Projectile Motion

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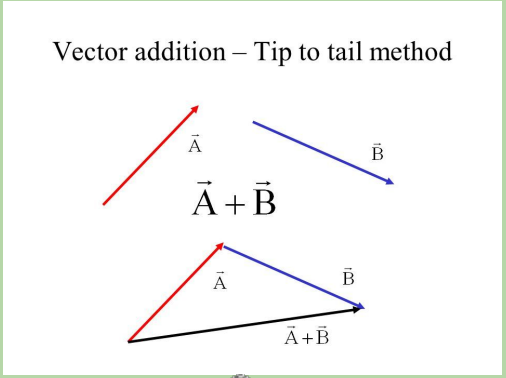
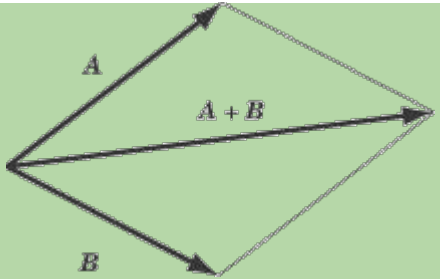
Vector Math

- When adding vectors in the same dimension, simply add or subtract them according to which direction they travel.

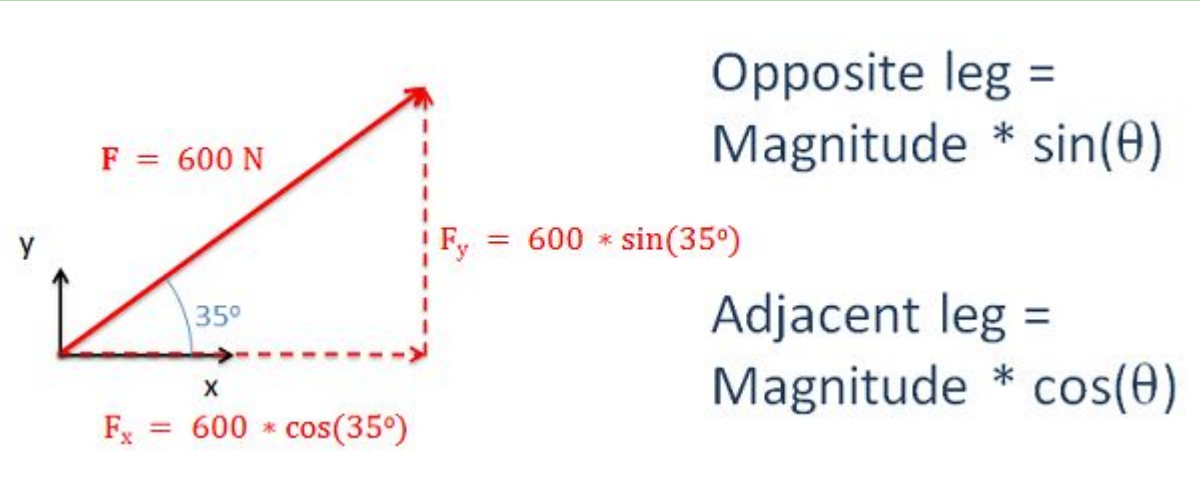
- If they are not along the same line:
  - Tail to tip method
  - Parallelogram method





Vector Math Cont.

- Use trig to find the angle of resultant vector



You could describe this vector as **V= 600 @ 35 degrees** or **V= 491x + 344y**

Vector Math Cont.

- To decompose vectors:
  - Break them into their x and y components
  - Add the x components to find resultant x
  - Add the y components to find resultant y
  - Use Pythagorean Thm to find magnitude
  - Use trig to find angles, directions

Common Mistakes:

1. Make sure calculator is in **degree** mode
2. Pay attention to negative signs when adding multiple vectors with different directions

3 Common Misconceptions

1. Gravity has NO effect horizontally as there is nothing to accelerate

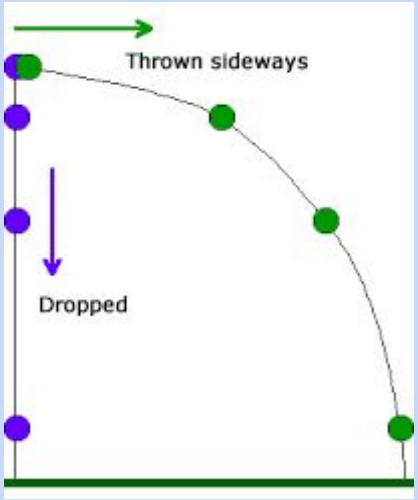
    -therefore, the horizontal velocity of a projectile will remain CONSTANT

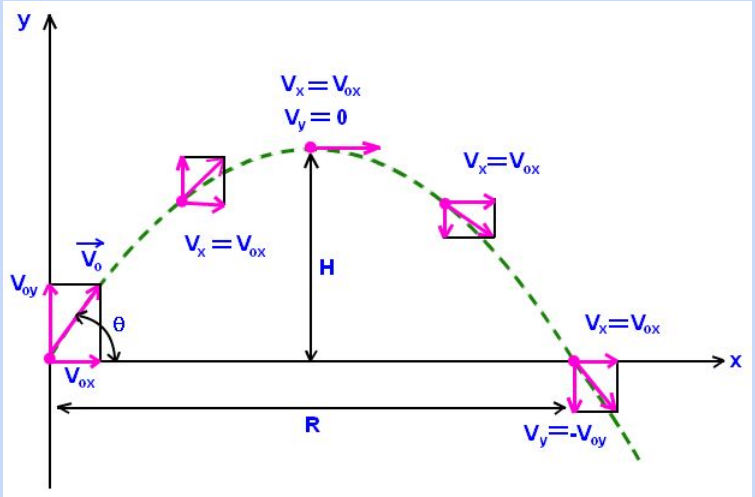
2. The horizontal and vertical components of a projectile are completely INDEPENDENT of each other

3. The vertical velocity of a projectile behaves EXACTLY the same as free fall (use kinematics)

Concepts

- Since vertical and horizontal components are independent of each other, they reach the ground at the same time
- The horizontal velocity will remain *constant*, the vertical velocity will act as if in free fall





Equations!

1. $v_f = v_o + at$
2. $x_f = x_o + v_o t + \frac{1}{2}at^2$
3. $v_f^2 = v_o^2 + 2a(x_f - x_o)$
4. $x_f = x_o + \frac{1}{2}(v_f + v_o)t$

Remember that when dealing with vectors you should use trig.

- SOH, CAH, TOA

Strategies for tackling FRQs

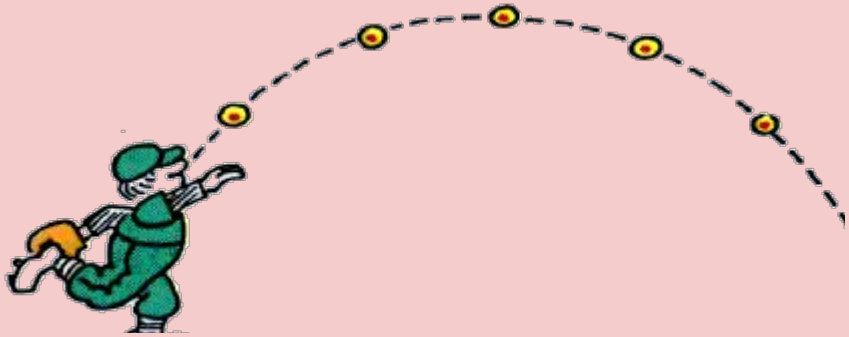
-Figure out what variables are given in order to determine which kinematic equation to use

-Keep in mind that the gravity constant (9.81 m/s^2) might not be directly stated

-Projectile motion deals with vectors, so make sure you are able to split up the vector into vertical and horizontal components using the vector length and the angle degree

Example of tackling an FRQ

Example: A ball is thrown with an initial velocity of 3.00 m/s. What is the ball's position and speed after 1.00 s and 2.00s?



-DO NOT USE: speed=distance/time

-INSTEAD→ use the kinematics to find the position and speed

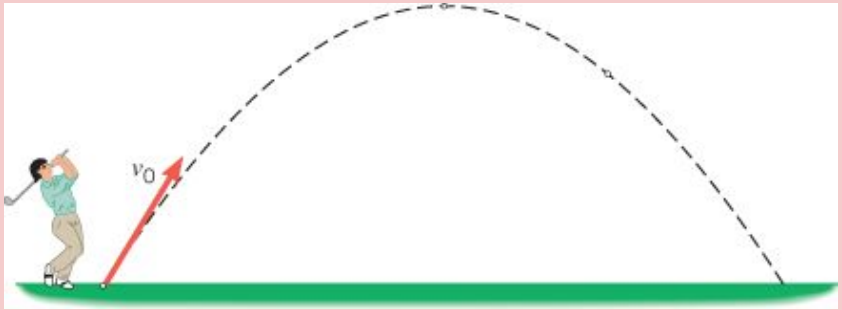
Another Example

-Remember at the top of of the maximum height, the velocity is **ZERO**.

-If you are trying to find the amount of time that passes before the ball hits the ground, you would use the kinematic:

$V_f = V_i + a\Delta t$

→ REMEMBER TO **DOUBLE** THE TIME!! Because you are only finding the time to the max height, so you need to double it



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A. 79 m
B. 47 m
C. 22 m
D. 62 m

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A. 9.8 m/s/s downward
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3. A bullet is fired horizontally, and at the same time a second bullet is dropped from the same height. Ignore air resistance. Compare fall times.

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4. You roll a 5 kg ball off a 1m high table. The ball leaves the table with a speed of 2 m/s. Before falling off the table, it has rolled for .5m. How long has the ball rolled on the table?

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B.) .35 s

C.) .50 s

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B.) 97.4 m/s

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