Projectile motion
Angular motion: Vertical and horizontal motion

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Proficiency:
- What are the individual X/Y components of velocity and acceleration ~~(level 1)~~
- How much time will the object be in the air? ~~(level 2)~~
- What is the maximum height? ~~(level 3)~~
- What is the maximum distance traveled? ~~(level 3)~~

$40°$

1. A rock is launched at ~~20°~~ at 30m/s. ~~(level 1)~~
   Determine the initial Velocity and Acceleration in each plain.
   Acceleration (x): ___0___   Acceleration (y): ___-9.8___

   $X:$ $\cos(40°) \cdot 30 =$ $\boxed{22.9}$ $Y:$ $\sin(40) \cdot 30 =$ $\boxed{19.2 \text{ m/s}}$

   Velocity (x): _____   Velocity (y): _____

2. How much time is the rock in the air? (level 2)

   $\underline{Y \text{ component}}$ $V_f = V_i + at$ $0 = 19.2 + -9.8t$

   $\dfrac{-19.2}{-9.8} = t_{1/2} = 1.95 \text{ sec}$

3. What is the maximum height of the rock? (level 3)

   $\underline{Yt @ 1.95 sec}$ $Y_t = Y_0 + V_i t + \frac{1}{2}at^2$ $\boxed{\text{x2}}$ $\boxed{3.9 \text{ sec}}$

   $\boxed{} = 0 + 19.2(1.95) + \frac{1}{2}(-9.8)(1.95)^2$

   $37.5 - 18.6 = \boxed{18.8 m}$

4. What is the maximum distance the ball will travel along the ground? ~~(level 3)~~

   $\underline{@ 3.9 sec}$ $X_t = X_i + V_i t + \frac{1}{2}at^2$ $\boxed{} = 0 + 22.9(3.9) + 0 = \underline{89.3 m}$

5. If the object is launched from a vehicle traveling 5m/s ~~at at~~ 20° at 30m/s relative to the truck.
   Determine the initial Velocity and Acceleration in each plain.
   Acceleration (x): ___0___   Acceleration (y): ___-9.8___

   $X:$ $\cos(20) \cdot 30 = 28.1 + 5\text{m/s} = \boxed{33.1 \text{ m/s}}$ $\sin(20) \cdot 30 = \boxed{10.2 \text{ m/s}}$

   Velocity (x): _____   Velocity (y): _____

6. How much time is the rock in the air? ~~(level 2)~~ only y –

   $V_f = V_i + at$ $t_{1/2}:$ $0 = 10.2 + -9.8(t)$

   $-10.2/9.8 = 1.04 \times 2 = \boxed{2.08 sec}$ → Time of Max height = 1.04 sec

7. What is the maximum height of the rock? ~~(level 3)~~

   only Y: $Y_t = Y_0 + V_i t + \frac{1}{2}at^2$ $\boxed{} = 0 + 10.2(1.04) + \frac{1}{2}(-9.8)(1.04)^2$

   $\boxed{5.3 m} = 10.6 - 5.3$
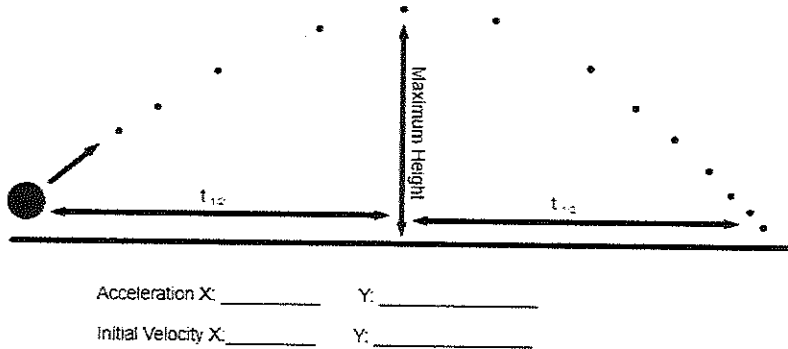
8. What is the maximum distance the ball will travel along the ground? ~~(level 3)~~

   $X_t @ 2.08$ $X_t = 0 + 2.08 \cdot 33.1 = \boxed{68.8 M}$

   $a = 0$

Projectile Motion Angular

How do I calculate the time the object is in the air?

Acceleration X: _____   Y: _____

Initial Velocity X: _____   Y: _____

1. A rock is launched at 20⁰ with a velocity of 35m/s.

Step 1: Break apart the vector into its individual X/Y components (Level 1)

$X: Cos(20) \cdot 35 = 32.8$ m/s

$Y: Sin(20) \cdot 35 = 11.97$ m/s

Step 2: How much time is the rock in the air?

> Time in the air is normally one of the first things we need to know!
>
> X: Determines distance traveled
>
> Y: Determines the time in the air and height at specific times.

Method 1: Utilizing the fact that the Y component velocity is zero at the peak.

Y=0   only Y Component

$V_f = 0$

$V_f = V_i + at$

$0 = 11.7 + -9.8(t)$

$t_{1/2} = \frac{-11.7}{-9.8} = 1.22 sec$

time up

$Y2$ full time = 2.44 sec

Method 2: Utilizing the distance formula to solve for X_t = zero. At what time is the rock at location of zero. The answer is twice. At the beginning and at the end.

S = 0 $S = X_c + vt + 0.5at^2$ S = 0

Solving for t, when S = 0 will require a quadratic and will give 2 answers, one for each time it is at the zero point.

only "y" component

$Y_t = Y_0 + V_i t + \frac{1}{2}at^2$

$0 = 0 + 11.97(t) + \frac{1}{2}(9.8)t^2$, -4.9

$0 = 0 \cdot 11.97(t) + -4.9t^2$

use quad solver

$t = 2.44 sec$