Name: _____

Period: _____

Adding Vectors

Setting Up Individual Vectors

Before you begin, be sure all of your vectors have the same units and all angles start at the +x-axis. Then, your calculator will automatically calculate any positive or negative components.

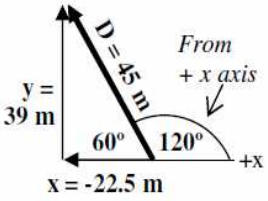
All angles MUST start at the + x axis

$\sin 120^\circ = \frac{y}{45\text{ m}}$

$45(\sin 120^\circ) = y$

$45(.866) = y$

$y = 39\text{ m}$



$\cos 120^\circ = \frac{x}{45\text{ m}}$

$45(\cos 120^\circ) = x$

$45(-0.5) = x$

$x = -22.5\text{ m}$

Using 120° gave a –x component!

X and Y Components

$x = H\cos\theta$ and $y = H\sin\theta$

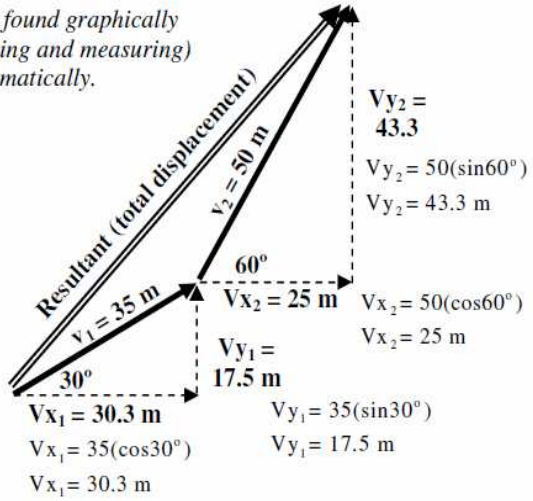
Where H is the vector, θ is the angle from the + x axis, x is the x component of H, and y is the y-component of H.

These 2 equations work for <u>any</u> vector (even if the vector is vertical [θ = 90° or 270°] or horizontal [θ = 0° or 180°]).

Example: A person walks 35 m at 30° then 50 m at 60°. Calculate the person's total displacement.

Step 1. Resolve vectors into their components.

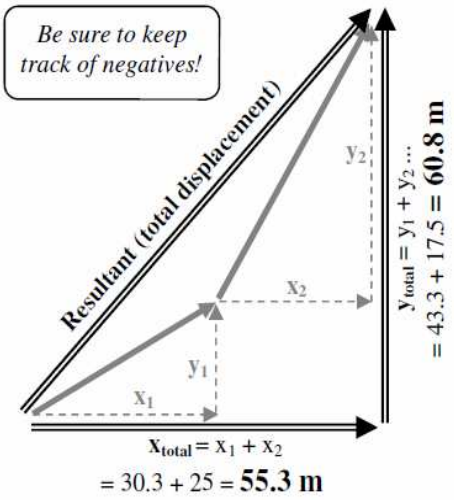
R can be found graphically (by drawing and measuring) or mathematically.



In this example all components are positive. By taking your angle from the +x-axis, sine and cosine will give you positive and negative components automatically.

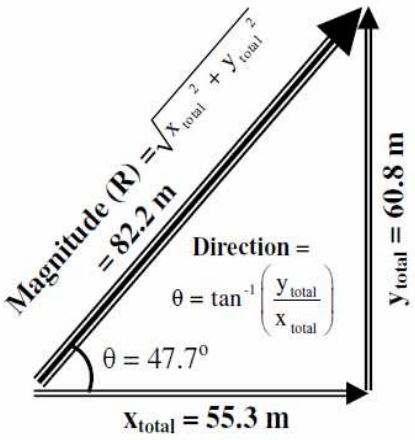
Step 2. Calculate x_{total} and y_{total} by adding up all x-components and all y-components.

Be sure to keep track of negatives!



$= 30.3 + 25 = \mathbf{55.3\text{ m}}$

*Step 3. Draw a resultant triangle with x_{total} and y_{total}. Then, **calculate** the resultant's **magnitude and direction.***



Answer: R = 82.2 m at 47.7°

Use the **Pythagorean Theorem** to find the resultant's **magnitude**.

$R^2 = x_{total}^2 + y_{total}^2$

$R^2 = 55.3^2 + 60.8^2 = 6754.73$

$R = \sqrt{6754.73} = 82.2\text{ m}$

Use **inverse tangent** to find the resultant's **direction**.

$\tan\theta = \frac{\text{opp.}}{\text{adj.}} = \frac{y_{total}}{x_{total}}$

$\tan\theta = \frac{60.8}{55.3}$

$\theta = \tan^{-1}\left(\frac{60.8}{55.3}\right) = 47.7^\circ$

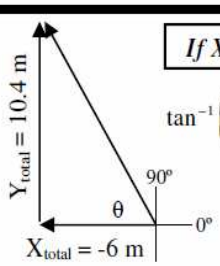
Tan Can't See –X

$\tan^{-1}\left(\frac{-4}{2}\right) = \tan^{-1}(-2) = -63.4^\circ$

Tan sees these as the same!

$\tan^{-1}\left(\frac{4}{-2}\right) = \tan^{-1}(-2) = -63.4^\circ$

Tan can't see the difference between a negative x and a negative y. Tan only gives angles between +90° and –90.°, so it will never give you an angle in quadrants 2 or 3.



If X_{total} is negative add 180 degrees

$\tan^{-1}\left(\frac{10.4}{-6}\right) = 60^\circ$

But we know that this direction is greater than 90°.

Since X_{total} is negative: $\theta = 60 + 180 = 120^\circ$

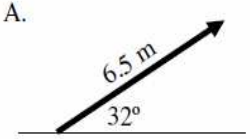
Which we can see is true.

1. A drag racer moves 350 m down a race track. X = Y =

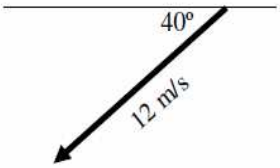
2. A person walks 150 m north. X = Y =

3. Resolve the following vectors into their components.

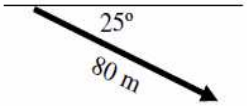
A.



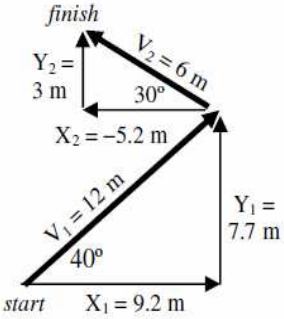
B.



C.



4. Find the resultant of the following two vectors.



A. Draw the resultant from the start of the first vector to the end of the second. Label it "R".

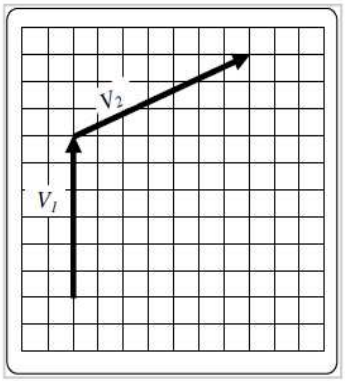
B. X_{total} =

C. Y_{total} =

D. Calculate the magnitude (length) of R.

E. Calculate the direction of R.

5. Add these vectors together. Assume each square = 1 m.



A. X_1 =
Y_1 =

B. X_2 =
Y_2 =

C. X_{total} =
Y_{total} =

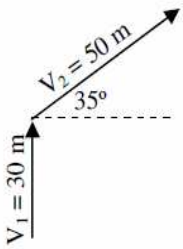
D. Draw the resultant (R).

E. Calculate R's magnitude.

F. Calculate R's direction.

6. A person walks 30 m north, then 50 m at 35°. Find their total displacement.

A. Below draw R from the start of V_1 to the end of V_2.



B. Resolve v_1 and v_2 into their components (*Step 1 on the front*)

X_1 = X_2 = X_{total} =

Y_1 = Y_2 = Y_{total} =

Magnitude = Direction =

7. Add these vectors: V_1 = 55 m at 38° and V_2 = 10 m at 260°.

A. Draw V_1, V_2, and R below.

B. Resolve v_1 and v_2 into their components (*Step 1 on the front*)

X_1 = X_2 =

Y_1 = Y_2 =

X_{total} =

Y_{total} =

Magnitude =

Direction =