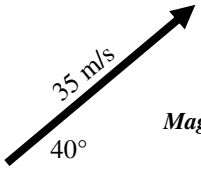
Vectors Basics

We use arrows to represent vectors. Vectors have both **magnitude** and **direction**.

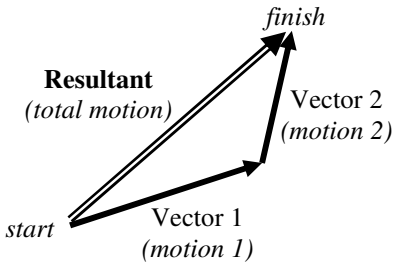


Direction = 40°

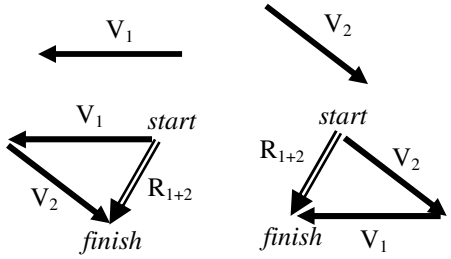
Magnitude = 35 m/s

The *result* of adding together two or more vectors is called a ***resultant***.

When adding vectors graphically, put the arrows head to tail. The resultant goes from start to finish.

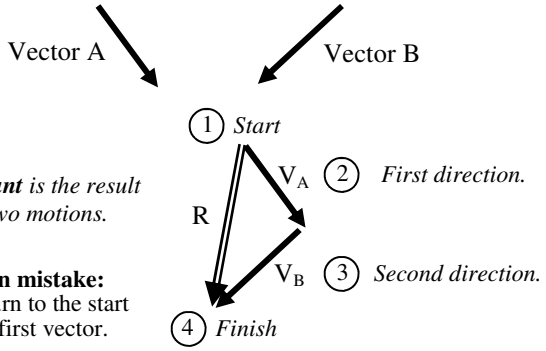


Order doesn't matter when adding vectors. The resultant will be the same.



Notice: same resultant with a different order.

Helpful Hint: Think of vectors as following directions.



*The **resultant** is the result of the two motions.*

Common mistake:
Do not return to the start after the first vector.

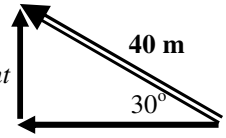
Using trigonometry, we **resolve** non-vertical or non-horizontal vectors into x and y **components**.

$$\sin 30^o = \frac{y}{40\text{ m}}$$

$$y = (40\text{m})\sin 30^o$$

$$\mathbf{y} = (40\text{m})0.5 = \mathbf{20\ m}$$

y – component ***= 20 m***



x – component ***= -34.6 m***

$$\cos 30^o = \frac{x}{40\text{ m}}$$

$$x = (40\text{m})\cos 30^o$$

$$x = (40\text{m}).866 = \mathbf{-34.6\ m}$$

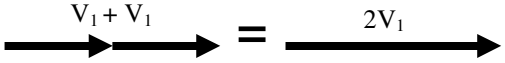
x is negative because it's going left.

Working independently in the x and y dimensions is easier than working in two dimensions.

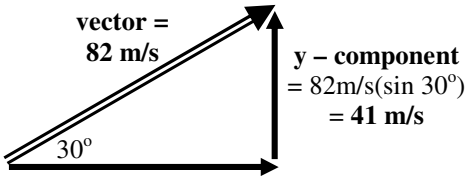
Math and Vectors

Subtracting vectors: add its opposite (the negative of the vector).

Multiplying vectors: multiply the size of the vector.



Components retain the units of the vector (*and vice-versa*).



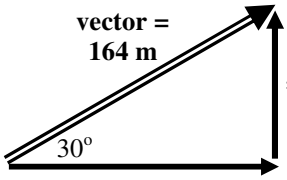
y – component
= 82m/s(sin 30°)
= **41 m/s**

x – component
= 82m/s(cos 30°)
= **71 m/s**

If the vector was a plane, the x-component could be a race car trying to stay under it on the ground. The y-component could be how much fast it gains altitude.

When calculating with a vector the result is a different vector with the same direction, but different units.

*If you **multiply** the **velocity** vector on the right **by time** (2 seconds) **you get a distance** vector.*



y – component
= 164m(sin 30°)
= **82 m**

OR 41m/s(2sec)
= 82 m

x – component
= 164m(cos 30°)
= **142 m**

OR (71m/s) x (2sec) = 142 m

Multiplying any component of the velocity vector by time gives the correlating component of the displacement vector.
OR
A velocity triangle becomes a displacement triangle when multiplied by time.

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1. Resolve	A. The portion of the vector on the x or y axis.
2. Magnitude	B. To find the x– or y-component of a vector.
3. Resultant	C. The size of a vector ("35" of "35m").
4. Component	D. Tells where a vector is pointing or the angle of the vector.
5. Direction	E. What you find by adding two vectors together.
6. Vector	F. Something that has magnitude and direction.

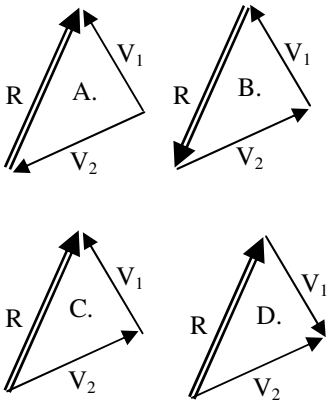
7. In figures A—D, which vectors are added correctly? If wrong, why?

A.

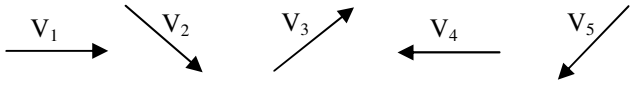
B.

C.

D.



Using the vectors at the right, draw the resultants for the following operations.



8. $-V_4 =$

9. $3V_1 =$

10. $-2V_5 =$

11. $V_2 - V_5 =$

12. $2V_2 + V_4 =$

13. $V_3 - V_4 =$

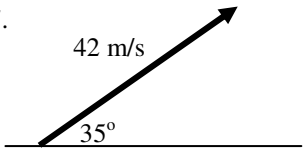
14. $2V_2 - V_3 =$

15. $V_3 + 2V_4 - V_2 =$

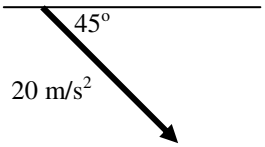
16. $2V_1 - 2V_4 =$

Resolve the following vectors into their x and y-components.

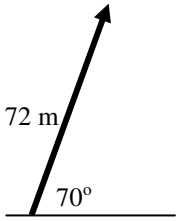
17.



18.

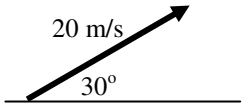


19.



20. An object moves at 20 m/s at 30º.

A. Draw how far it travel in 3 second? *(Be sure to show magnitude and direction.)*



B. How far does the object travel in the x-direction during the same 3 seconds?

21. A person walks 6 m East, 9 m North, 2 m South, 1 m West, and then 3 m North.

A) Find the total x-displacement.

B) Find the total y-displacement.

C) Using the x and y-components above, draw the resultant.

D) Find the resultant's magnitude and direction.

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