Adding Vectors

Problem: Add these vectors together mathematically:
v_1 = 45 m at 60° North of West; v_2 = 35 m East.

Step 1. Resolve *non-vertical or non-horizontal vectors into their* ***components*** *using trigonometry. (Hint: some components may be zero; some may be negative.)*

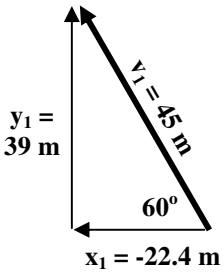
The y-component is opposite so use sine.

$$\sin 60^\circ = \frac{y_1}{45\text{ m}}$$

$$45\text{ m}(\sin 60^\circ) = y_1$$

$$y_1 = 39\text{ m}$$

And y is ***positive*** *because it is* ***north****.*



The x-component is adjacent so use cosine.

$$\cos 60^\circ = \frac{x_1}{45\text{ m}}$$

$$45\text{ m}(\cos 60^\circ) = x_1$$

$$x_1 = -22.5\text{ m}$$

And x is ***negative*** *because it is* ***west****.*

Since it is horizontal, you don't need to resolve v_2.

The y-component is zero for a horizontal vector.

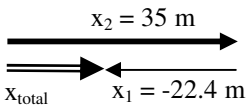
y_2 = 0 m

v_2 = 35 m

x_2 = 35 m

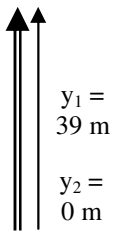
If you have more than two vectors, you will have to resolve each one.

Step 2. Find the total x and y displacements *by adding up all x-components and y-components, remembering any negatives.*

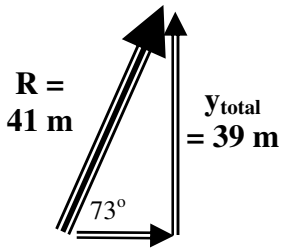


$$x_{total} = x_1 + x_2$$
$$x_{total} = -22\text{ m} + 35\text{ m}$$
$$\mathbf{x_{total} = 12.6\text{ m}}$$

$$y_{total} = y_1 + y_2 + y_3 \ldots$$
$$y_{total} = 39\text{ m} + 0\text{ m}$$
$$\mathbf{y_{total} = 39\text{ m}}$$



Step 3*. Draw a resultant triangle with x_{total} and y_{total} as the components.* ***Find*** *the resultant's* ***magnitude and direction.***



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

$$R^2 = x_{total}^2 + y_{total}^2$$
$$R^2 = 12.6^2 + 39^2 = 1679.76$$
$$R = \sqrt{1679.76} = 41\text{ m}$$

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

$$\tan\theta = \frac{\text{opp.}}{\text{adj.}} = \frac{y_{total}}{x_{total}}$$
$$\tan\theta = \frac{39\text{ m}}{12.6\text{ m}} = 3.1$$
$$\theta = \tan^{-1}(3.1) = 72^\circ$$

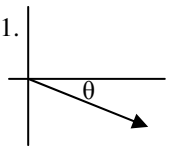
Organization Helps

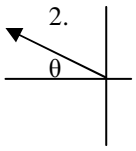
Using a table can make adding vectors simpler by keeping all of your information organized.

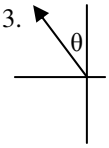
	Vector 1	Vector 2	Totals
X			
Y			
	Resultant	**Magnitude**	
		Direction	

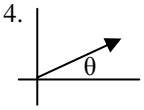
If more than two vectors are given, add more columns to table.

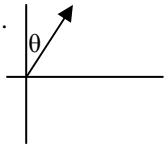
Give one of the following directions to these vectors: a) S of E; b) E of N; c) W of N; d) N of W; e) N of E.

1. 

2. 

3. 

4. 

5. 

6. Find the vertical component of a drag racer going 5 m/s^2 down the track.

7. Add these vectors: V_1: 32 m at 50° N of E; V_2 = 50 m at 60° S of E.

8. A boat is traveling north at 6 m/s. The water has a current of 3 m/s pushing 30° S of E. Find the boat's total velocity and direction.

9. A toy plane's engines gives 350 newtons of force. The plane is flying 45 degrees north of west. If the wind pushes with 60 newtons west, find the total force pushing on the plane.

10. A plane flies 230 mph at 60° North of West for 2.5 hours. Answer the following questions.

    A) How far did the plane travel?

    B) How far west did it go?

    C) How far north did it go?

    D) How fast did it go West?