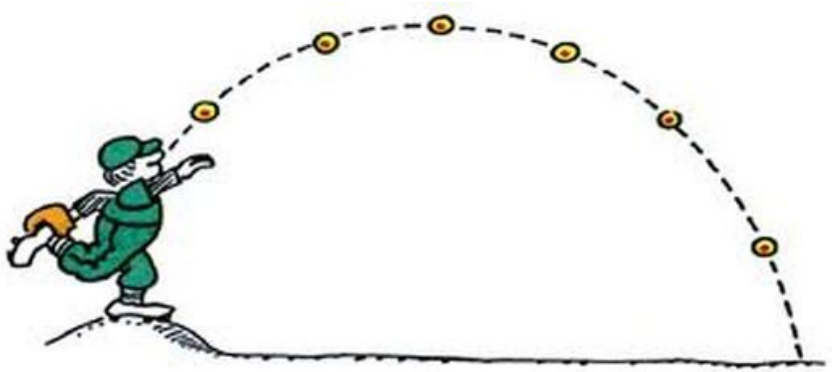
Projectile Motion

By: Stephen Horne, Sara Shoar, Justin Sabourin, and Grayson Kruizinga



Review

Projectile motion is a **vector**

- Has magnitude and direction

When solving projectile motion problems, draw it out

Two methods to drawing out vectors:

1. Tail-to-tip method
2. Parallelogram method

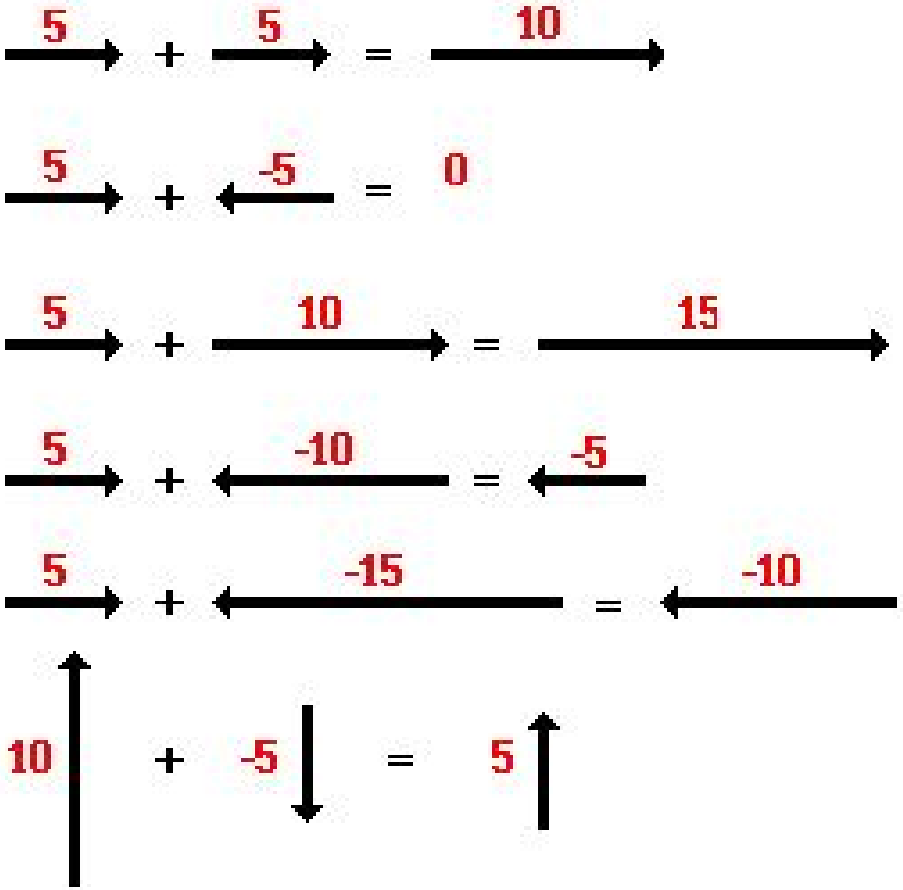
What is Projectile Motion?

- Much like free fall, but the falling object has a horizontal component
- The vertical and horizontal components of projectile motion are completely independent of each other (they will reach the ground at the same time)
- Vertical velocity behaves exactly the same the same as in free fall
- Horizontal velocity will remain constant

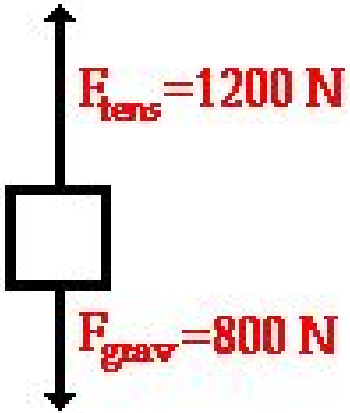
Rules for Resolving Vectors

1. Decompose all vectors into x and y components
2. Add the x components together to get the x component of the resultant vector, and do the same for y.
3. £Vx=V1x + V2x +....
4. £Vy=V1y+V2y+....

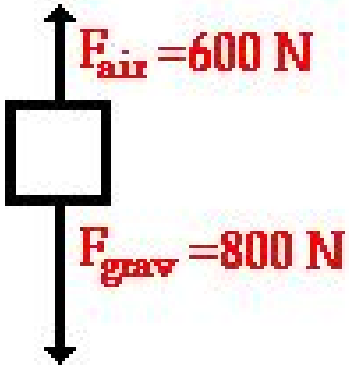
Tail to Tip Method ;) and Parallelogram


5
5
10
5
-5
0
5
10
15
5
-10
-5
5
-15
-10
10
-5
5

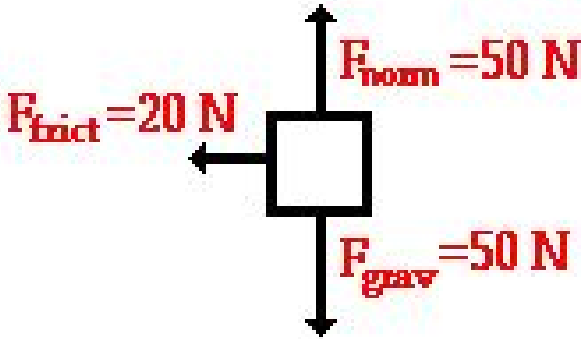
F_{net} is 400 N, up

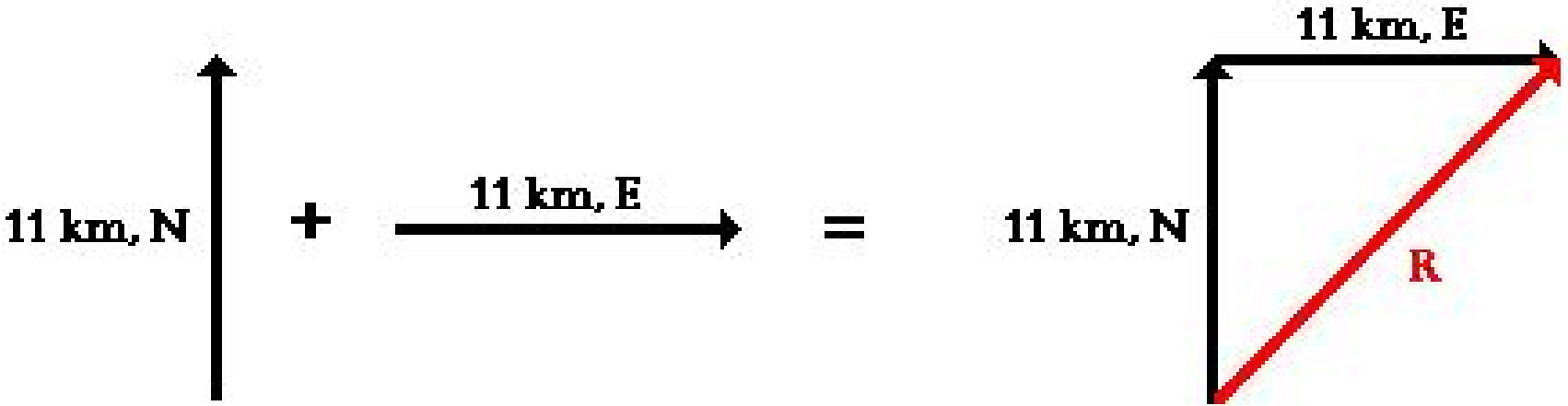


F_{net} is 200 N, down



F_{net} is 20 N, left





$$11^2 + 11^2 = R^2$$

$$242 = R^2$$

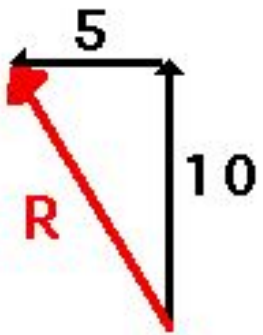
$$15.6 = R$$

Practice A

10 km, North

+

5 km, West

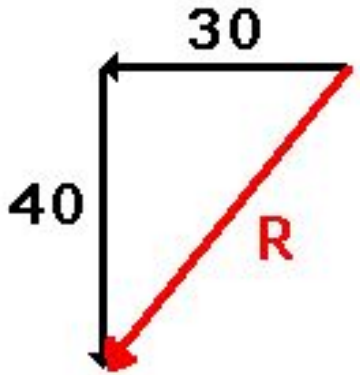


Practice B

30 km, West

+

40 km, South



Practice A
R2 = (5)2 + (10)2

R2 = 125

R = SQRT (125)

R = 11.2 km

Practice B
R2 = (30)2 + (40)2

R2 = 2500

R = SQRT (2500)

R = 50 km

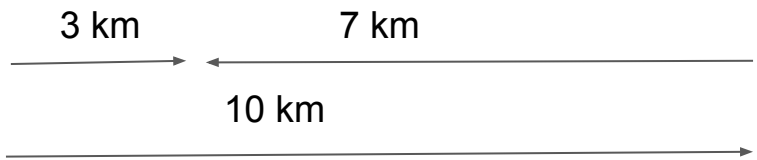
Adding Vectors Example

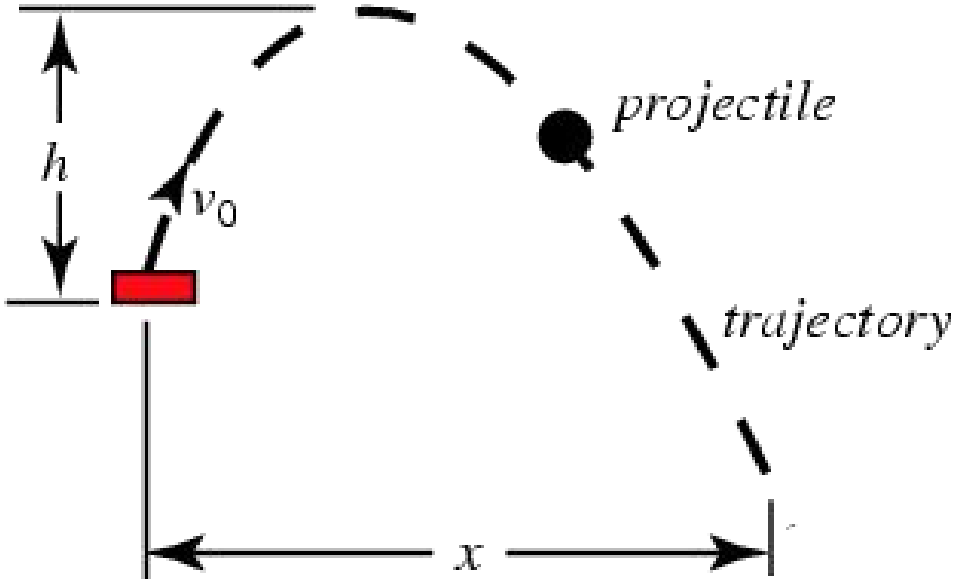
Stephen walks 8 km east, then turns around and walks 6 km west.

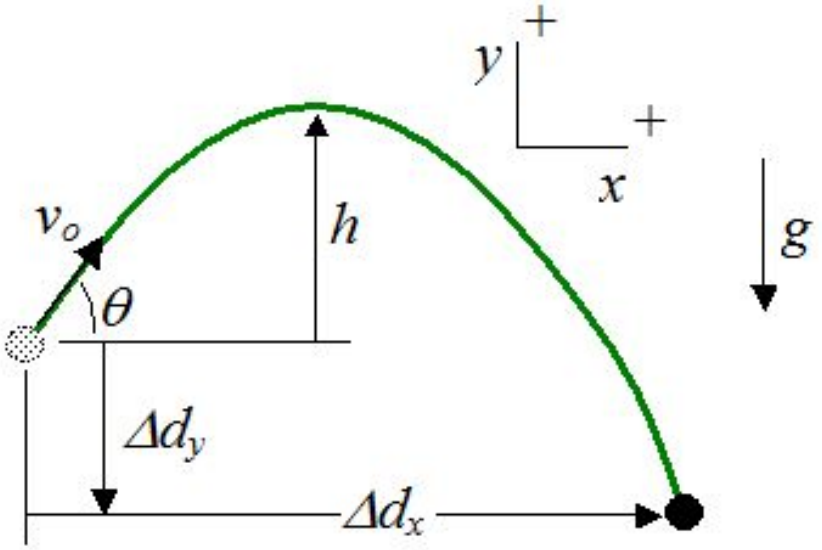
The scalar distance traveled is 10 km + 7 km = 17 km

The net or resultant displacement accounts for the change in direction.

10 km - 7 km = 3 km east




projectile
h
v_0
trajectory
x


y
+
+
x
v_o
h
θ
g
Δd_y
Δd_x

Gravity = 9.8 m/s^2

$v_y = v_{yo} - gt$ - The vertical velocity is equal to the initial vertical velocity minus gravity times time.

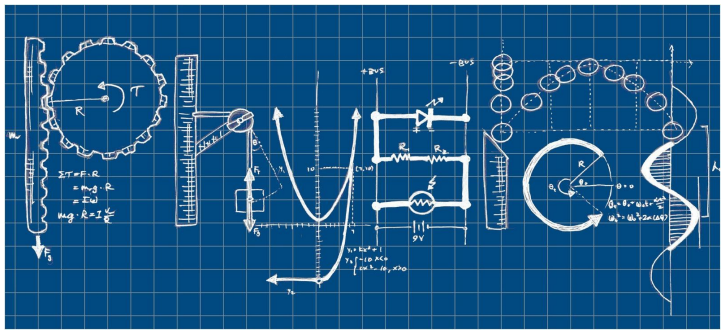
$y = v_{yo}t - \frac{1}{2}gt^2$ - The vertical distance is equal to the initial vertical velocity times time, minus one half gravity times the time squared.

$v_x = v_{xo}$ - The horizontal velocity is always equal to the initial horizontal velocity.

$x = v_x t$ - The horizontal distance is equal to the horizontal velocity times time.

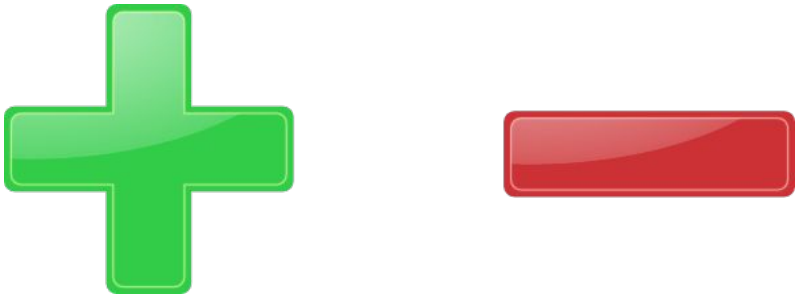
Relation to other Chapters

- Force has direction and magnitude, so it is considered as a vector.
- When solving a problem involving forces, you break them up into components, just like vector problems.
- Momentum is also considered as a vector



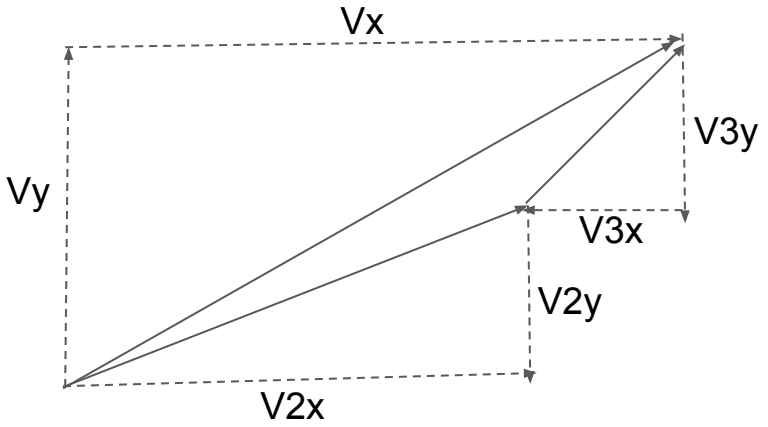
Mistakes & Misconceptions (and how to avoid them)

- A common mistake made when solving projectile motion problems is that the calculator being used is not it degree mode.
  - To avoid this, press mode on your calculator and change it to degrees before starting the problem!
- Another mistake is not paying attention to positive and negative signs.
  - To make sure your signs are right, make sure any values on the negative sides of the coordinate plane are negative in your equation!



Mistakes & Misconceptions (and how to avoid them)

- The final mistake that is commonly made is that when solving, the vectors are not decomposed into x and y components.
  - To avoid, look at all the vectors given in the equation and split them into x and y components.



Steps to Take for Free Response Questions

1. Draw out vectors (depend on direction) using arrows to show direction. Then decide what way will be positive and what way will be negative. (Note: some problems may only include positive values)
2. Fill in the given values for the arrows you drew.
3. Find the equation that will work for the variable that needs to be solved. Remember that unknown variable does not have to be isolated in the equation. You can use algebra to manipulate the equations.
4. Plug the given information into the equation you want to use. (Note: some of the information needed for the final equation might need to be found using other equations)

Strategies for Solving Free Response Questions

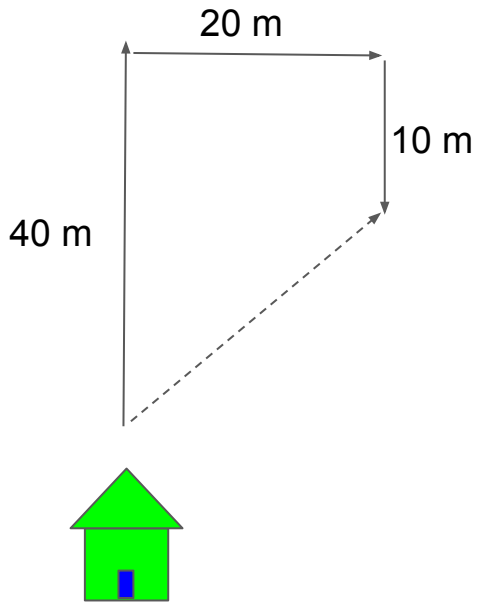
- Make sure that you understand what the problem is asking before you attempt to solve it.
- The test is multiple choice, If you do not know how to solve a problem look at the answers and choose from values that seem reasonable instead of just filling in a random answer.
- Before giving the final answer make sure that you are in the right units.

Multiple Choice 1

Stephen walks 40 m north, 20 m east, and 10 m south

How far is Stephen from home?

A) 10 m
B) 16 m
C) 20 m
D) 22 m



Answer 1

√(20^2 + 10^2)=

D) 22 m

Multiple Choice 2

Stephen walks 40 m north, 20 m east, and 10 m south

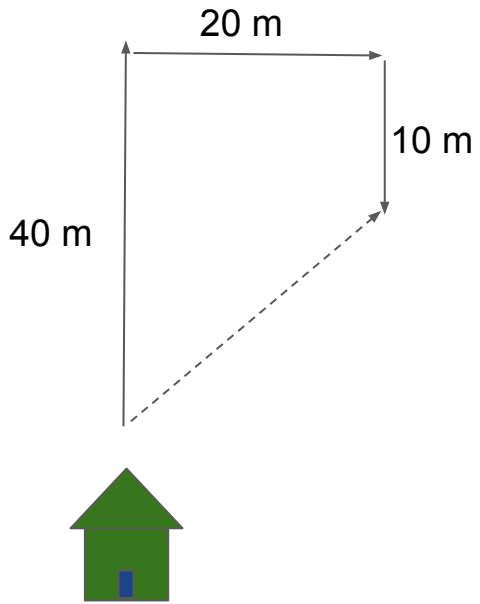
In what direction?

A) 27° South of East

B) 27° North of East

C) 36° North of South

D) 36° East of North



Answer 2

tan^-1 (10/20) = 27° North of East

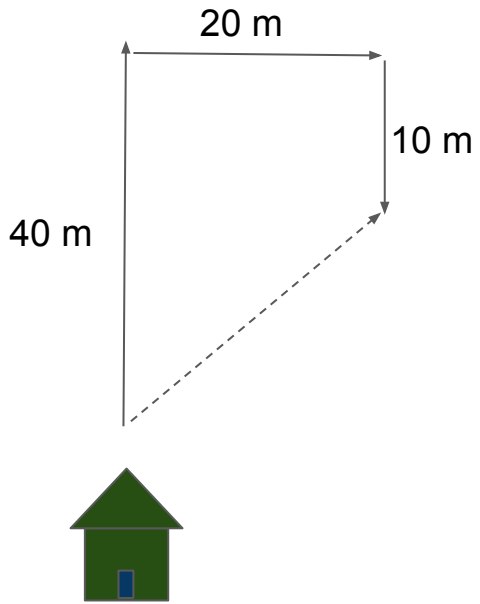
B) 27° North of East

Multiple Choice 3

Stephen walks 40 m north, 20 m east, and 10 m south

What is Stephen's displacement?

A) 22 m @ 27° N of E
B) 27 m @ 20° N of S
C) 20 m @ 27° N of S
D) 27 m @ 22° N of E



Answer 3

A) 22m @ 27° N of E

Multiple Choice 4

Ignoring air resistance, the horizontal component of projectile's velocity

A) Is zero
B) Remains constant
C) Continuously decreases
D) Continuously increases

Answer 4

B) remains constant

Multiple Choice 5

Ignoring air resistance, the vertical component of a projectile's velocity

A) Is zero
B) Remains constant
C) Continuously increases
D) Continuously decreases

Answer 5

D) continuously decreases