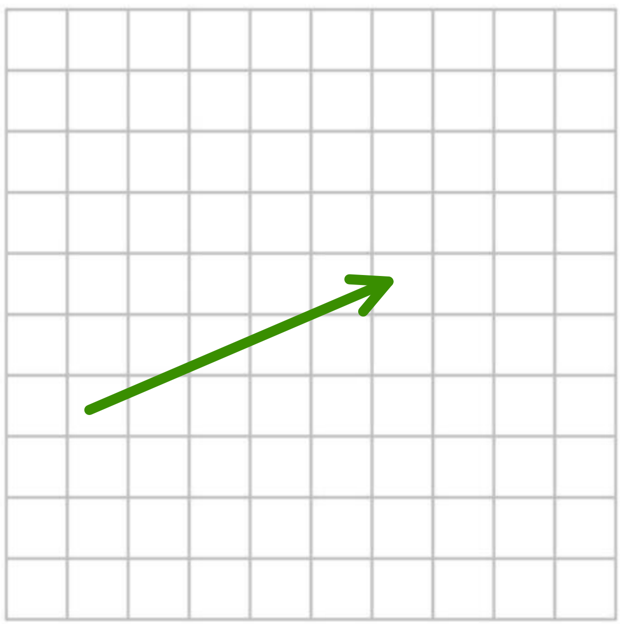
Vectors

We've already been using vectors a lot in this class. Vectors have magnitude AND direction associated with them.

Name vectors that have come up in this class:

velocity, displacement



I can move a vector to any convenient location on my grid. It is the same vector. As long as I do not change the magnitude or direction, I am not changing the vector.

Whenever you have a vector in your calculation, you must make sure to note it's direction. 12.3m/s EAST. (down, to the left, etc…)

Physics is heavy with vectors. Here are some that you will see this course:

Velocity	Displacement	Acceleration
Forces	Momentum	Impulse
	Gravitational Field	

Textbooks often write vectors with **boldface.** ie: **v**. This is hard to do with a pencil. When, it is customary to write a small arrow over the letter representing the vector.

Arrow: $\vec{v}$

Angled brackets: $\langle x, y \rangle$

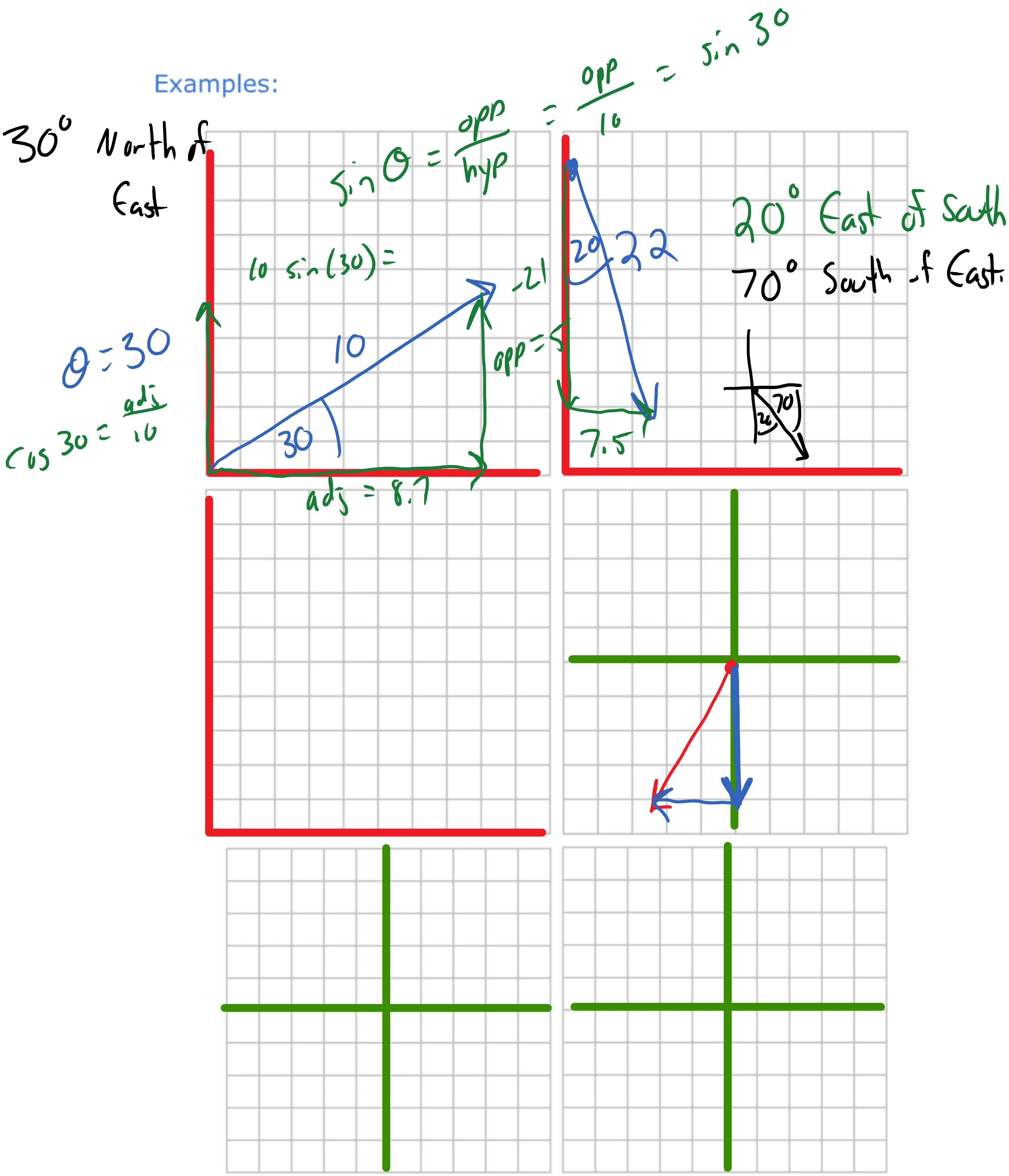
Vertical Square brackets: $\begin{bmatrix} x \\ y \end{bmatrix}$

Hats: $\hat{i}, \hat{j}, \hat{k}$

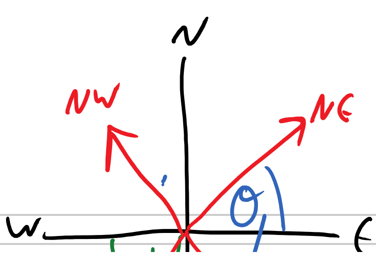
x, y, z

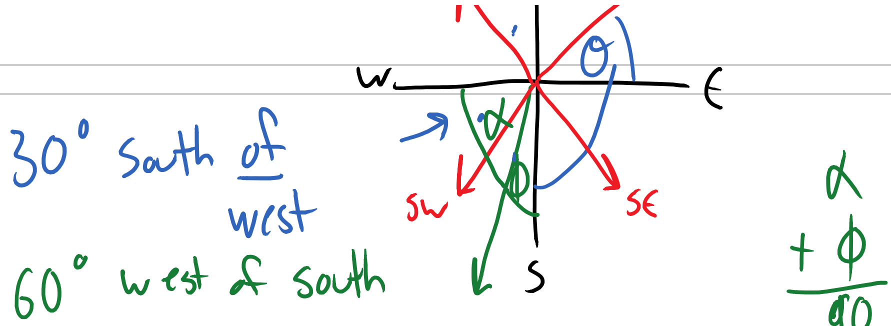
When something is moving on a plane (as with 3D space… but we will not worry about that yet.) it can be broken down into COMPONENTS. One piece is parallel to the x-axis. One piece is parallel to the y-axis.

Examples:



$\alpha = 30$





This was just the trig that you already knew. We must report the direction of the vector as well! We tend to do this with compass bearings. Let's write the above examples with cardinal (compass) directions.

Now some examples the other way:

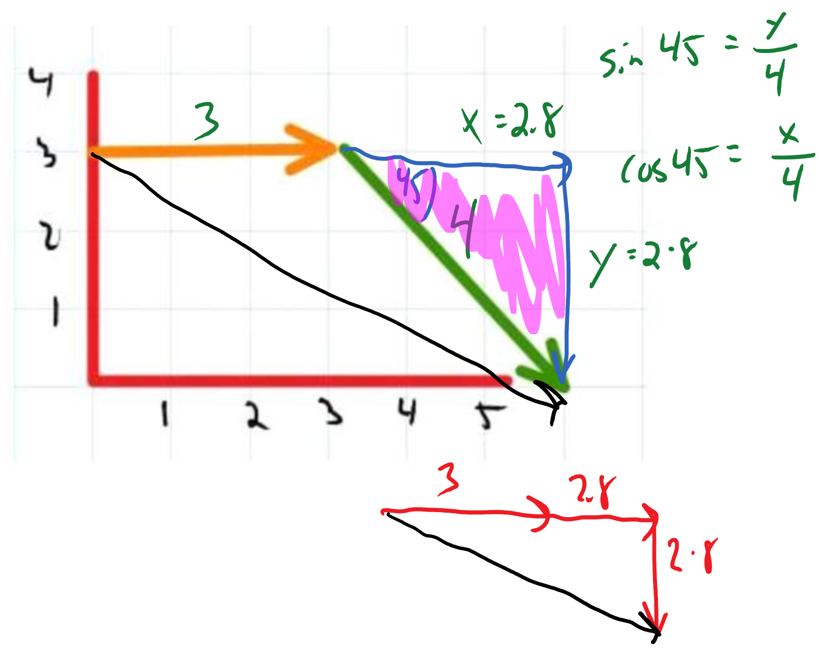
1) Draw 10 m at 30° west of north.
2) 5m at 30° west of south.
3) 10m at 10° north of east.
4) 5 m at 10° south of west.

We can see we can't just add them.

Resultant Vector: The vector that is formed from the combination of other vectors.

What is the resultant vector?

1. Kyle walks 3 km north, then 4 km north.
2. Caleb walks 3 km east, then walks 4 km south. What is the resultant vector?
3. Christian bikes 3km east, then 4 km west.
4. Alex drives 3km east then turns and drives 4km south east.



We have learned that 3+4= 7, 5, -1, 4.6...

Adding vectors is easily done by arranging the vectors in TIP TO TAIL fashion. Remember, we can move the vector where we want, we just cannot change its magnitude or direction. Place the tail of your second vector on the tip of the first vector. Your resultant vector is the line from where you start to where you finish.

Don’t' subtract. Add the opposite.
Ie: don't subtract west; add east.

To solve #4 above we can use cosine or sin laws…

Sin Law:

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

Cosine Law:

$$c^2 = a^2 + b^2 - 2ab \cdot cosC$$

$$b^2 = a^2 + c^2 - 2ac \cdot cosB$$

$$a^2 = b^2 + c^2 - 2bc \cdot cosA$$