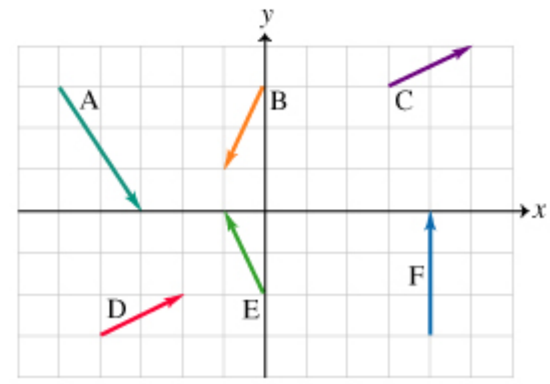
#2 Addition and Subtraction of Vectors Pre-class

Due: 11:00am on Monday, August 27, 2012

Note: You will receive no credit for late submissions. To learn more, read your instructor's Grading Policy

Adding and Subtracting Vectors Conceptual Question

Six vectors (A to F) have the magnitudes and directions indicated in the figure.



Part A

Which two vectors, when added, will have the largest (positive) *x* component?

Hint 1. Largest *x* component

The two vectors with the largest *x* components will, when combined, give the resultant with the largest *x* component. Keep in mind that positive *x* components are larger than negative *x* components.

ANSWER:

- C and E
- E and F
- A and F
- C and D
- B and D

Correct

Part B

Which two vectors, when added, will have the largest (positive) *y* component?

Hint 1. Largest *y* component

The two vectors with the largest *y* components will, when combined, give the resultant with the largest *y* component. Keep in mind that positive *y* components are larger than negative *y* components.

ANSWER:

- C and D
- A and F
- E and F
- A and B
- E and D

Correct

Part C

Which two vectors, when *subtracted* (i.e., when one vector is subtracted from the other), will have the largest magnitude?

Hint 1. Subtracting vectors

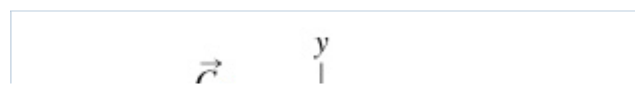
To subtract two vectors, add a vector with the same magnitude but opposite direction of one of the vectors to the other vector.

ANSWER:

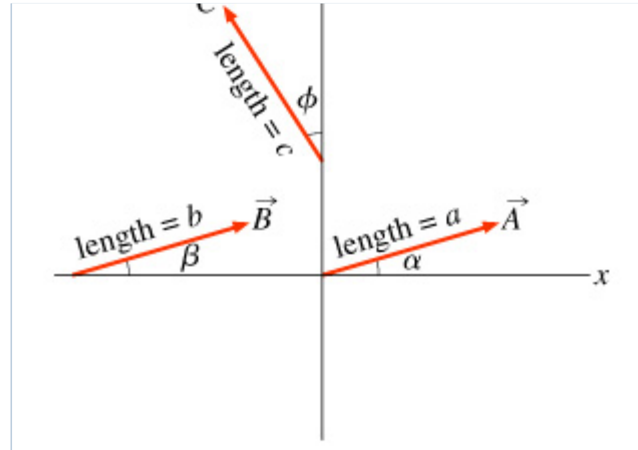
- (selected) A and F
- A and E
- D and B
- C and D
- E and F

Correct

± Resolving Vector Components with Trigonometry



Often a vector is specified by a magnitude and a direction; for example, a rope with tension $\vec{T}$ exerts a force of magnitude T in a direction 35° north of east. This is a good way to think of vectors; however, to calculate results with vectors, it is best to select a coordinate system and manipulate the components of the vectors in that coordinate system.



Part A

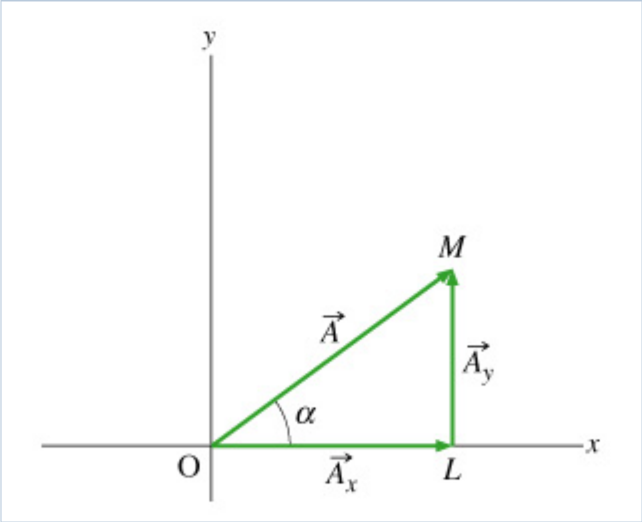
Find the components of the vector $\vec{A}$ with length a = 1.00 and angle α=15.0° with respect to the x axis as shown.

Enter the *x* component followed by the *y* component, separated by a comma.

Hint 1. What is the *x* component?

Look at the figure shown.

$\vec{A}_x$ points in the positive *x* direction, so A_x is positive. Also, the magnitude $|A_x|$ is just the length $\mathrm{OL} = \mathrm{OM}\cos(\alpha)$.



ANSWER:

$\vec{A}$ = 0.966,0.259

Correct

Part B

Find the components of the vector $\vec{B}$ with length b = 1.00 and angle β=10.0° with respect to the *x* axis as shown.

Enter the *x* component followed by the *y* component, separated by a comma.

Hint 1. What is the *x* component?

The *x* component is still of the same form, that is, L\cos(\theta).

ANSWER:

$\vec{B}$ = 0.985,0.174

Correct

The components of $\vec{B}$ still have the same form, that is, $(L\cos(\theta), L\sin(\theta))$, despite $\vec{B}$'s placement with respect to the *y* axis on the drawing.

Part C

Find the components of the vector $\vec{C}$ with length c = 1.00 and angle $\phi = 35.0°$ as shown.

Enter the *x* component followed by the *y* component, separated by a comma.

Hint 1. Method 1: Find the angle that $\vec{C}$ makes with the positive *x* axis

Angle ϕ = 0.611 differs from the other two angles because it is the angle between the vector and the *y* axis, unlike the others, which are with respect to the *x* axis. What is the angle that $\vec{C}$ makes with the positive *x* axis?

Express your answer numerically in degrees.

ANSWER:

125

Correct

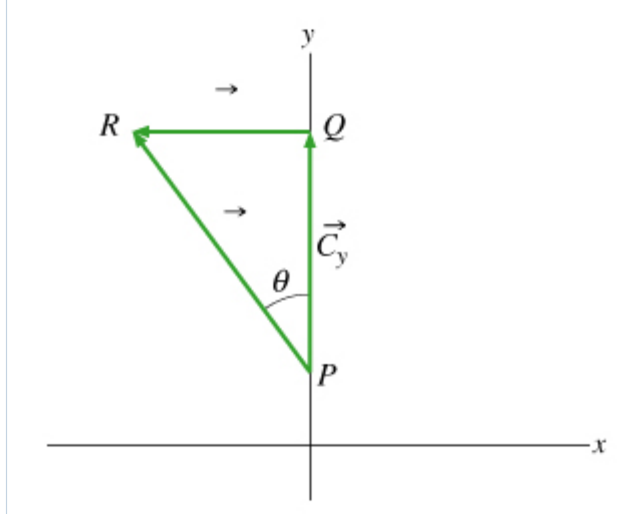
The *x* component is still of the same form, that is, L\cos(\theta), where θ is the angle that the vector makes with the *positive x axis* .

Hint 2. Method 2: Use vector addition

Look at the figure shown.

1. $\vec{C} = \vec{C}_x + \vec{C}_y$.
2. |\vec{C}_x| = {\rm length(QR)} = c \sin(\phi).
3. C_x, the *x* component of $\vec{C}$ is negative, since C_vec_x points in the negative *x* direction.

Use this information to find C_x. Similarly, find C_y.



ANSWER:

$\vec{C}$ = -0.574,0.819

Correct

± Vector Math Practice

Let vectors $\vec{A} = (2, -1, 1)$, $\vec{B} = (3, 0, 5)$, and \vec{C}=(1,4,-2), where (x,y,z) are the components of the vectors along i_unit, j_unit, and k_unit respectively.

Calculate the following:

Part A

Express your answer as an ordered triplet of components (x, y, z) with commas to separate the components.

Hint 1. How to approach this problem

Components can be multiplied by constants and added up individually.

ANSWER:

2\vec{A}+3\vec{B}+\vec{C} = 14,2,15

Correct

Part B

Express your answer as an ordered triplet |{\vec A}|, |{\vec B}|, |{\vec C}| with commas to separate the magnitudes.

Hint 1. Magnitude of a vector

Is the magnitude of a vector a scalar quantity or a vector quantity?
Recall that a scalar quantity is described simply by a number.

ANSWER:

|{\vec A}|, |{\vec B}|, |{\vec C}| = 2.45,5.83,4.58

Correct

Part C

ANSWER:

\vec{A}\cdot\vec{B} = 11

Correct

Part D

Determine the angle θ between $\vec{B}$ and $\vec{C}$.

Express your answer numerically in radians, to two significant figures.

Hint 1. Definition of the dot product

\vec{B}\cdot\vec{C}=B_x C_x+B_y C_y + B_z C_z = \left|\vec{B}\right|\left|\vec{C}\right|\cos(\theta), where θ is the angle between vectors $\vec{B}$ and $\vec{C}$.

ANSWER:

θ = 1.8 radians

Correct

Part E

Express your answer as an ordered triplet of components (x, y, z) with commas to separate the components.

ANSWER:

\vec{B}\times\vec{C} = -20,11,12

Correct

Part F

ANSWER:

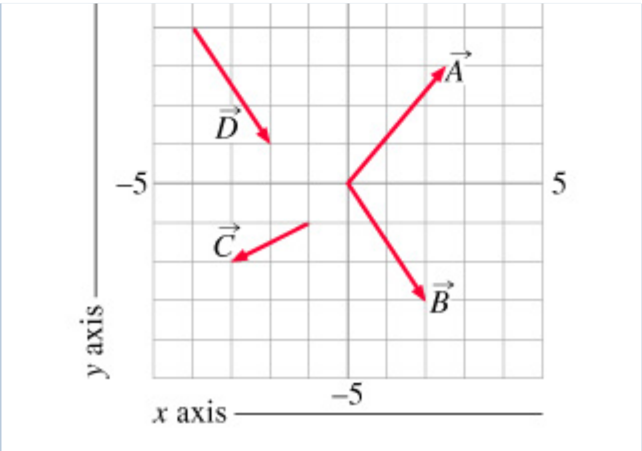
\vec{A}\cdot(\vec{B}\times\vec{C}) = -39

Correct

Components of Vectors

Shown is a 10 by 10 grid, with coordinate axes *x* and *y*
.

The grid runs from -5 to 5 on both axes. Drawn on this grid are four vectors, labeled $\vec{A}$ through D_vec. This problem will ask you various questions about these vectors. All answers should be in decimal notation, unless otherwise specified.



Part A

What is the x component of $\vec{A}$?

Express your answer to two significant figures.

Hint 1. How to derive the component

A component of a vector is its length (but with appropriate sign) along a particular coordinate axis, the axes being specfied in advance. You are asked for the component of $\vec{A}$ that lies along the x axis, which is horizontal in this problem. Imagine two lines perpendicular to the x axis running from the head (end with the arrow) and tail of $\vec{A}$ down to the x axis. The length of the x axis between the points where these lines intersect is the x component of $\vec{A}$. In this problem, the x component is the x coordinate at which the perpendicular from the head of the vector hits the origin (because the tail of the vector is at the origin).

ANSWER:

A_x = 2.5

Correct

Part B

What is the *y* component of $\vec{A}$?

Express your answer to the nearest integer.

ANSWER:

A_y = 3

Correct

Part C

What is the *y* component of $\vec{B}$?

Express your answer to the nearest integer.

Hint 1. Consider the direction

Don't forget the sign.

ANSWER:

B_y = -3

Correct

Part D

What is the x component of $\vec{C}$?

Express your answer to the nearest integer.

Hint 1. How to find the start and end points of the vector components

A vector is defined only by its magnitude and direction. The starting point of the vector is of no consequence to its definition. Therefore, you need to somehow eliminate the starting point from your answer. You can run two perpendiculars to the *x* axis, one from the head (end with the arrow) of $\vec{C}$, and another to the tail, with the *x* component being the difference between *x* coordinates of head and tail (negative if the tail is to the right of the head). Another way is to imagine bringing the tail of $\vec{C}$ to the origin, and then using the same procedure you used before to find the components of $\vec{A}$ and $\vec{B}$. This is equivalent to the previous method, but it might be easier to visualize.

ANSWER:

C_x = -2

Correct

The following questions will ask you to give both components of vectors using the ordered pairs method. In this method, the *x* component is written first, followed by a comma, and then the *y* component. For example, the components of $\vec{A}$ would be written 2.5,3 in ordered pair notation.

The answers below are all integers, so estimate the components to the nearest whole number.

Part E

In ordered pair notation, write down the components of vector $\vec{B}$.

Express your answers to the nearest integer.

ANSWER:

B_x, B_y = 2,-3

Correct

Part F

In ordered pair notation, write down the components of vector D_vec.

Express your answers to the nearest integer.

ANSWER:

D_x, D_y = 2,-3

Correct

Part G

What is true about $\vec{B}$ and D_vec? Choose from the pulldown list below.

ANSWER:

- They have different components and are not the same vectors.
- They have the same components but are not the same vectors.
- They are the same vectors.
-

Correct

Score Summary:

Your score on this assignment is 98%.
You received 19.6 out of a possible total of 20 points.