✖

Vectors and Scalars

8/8 points earned (100%)

Retake

Course Home

Excellent!

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1 / 1
points

1.
[#131] **Scalars *vs* vectors**

Which of these quantities are scalars (as opposed to vectors)?

- [ ] Gravitational field at a point

Un-selected is correct

- [ ] Acceleration

Un-selected is correct

- [ ] Energy

Correct
Energy is a scalar. Think of the amount of energy in the food we eat. We often measure the energy of our food in kJ or Calories. We don't say '1000 kJ to the left': Energy doesn't have direction.

- [ ] Momentum

Un-selected is correct

- [ ] Volume

Correct

Volume is a scalar. We say 'a litre', not 'a litre up' or 'a litre to the left': volume doesn't have direction.

☐ Density

Correct
Density is a scalar. It is the amount of mass (scalar) per volume (also a scalar). Density doesn't have direction.

☐ Force

Un-selected is correct

☐ Mass

Correct
Mass is a scalar. It has no direction.

☐ Weight

Un-selected is correct

☐ Kinetic energy

Correct
You may have been tempted to say vector because velocity (a vector quantity) is often used to compute kinetic energy. However, kinetic energy is one form of energy, and energy is always a scalar. More on this later in the course.

✔ 1 / 1 points

2.
[#132] **Vector geometry**

For the next series of questions, you will need pen and paper. Yes, you may be able to do some without drawing sketches, but you'll learn more if you do draw them. We won't cover trigonometry or vector algebra in detail in this course. If you've never encountered vectors before, these questions will pose a challenge, but they are still possible. The resource at http://www.animations.physics.unsw.edu.au/jw/vectors.htm

may be helpful.

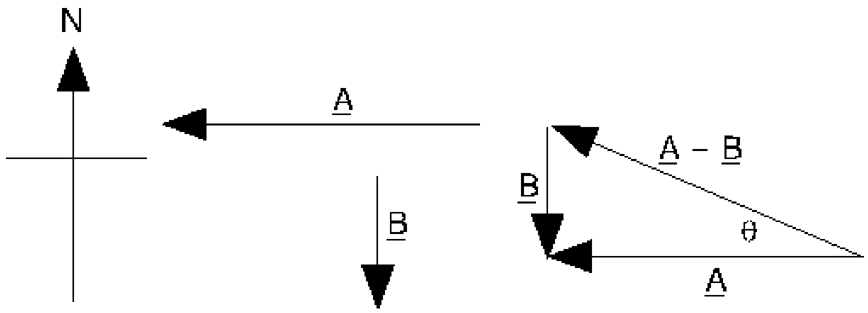
If $\vec{\mathbf{A}}$ is 2.0 km west, and $\vec{\mathbf{B}}$ is 1.0 km south, what is $\vec{\mathbf{A}} - \vec{\mathbf{B}}$?

Answer: $\vec{\mathbf{A}} - \vec{\mathbf{B}}$ is ___ km at ____° north of west. Write your answers below (separated by a comma *and with an appropriate number of significant figures*).

2.2, 27

Correct Response

The first thing to do in most physics problems is to draw a diagram. So draw the vectors and put them head to head for subtraction (or use the + (–B) method).



From Pythagoras, $|\vec{\mathbf{A}} - \vec{\mathbf{B}}| = \sqrt{(1.0 \text{ km})^2 + (2.0 \text{ km})^2} = 2.2 \text{ km}$. The diagram shows us that it lies at an angle θ north of west, where $\tan \theta = \frac{1.0}{2.0}$, so $\theta = 27^\circ$. So $|\vec{\mathbf{A}} - \vec{\mathbf{B}}|$ is 2.2 km at 27° north of west (or 63° west of north, etc.). (It this was tricky, you might need to review some trigonometry: we're assuming that you know basic trigonometric functions and Pythagoras' theorem.)

Show other acceptable response

1 / 1
points

3.

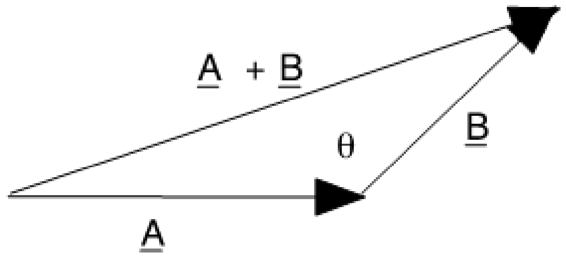
[#133] **Vector magnitudes**

You are told that $|\vec{\mathbf{A}}+\vec{\mathbf{B}}| = |\vec{\mathbf{A}}| + |\vec{\mathbf{B}}|$. What can you deduce about **A** and **B**? Write your answer using one word, commonly used in geometry: they are _____.

parallel

Correct Response

You may see a simple argument for this answer, but let's give a formal answer here. We draw $\vec{\mathbf{A}}$ and $\vec{\mathbf{B}}$ with some arbitrary angle between them:



Then write an expression for $|\vec{\mathbf{A}}+\vec{\mathbf{B}}|$.

From the condition given in the problem, we know that
$|\vec{\mathbf{A}}+\vec{\mathbf{B}}|^2 = (|\vec{\mathbf{A}}| + |\vec{\mathbf{B}}|)^2 = |\vec{\mathbf{A}}|^2 + |\vec{\mathbf{B}}|^2 + 2|\vec{\mathbf{A}}||\vec{\mathbf{B}}|. (\mathrm{Eq.1})$

We also know, using the cosine rule for two arbitrary vectors, that
$|\vec{\mathbf{A}}+\vec{\mathbf{B}}|^2 = |\vec{\mathbf{A}}|^2 + |\vec{\mathbf{B}}|^2 - 2|\vec{\mathbf{A}}||\vec{\mathbf{B}}|\cos\theta,\ (\mathrm{Eq.2})$

where θ is the angle opposite $|\vec{\mathbf{A}}+\vec{\mathbf{B}}|$.

Setting equations (1) and (2) equal to one another and solving for $\cos\theta$, we find $\cos\theta = -1$.

Thus θ must be π radians, or 180°. The answer is **parallel** (or collinear).

Show other acceptable responses

1 / 1
points

4.

[#134] **Add three vectors**

Draw an example of $|\vec{\mathbf{A}} + \vec{\mathbf{B}} + \vec{\mathbf{C}}| = 0$, in which none of the vectors is zero. Okay, this and the next question are honesty questions – you draw the answer and you mark it yourself!

Did you come up with a solution?

- Yes

  There are two sorts of answers: any triangle with all of the vectors in the clockwise direction, and any triangle with all of the vectors in the anticlockwise direction. How did you go?

- No
- I think so...

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1 / 1 points

5.

[#135] **Subtract three vectors**

Draw an example of $|\vec{\mathbf{A}} - \vec{\mathbf{B}} + \vec{\mathbf{C}}| = 0$, in which none of the vectors is zero. This is another honesty question...

Did you come up with a solution?

- Yes

  In this case, any triangle of vectors where **B** is in the clockwise direction and the others anticlockwise is correct. Or any triangle of vectors where **B** is in the anticlockwise direction and the others clockwise is correct. How did you go?

- No
- I think so...

1 / 1
points

6.
[#136] **Components of vectors: algebra**

Draw a vector $\vec{\mathbf{A}}$ in the (x, y) plane. Draw it so that its tail is at the origin and it points upwards and to the right. Label the angle θ it makes with the x axis. (We call this θ positive, where positive angle is measured in the geometric or anticlockwise sense.) Label the magnitude of $\vec{\mathbf{A}}$ as A.

Now draw $\vec{\mathbf{A}}$ as the sum of two vectors: one vector in the x direction with magnitude A_x, and one in the y direction with magnitude A_y. Label these magnitudes on your drawing, and write expressions for them in terms of θ .To summarise:

i) draw $\vec{\mathbf{A}}$

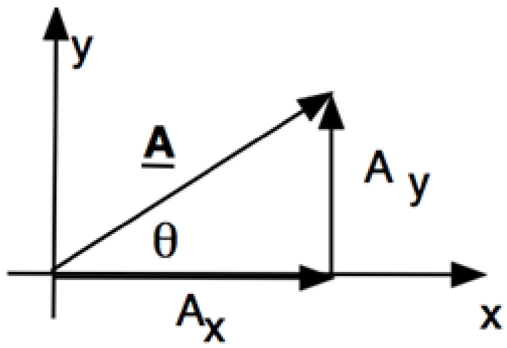
ii) show the magnitudes of the two vectors that add to give $\vec{\mathbf{A}}$.

iii) write expressions for A_x and A_y in terms of A and θ.

Did you get this one?

Yes

Great! How does your answer compare to the one given here?



(Of course, it doesn't have to be exactly the same shape.) From trigonometry, $A_x = A\cos\theta$, and $A_y = A\sin\theta$.

No

I think so

1 / 1

points

7.

[#137] **Vector components**

A displacement vector $\vec{\mathbf{A}}$ in the (x, y) plane makes an angle of 45° with the positive x axis, and also with the positive y axis. If its magnitude is 2.0, what are its x and y components, in meters?

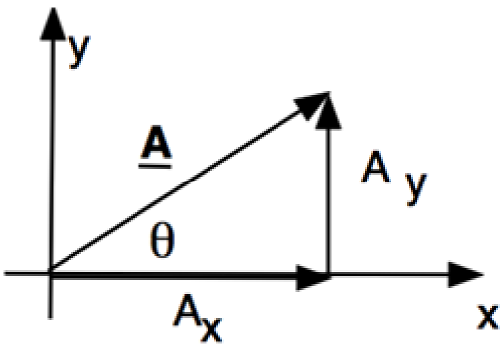
Write your answer as "value of x, value of y". For example: 1.5, 3.0

(Remember significant figures).

1.4, 1.4

Correct Response

$A_x = 1.4, A_y = 1.4$



Since $\theta = 45^\circ$, $A_x = A\cos\theta = 1.4$, and $A_y = A\sin\theta = 1.4$.
(Drawing may not be to scale in your browser.)

Show other acceptable response

1 / 1
points

8.

[#138] **What's my bearing**

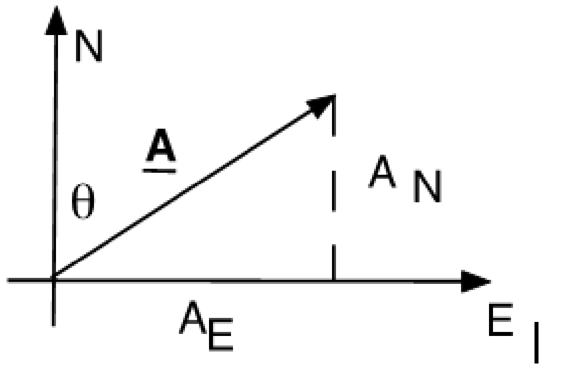
The horizontal vector $\vec{\mathbf{A}}$ has magnitude $A = 2.2$ and its direction is $\theta = 35^\circ$ east of north*. (For your own benefit, we strongly recommend that you draw a sketch.) Calculate its components in the north and east directions.

You should write your answer in the following format: "north, east". For example, if the components are 1.2 north and 3.5 east, you should write: 1.2, 3.5

* Notice and be careful with the different conventions: in mathematics, we measure angles anticlockwise from the x axis. In navigation, we often give angles in the clockwise direction from North.

1.8, 1.3

Correct Response



$A_{\text{East}} = A \sin \theta \qquad A_{\text{North}} = A \cos \theta.$

Diagram may not be to scale in your browser.

Show other acceptable response