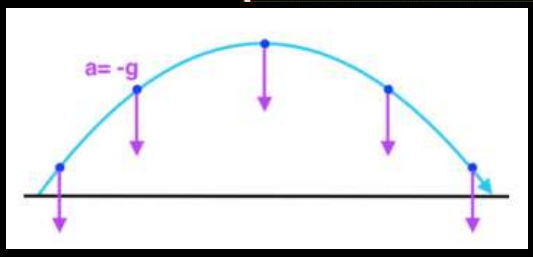
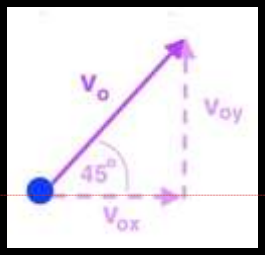


Figure 1 : showing the acceleration of projectile motion

In projectile motion, the initial velocity is split into horizontal (Vox) and vertical (Voy) where



- Vox = V cos(Θ)
- Vox = V cos(Θ)
- V = $\sqrt{(Vox)^2 + (Voy)^2}$
- Θ = atan($\frac{Voy}{Vox}$)

Commented [SD2]: Atan = shift + tan

Note : the initial velocity can be negative because the direction can be downwards

projectile motion

is the motion of an object thrown into the air, subject only to gravitational acceleration (air resistance is neglected)

to describe projectile motion, we must include velocity, acceleration, and distance in their xy axes

we can solve projectile motion problems using the **kinematic equations**

1. $d = Vo.t$
2. $Vf = Vo + at$
3. $Vf^2 = Vo^2 + 2ad$
4. $d = Vo.t + \frac{1}{2}a.t^2$

WHERE :

d : is the displacement or the distance
Vo : is the initial velocity
Vf : is the final velocity
T : is time of flight
a : is the acceleration which = the gravity

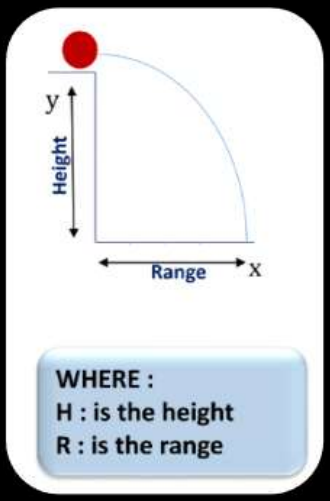
Note: You apply these equations to each of the axes

TYPES OF PROJECTILE MOTION

1. **Horizontal motion**
   the object gets thrown with initial velocity y being 0

X AXIS	Y AXIS
$a = 0\ m/s^2$	$a = 9.8\ m/s^2$
$dx = Vox * T$	$Voy = 0\ m/s$
$dx = R$	$dy = \frac{1}{2}a * t^2$
	$dx = H$

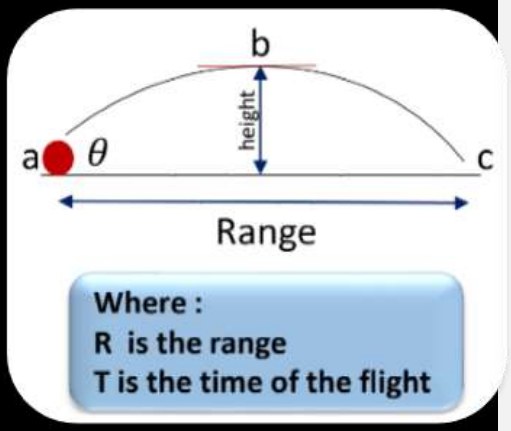
where



WHERE :
H : is the height
R : is the range

1. **Oblique motion**
   where the object gets thrown with initial velocity y being 0

X AXIS	Y AXIS
Vox = V cos(Θ) = R/t	Voy = V sin(Θ)



Notes

1. At maximum height -> Vy = 0
2. for maximum horizontal range: Θ = 45

in a oblique motion, to calculate the

- **time**
  - from a -> b
    - $T_{a\to b} = \frac{V\,sin(\theta)^2}{g}$
  - From a -> c
    - $T_{a\to c} = \frac{2V\,sin(\theta)^2}{g}$
- **range**
  - from a -> b
    - $R = \frac{V^2 \sin(2\Theta)}{g}$
  - From a -> c
    - $R = \frac{V^2\,(2\sin(\theta)\cos(\theta))}{g}$
- **Maximum height**
  - H = $\frac{V^2\,sin(\theta)^2}{2g}$

Trajectory equation (equation of path) :

$$y = x\tan\theta - \frac{gx^2}{2u^2\cos^2\theta} = x\tan\theta\,(1-\frac{x}{R})$$

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