

Vectors in-class assignment

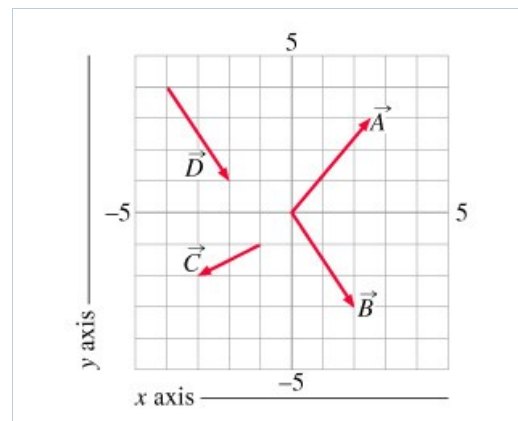
Due: 11:59pm on Sunday, May 8, 2022

You will receive no credit for items you complete after the assignment is due. [Grading Policy](#)

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 \vec{D} . 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 specified 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 x axis (because the tail of the vector is at the origin).

ANSWER:

Correct

Part B

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

Express your answer to the nearest integer.

ANSWER:

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 \vec{D} .

Express your answers to the nearest integer.

ANSWER:

$$D_x, D_y = 2, -3$$

Correct

Part G

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

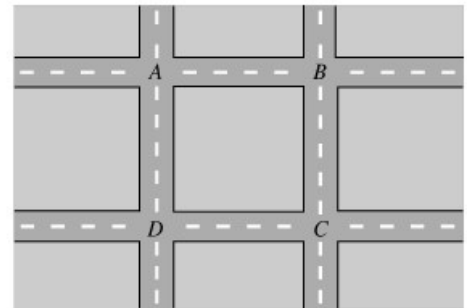
ANSWER:

- ☐ 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

Vector Magnitude and Direction Conceptual Question

A man out walking his dog makes one complete pass around a perfectly square city block. He starts at point A and walks clockwise around the block.



Let \vec{r}_{AB} be the displacement vector from A to B, \vec{r}_{BC} be the displacement vector from B to C, etc.

Part A

Which of the following vectors is equal to \vec{r}_{AB} ?

Hint 1. Determining a vector

Recall that \vec{r}_{AB} is a vector representing the displacement of the man and his dog as they walk from point A to point B. This vector has a magnitude equal to one block and a direction along the positive x axis.

Hint 2. Equal vectors

Two vectors are equal if they have the same *magnitude* and the same *direction*.

ANSWER:

- ☐ \vec{r}_{BC} only
- ☐ \vec{r}_{CD} only
- ☐ \vec{r}_{DA} only
- ☐ All of the above
- ☒ None of the above

Correct

Recall that, for vectors to be equal, they must have the same *magnitude* and *direction*.

Part B

Which of the following vectors is equal to $-\vec{r}_{AB}$?

ANSWER:

- ☐ \vec{r}_{BC} only
- ☒ \vec{r}_{CD} only
- ☐ \vec{r}_{DA} only
- ☐ All of the above
- ☐ None of the above

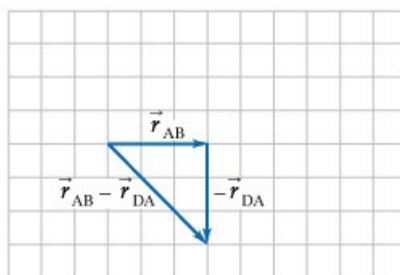
Correct

Part C

Which of the following vectors is equal to $\vec{r}_{AB} - \vec{r}_{DA}$?

Hint 1. Determining the difference of two vectors

$\vec{r}_{AB} - \vec{r}_{DA}$ can be determined by adding the vector \vec{r}_{AB} to the vector pointing opposite to \vec{r}_{DA} . Thus $\vec{r}_{AB} - \vec{r}_{DA}$ looks like this:



Carefully perform the vector addition in each of the options and compare the resultant vectors to the one shown above.

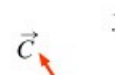
ANSWER:

- ☐ $-(\vec{r}_{CD} + \vec{r}_{DA})$ only
- ☐ $\vec{r}_{AB} + \vec{r}_{BC}$ only
- ☐ $\vec{r}_{BC} - \vec{r}_{CD}$ only
- ☒ All of the above
- ☐ None of the above

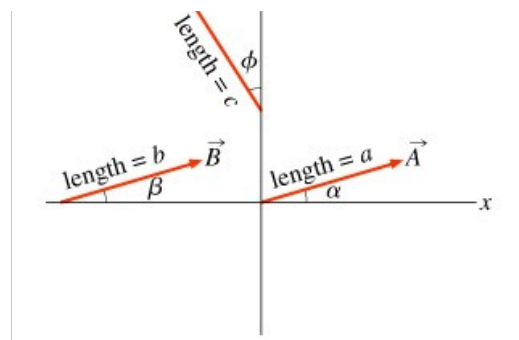
Correct

± 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

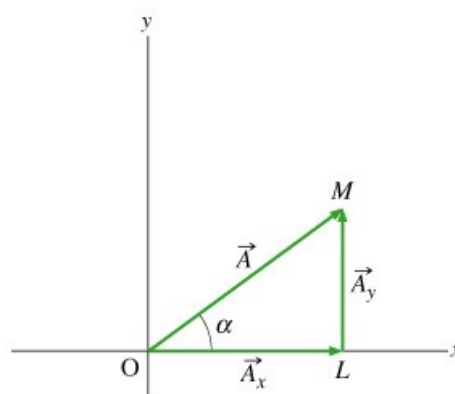
Find the components of the vector \vec{A} with length $a = 1.00$ and angle $\alpha = 20.0^\circ$ with respect to the x axis as shown.

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 $OL = OM \cos(\alpha)$.



ANSWER:

$\vec{A} = 0.940, 0.342$

Correct

Part B

Find the components of the vector \vec{B} with length $b = 1.00$ and angle $\beta = 20.0^\circ$ 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:

$\vec{B} = 0.940, 0.342$

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 $\phi = 30.0^\circ$ 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 $\phi = 0.524$ 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:

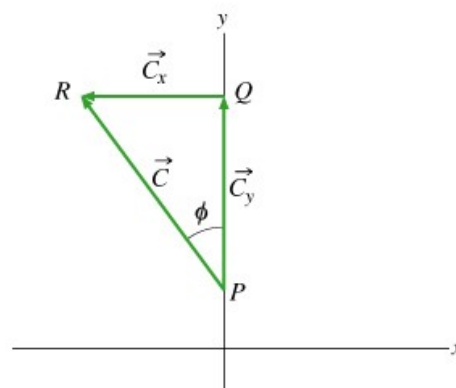
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Hint 2. Method 2: Use vector addition

Look at the figure shown.

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

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



ANSWER:

$\vec{C} = -0.500, 0.866$

Correct

± Vector Dot Product

Let vectors $\vec{A} = (2, 1, -4)$, $\vec{B} = (-3, 0, 1)$, and $\vec{C} = (-1, -1, 2)$.
Calculate the following:

Part A

Hint 1. Remember the dot product equation

If $\vec{M} = (M_x, M_y, M_z)$ and $\vec{N} = (N_x, N_y, N_z)$, then

$$\vec{M} \cdot \vec{N} = M_x N_x + M_y N_y + M_z N_z.$$

ANSWER:

$\vec{A} \cdot \vec{B} = -10$

Correct

Part B

What is the angle θ_{AB} between \vec{A} and \vec{B} ?

Express your answer using one significant figure.

Hint 1. Remember the definition of dot products

$$\vec{A} \cdot \vec{B} = |\vec{A}| |\vec{B}| \cos(\theta), \text{ where } \theta \text{ is the angle between } \vec{A} \text{ and } \vec{B}.$$

ANSWER:

$$\theta_{AB} = 2 \text{ radians}$$

Correct

Part C

ANSWER:

$$2\vec{B} \cdot 3\vec{C} = 30$$

Correct

Part D

ANSWER:

$$2(\vec{B} \cdot 3\vec{C}) = 30$$

Correct

Part E

Which of the following can be computed?

Hint 1. Dot product operator

The dot product operates only on two vectors. The dot product of a vector and a scalar is not defined.

ANSWER:

- ☐ $\vec{A} \cdot \vec{B} \cdot \vec{C}$
- ☐ $\vec{A} \cdot (\vec{B} \cdot \vec{C})$
- ☒ $\vec{A} \cdot (\vec{B} + \vec{C})$
- ☐ $3 \cdot \vec{A}$

Correct

\vec{V}_1 and \vec{V}_2 are different vectors with lengths V_1 and V_2 respectively. Find the following:

Part F

Express your answer in terms of V_1

Hint 1. What is the angle between a vector and itself?

The angle between a vector and itself is 0.

Hint 2. Remember the definition of dot products

$\vec{A} \cdot \vec{B} = |\vec{A}| |\vec{B}| \cos(\theta)$, where θ is the angle between \vec{A} and \vec{B} .

ANSWER:

$$\vec{V}_1 \cdot \vec{V}_1 = V_1^2$$

Correct

Part G

If \vec{V}_1 and \vec{V}_2 are perpendicular,

Hint 1. What is the angle between perpendicular vectors?

The angle between vectors that are perpendicular is equal to $\pi/2$ radians or 90 degrees.

ANSWER:

$$\vec{V}_1 \cdot \vec{V}_2 = 0$$

Correct

Part H

If \vec{V}_1 and \vec{V}_2 are parallel,

Express your answer in terms of V_1 and V_2 .

Hint 1. What is the angle between parallel vectors?

The angle between vectors that are parallel is equal to 0.

ANSWER:

$$\vec{V}_1 \cdot \vec{V}_2 = V_1 V_2$$

Correct

Exercise 1.38

Part A

Given the vector $\vec{A} = 4.00\hat{i} + 7.00\hat{j}$, find the magnitude of the vector.

ANSWER:

8.06

Correct

Part B

Given the vector $\vec{B} = 5.00\hat{i} - 2.00\hat{j}$, find the magnitude of the vector.

ANSWER:

5.39

Correct

Part C

Write an expression for the vector difference $\vec{A} - \vec{B}$ using unit vectors.

Express your answer in terms of unit vectors.

ANSWER:

$$\vec{A} - \vec{B} = -\hat{i} + 9\hat{j}$$

Correct

Part D

Find the magnitude of the vector difference $\vec{A} - \vec{B}$.

ANSWER:

9.06

Correct

Part E

Find the direction of the vector difference $\vec{A} - \vec{B}$.

ANSWER:

96.3 ° counterclockwise from +x direction

Correct

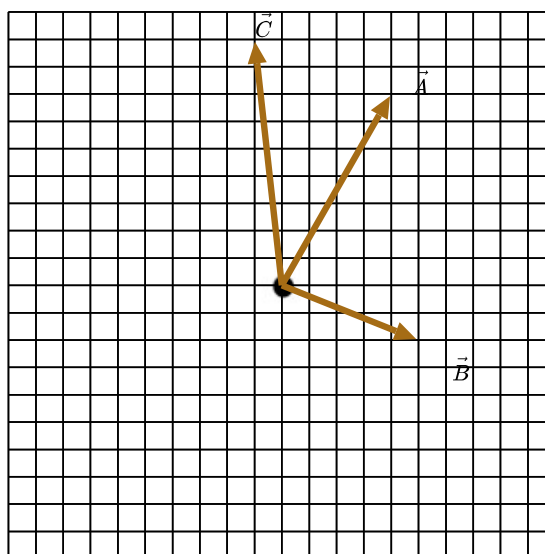
Part F

In a vector diagram show \vec{A} , \vec{B} , and $\vec{C} = \vec{A} - \vec{B}$.

Draw the vectors starting at the black dot. Both the orientation and length of your vectors will be graded. Use "vector info" button to see the angle and length of your vectors.

ANSWER:

No elements selected

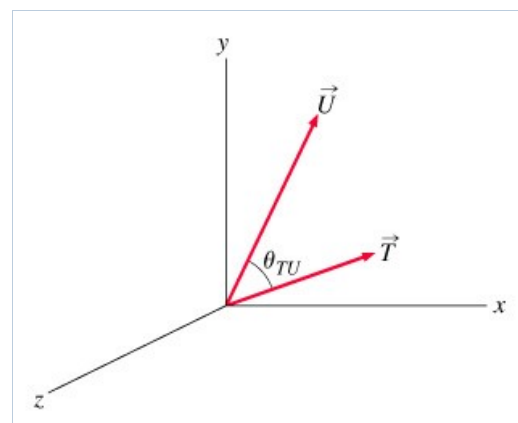


Correct

Finding the Cross Product

The figure shows two vectors \vec{T} and \vec{U} separated by an angle θ_{TU} .

You are given that $\vec{T} = (3, 1, 0)$, $\vec{U} = (2, 4, 0)$, and $\vec{T} \times \vec{U} = \vec{V}$.



Part A

Express \vec{V} as an ordered triplet of values, separated by commas.

ANSWER:

$$\vec{V} = 0,0,10$$

Correct

Part B

Find the magnitude of \vec{V} .

ANSWER:

$$|\vec{V}| = 10$$

Correct

Part C

Find the sine of the angle between \vec{T} and \vec{U} .

ANSWER:

$$\sin(\theta_{TU}) = 0.707$$

Correct

Exercise 1.44

Part A

Given two vectors $\vec{A} = 4.00\hat{i} + 7.00\hat{j}$ and $\vec{B} = 5.00\hat{i} - 2.00\hat{j}$, find the vector product $\vec{A} \times \vec{B}$ (expressed in unit vectors).

Express your answer in terms of the unit vectors \hat{i} , \hat{j} , and \hat{k} .

ANSWER:

$$\vec{A} \times \vec{B} = 0\hat{i} - 0\hat{j} - 43\hat{k}$$

Correct

Part B

What is the magnitude of the vector product?

ANSWER:

$$|\vec{A} \times \vec{B}| = 43.0$$

Correct

Score Summary:

Your score on this assignment is 95.6%.

You received 95.59 out of a possible total of 100 points.