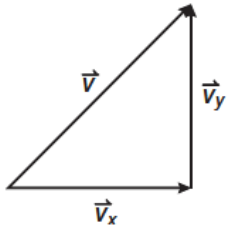


Geometry Lesson 89

Objective: TSW use vector decomposition.



Decomposing a vector means to separate it into two vectors which, when added, result in the original vector. When a vector is decomposed, it is split into a horizontal vector and a vertical vector. In the diagram, \vec{v} is decomposed into vertical, \vec{v}_y and horizontal, \vec{v}_x .

Notice that the vector makes a right triangle with its vertical and horizontal components. Since it makes a right triangle, trigonometric ratios can be used to find the magnitude of the vertical and horizontal components.

The angle of a vector is always given counterclockwise from the positive x-axis.

Example 1 Decomposing Vectors

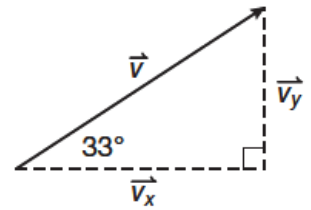
Decompose each vector. Round your answer to the nearest hundredth.

a. $\langle 2, 3 \rangle$

SOLUTION

b. \vec{v} has a 33° angle and a magnitude of 7.

SOLUTION



Vectors can also be added by decomposition. To add two vectors, decompose them and add their vertical and horizontal components. This will give the resultant vector in component form.

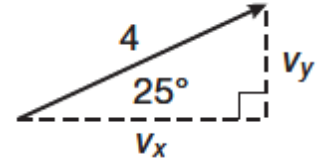
Example 2 Adding Vectors by Decomposition

Vector \vec{v} has a magnitude of 4 and makes a 25° angle with the horizontal.

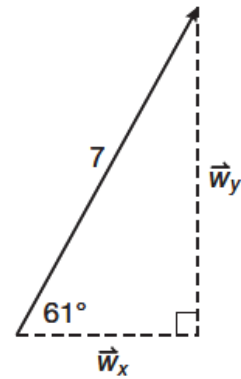
Vector \vec{w} has a magnitude of 7 and makes a 61° angle with the horizontal.

Add the vectors by decomposition. Find the magnitude and the angle the resultant vector makes with the horizontal to the nearest tenth.

SOLUTION



Then, decompose \vec{w} .



Next, add the magnitudes of the components.

Now that we know the magnitudes of the legs of the right triangle, we can use the Pythagorean Theorem to find the magnitude of the resultant vector.

Finally, use one of the inverse trigonometric functions to find the angle measure that the resultant vector makes with the horizontal.

Because you know the values of all three sides, you can use any function.

Example 3 Adding More Than Two Vectors by Decomposition

Vector \vec{a} has a magnitude of 5 and makes a 34° angle counterclockwise.

Vector \vec{b} has a magnitude of 8 and makes a 90° angle counterclockwise.

Vector \vec{c} has a magnitude of 3 and makes a 60° angle counterclockwise.

Add the vectors by decomposition. Find the magnitude and angle of the resultant vector.

SOLUTION

Add the magnitudes of the horizontal and vertical vectors.

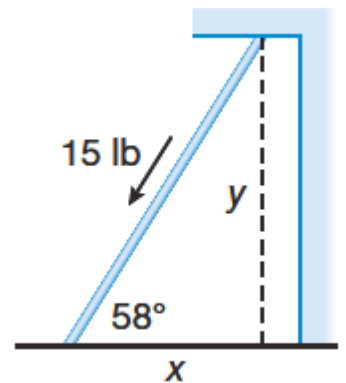
Next, use the Pythagorean Theorem to find the magnitude of the resultant vector.

Finally, find the angle ϑ that the resultant vector makes with the horizontal.

Example 4 Application: Camping

You can use vectors to calculate forces acting on an object. For example, if a tent pole is placed at a 58° angle and is supporting a load of 15 pounds, what are the vertical and horizontal loads on the pole? Round your answers to the nearest hundredth of a pound.

SOLUTION



You Try!!!!

Round to the nearest hundredth or nearest degree.

a. Vector \vec{d} has a magnitude of 100 and makes a 55° angle with the horizontal. Decompose the vector into its x- and y-components.

b. Vector \vec{p} makes a 35° angle with the horizontal. Vector \vec{q} makes a 40° angle with the horizontal. If \vec{p} has a magnitude of 30 and \vec{q} has a magnitude of 40, what is the angle and magnitude of the resultant vector when \vec{p} and \vec{q} are added?

c. Vector \vec{t} has a magnitude of 12 and a direction of 80° . Vector \vec{u} has a magnitude of 16 and a direction of 0° . Vector \vec{v} has a magnitude of 8 and a direction of 64° . Find the magnitude and angle of their sum.

d. Camping The pole for a tent makes an 86° angle with the ground. If the load on the pole is 25 pounds, what are the vertical and horizontal loads?