Physics 20 Chapter 2 - Vectors

Vectors in One and Two Dimensions

Vectors

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2. The direction of the arrow indicates the direction of the vector.

directed right **directed left**

3. Vectors can be represented by letters.

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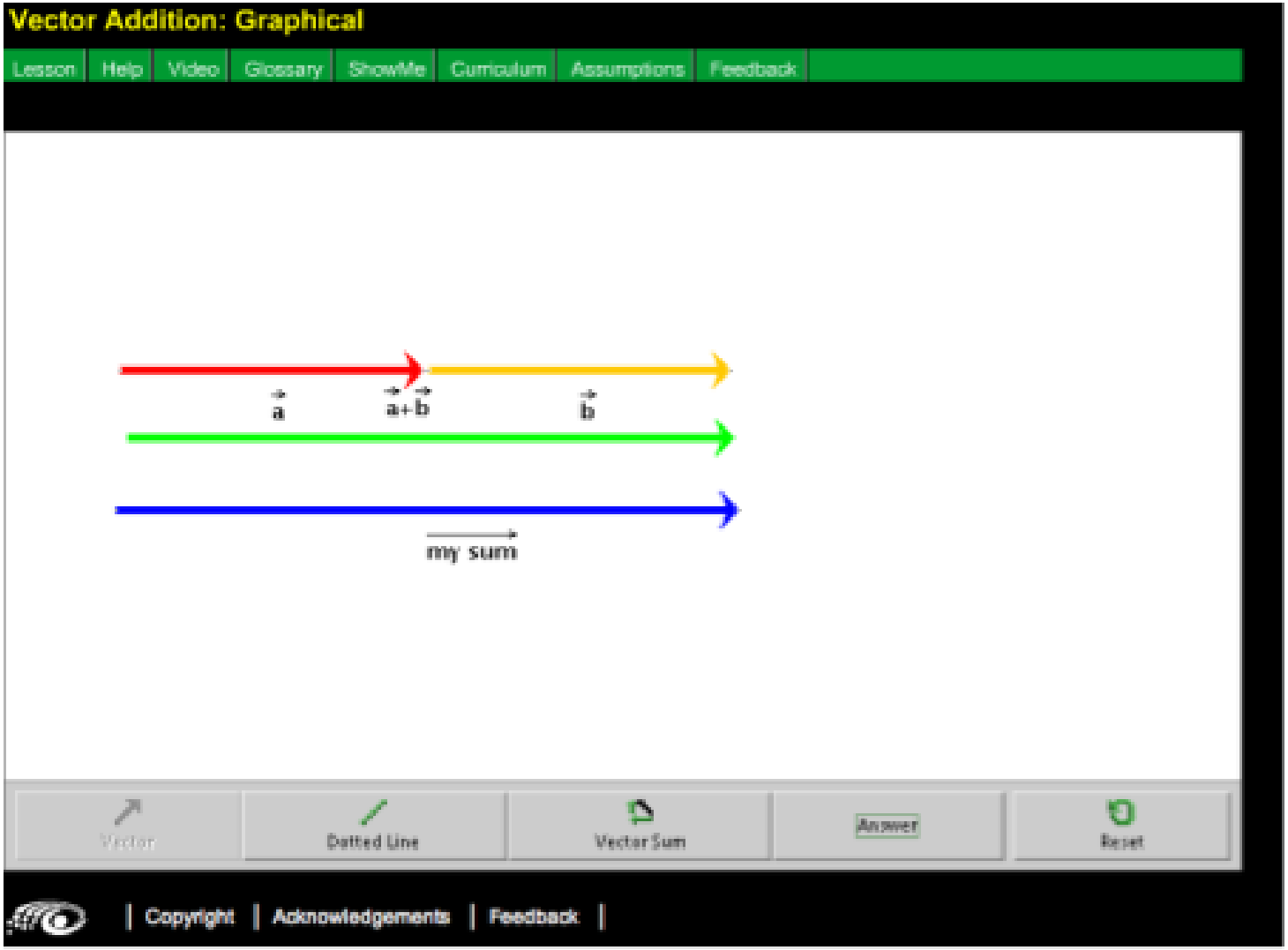
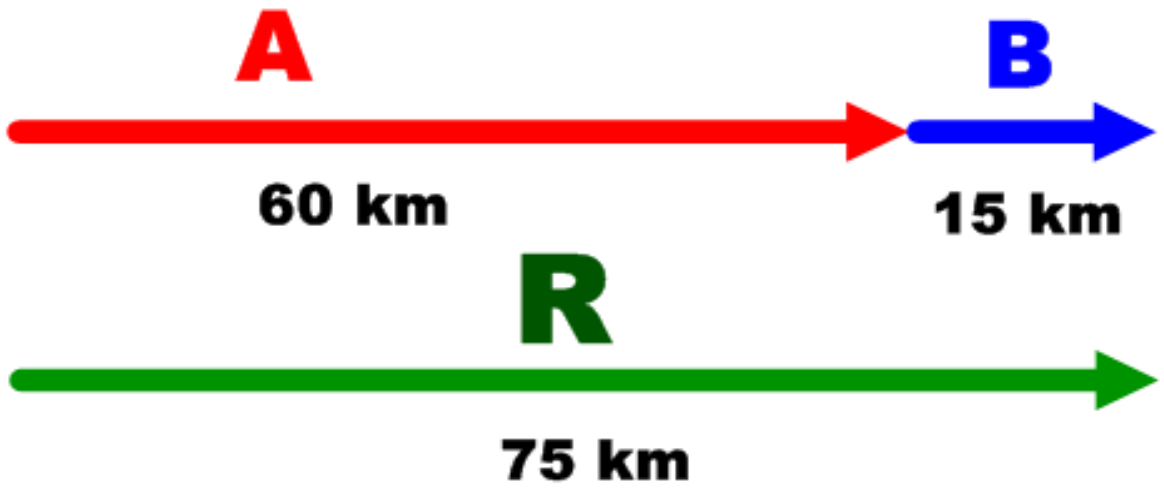


Vector Applet @ learnalberta.ca (LA389 5629)

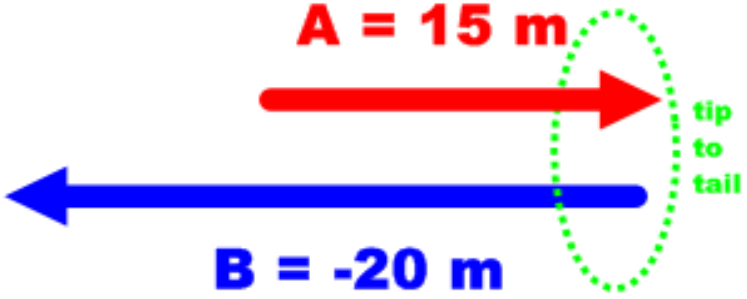
[Vector Applet]

ex) A car drives East for 60 km, then stops and continues driving East for another 15 km. What is the resultant distance the car has driven?



*Notice, the vectors are added tip-to-tail.

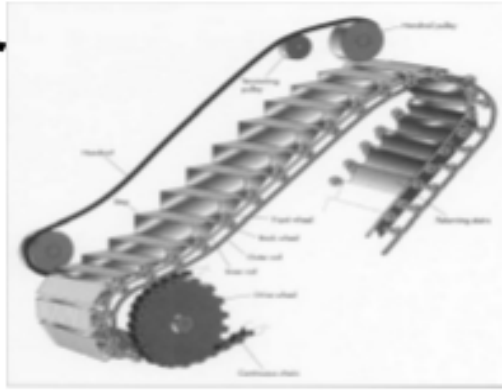
ex) A partridge walks 15 m to the right, then stops and walks 20 m left. What is the resultant distance?



$$R = A + B$$
$$= (15\ m) + (-20\ m)$$
$$= -5\ m$$

*Note: The resultant is not drawn tip-to-tail. This is okay.

ex) Pat is walking down the up escalator at W.E.M. at 1.5 m/s. The escalator goes up at 4.0 m/s. To an observer watching the motion, what is Pat's resultant velocity?



Ans: 2.5 m/s up

ex) A frog hops 25 cm left, then stops before hopping another 5 cm left. He then turns around and hops 15 cm right. What is his resultant displacement?

Ans: 15 cm left

Vectors in Two Dimensions

We can use a similar approach to adding vectors acting in two dimensions (i.e. vertically and horizontally).

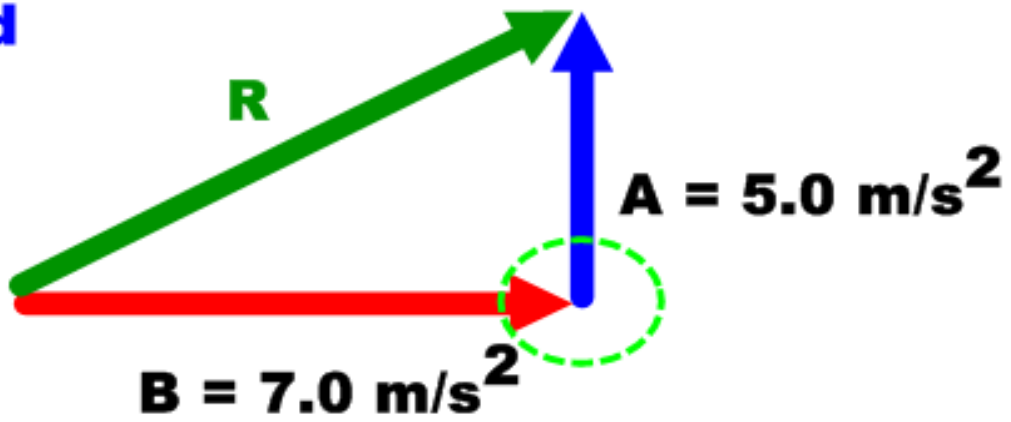
All you need to do is draw the vectors tip-to-tail.

After that, you can use simple trig/pythagorean theorem to find the resultant.

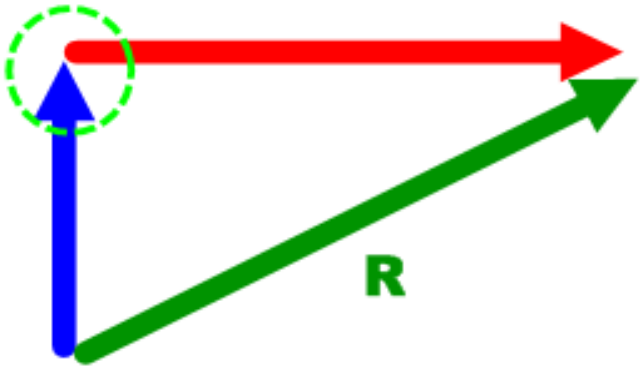
ex) An acceleration vector, A, of 5.0 m/s^2 is pointed vertically up. Another, B, is pointed horizontally right at 7.0 m/s^2. What is the resultant acceleration?

*Remember: Draw vectors tip-to-tail!

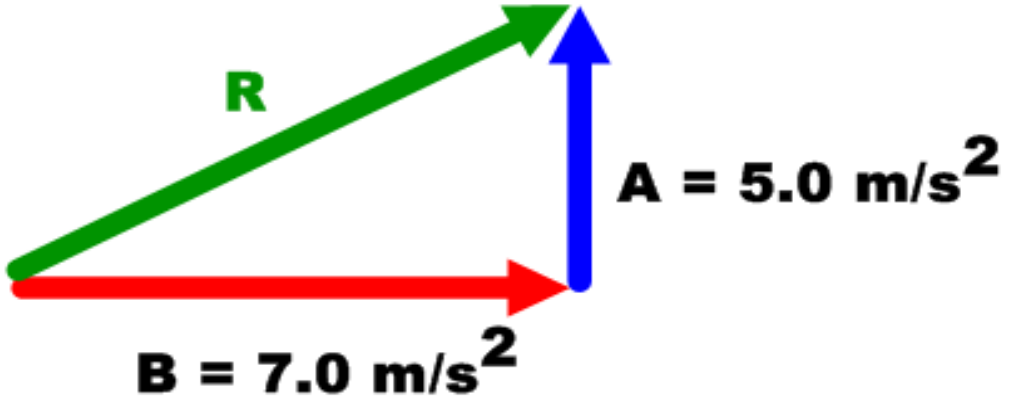
Step 1: Draw and label a vector diagram.



or



Step 2: Use pythagorean theorem to solve for R.



$$R^2 = A^2 + B^2$$

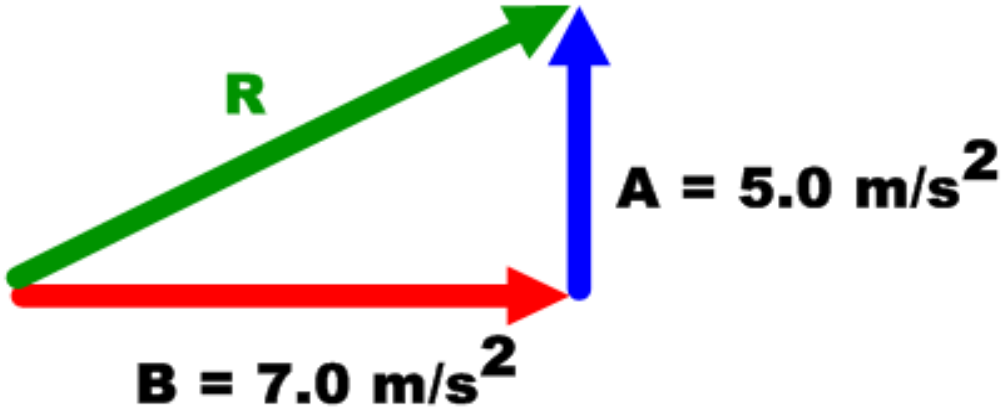
R = _____

However, this is not our final answer...

Because vectors have both magnitude and direction, we need to figure out what direction the vector is acting at.

We do this by stating the angle of the resultant.

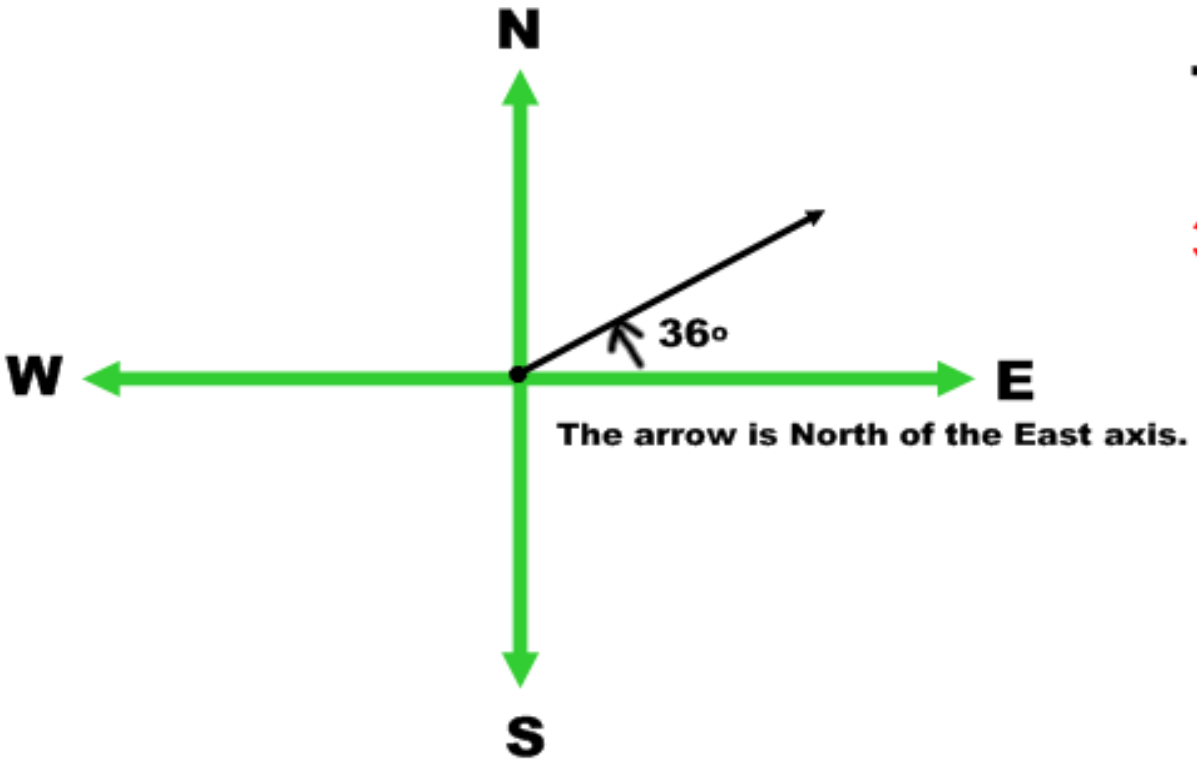
Step 3: Determine the angle of R.



...but we still ain't done...

Two Ways of Notating Direction:

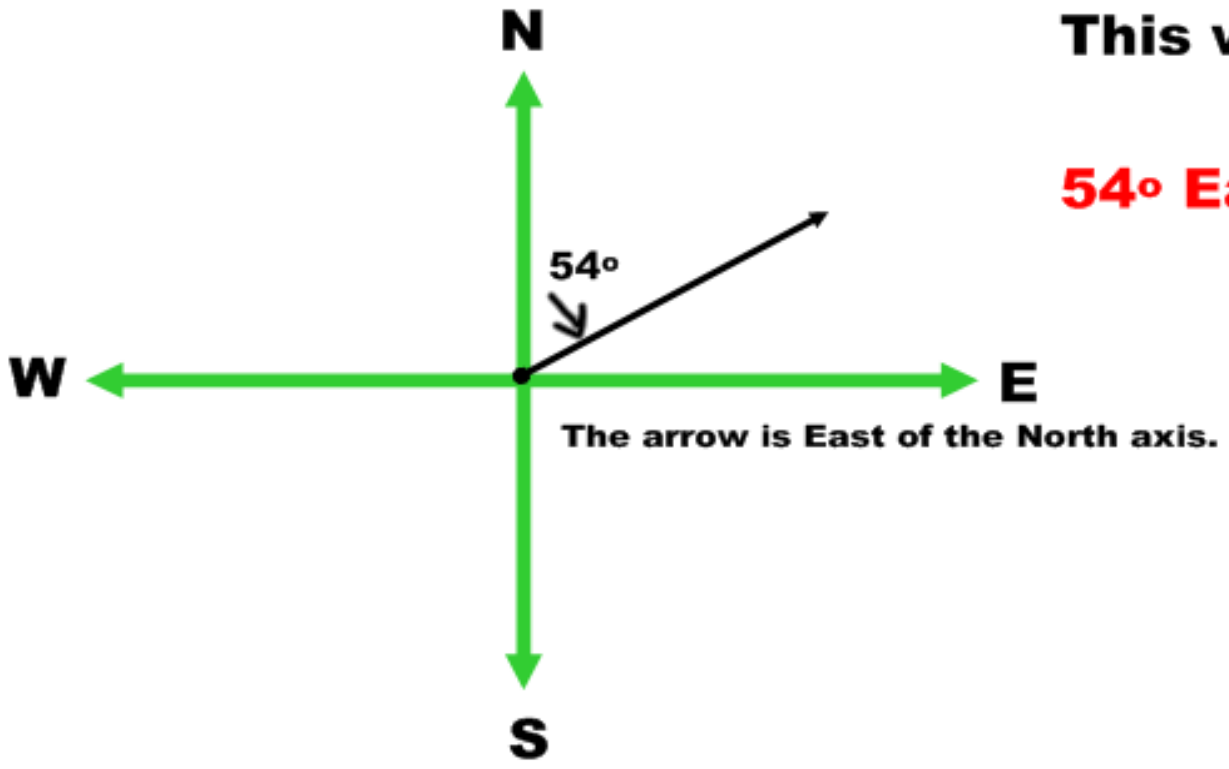
1. Navigational (Common Way)



This would be:

36° North of East.

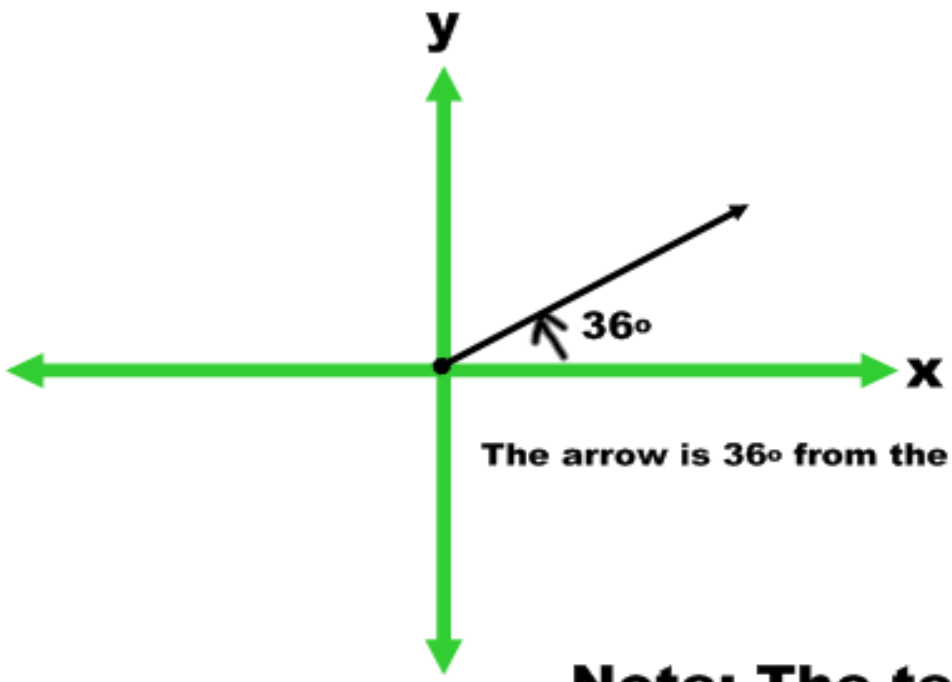
...this could also be:



This would be:

54° East of North.

2. The Rectangular Coordinate System (RCS) - Also called "Ladner's Way" or (in text) Cartesian Method.



The arrow is 36° from the x-axis.

- Measure the angle counter-clockwise with respect to the x-axis.

This would be:

36° RCS

Note: The text writes this as [36°]

ex) Add the following vectors. Express the direction of the resultant using both the navigational system and the RCS system.

a) 3.0 m South and 4.0 m East.

b) 3.0 m W and 8.0 m N.

c) 6.0 m right and 1.0 m down.

Breaking vectors into components

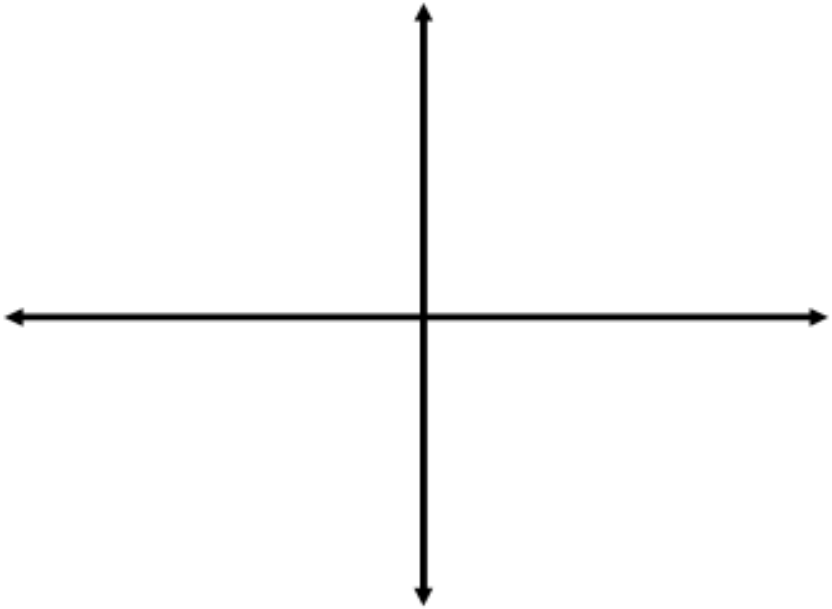
Being able to move forwards as well as backwards is a big idea in math & physics.

Therefore, I think it makes sense that if we can add two vectors together to make one resultant vector, we can also take the resultant and break it into two new vectors, called components.

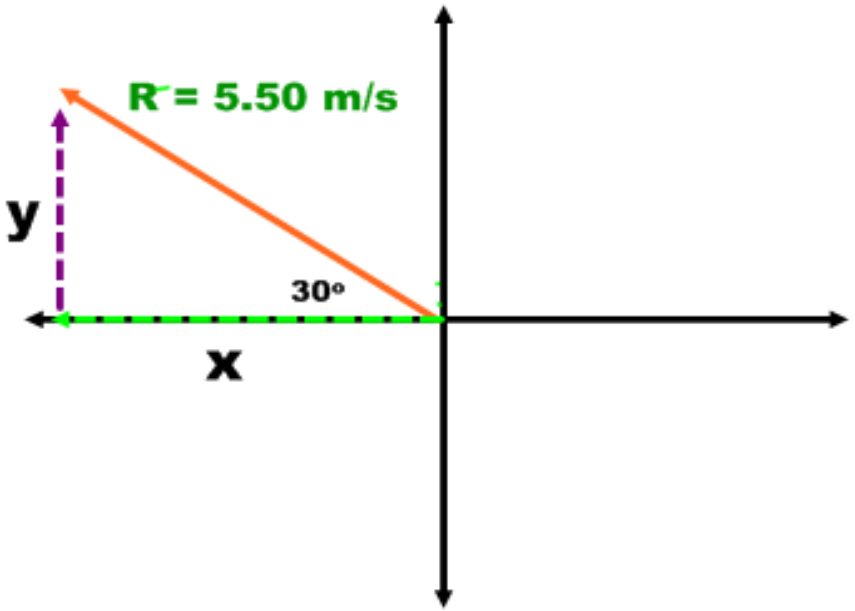
ex) A crow flies at an angle of 30° N of W with a velocity of 5.50 m/s.

What are the components of this movement?

Step 1: Draw out a vector diagram on a Cartesian Plane.



Step 2: Draw in and label the x and y components. Use proper vector notation.



Step 3: Using trig ratios, determine the measure of the components.

This is called "**breaking a vector into components**".

ex) Determine the North and East velocity components of a car traveling at 100 km/h at 25° N of E.