Learning Goal: I will be able to multiply a vector by a scalar.

Minds On: Airplane revisited

Action: Class Examples

Consolidation: Practice

Minds On

Pythagorean Theorem, soh cah toa, Sine Law, or Cosine Law?

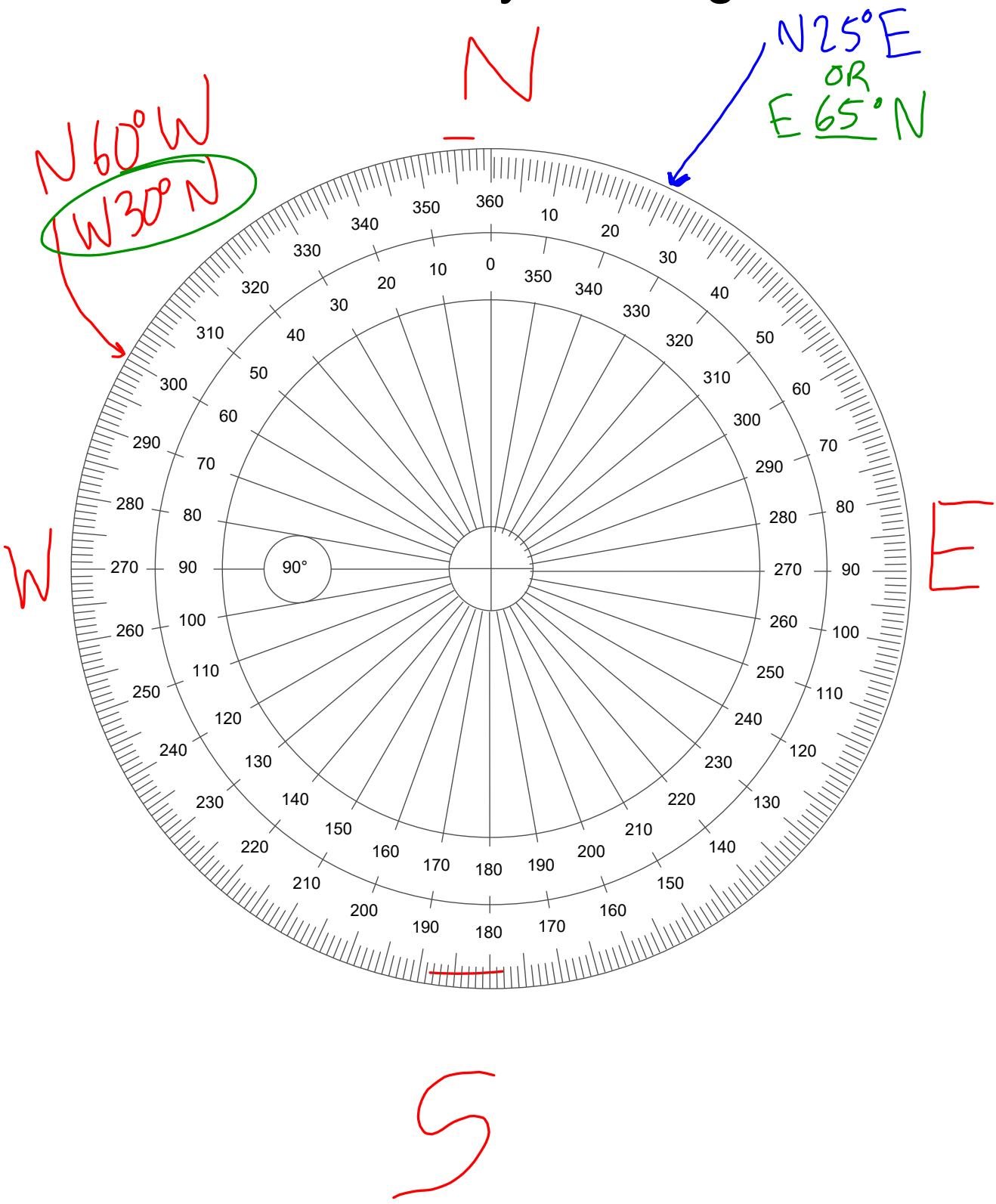
Come up with a brief explanation of how you know when to use each tool.

$$c^2 = a^2 + b^2 - 2ab\cos C$$

$$C = \cos^{-1}\left(\frac{a^2 + b^2 - c^2}{2ab}\right)$$

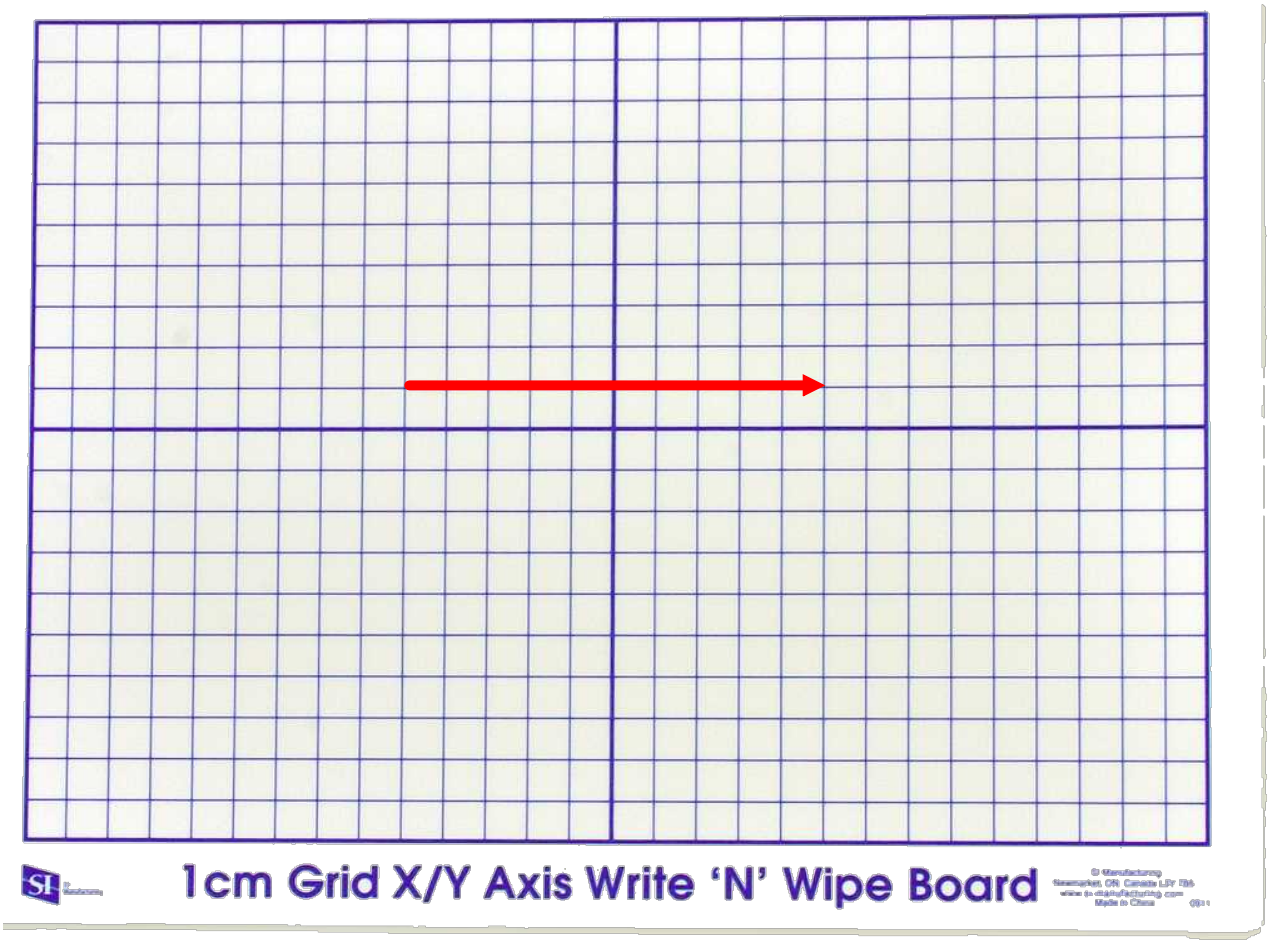
$$C = \cos^{-1}\left(\frac{c^2 - a^2 - b^2}{-2ab}\right)$$

Minds On What's my heading?



Minds On

Given $\vec{x}$, sketch...



$0\vec{x}$

$\vec{x}$

Minds On

6.3 Multiplication of a Vector by a Scalar

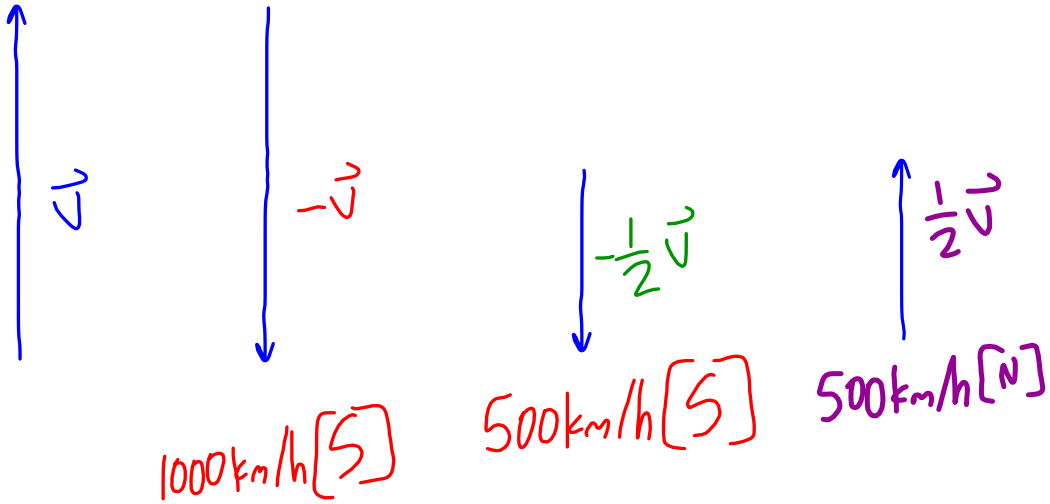
For the vector $k\vec{a}$, where k is a scalar and $\vec{a}$ is a nonzero vector:

- If k > 0, then $k\vec{a}$ is in the same direction as $\vec{a}$ with a magnitude of $k|\vec{a}|$.
- If k < 0, then $k\vec{a}$ is in the opposite direction as $\vec{a}$ with a magnitude of $k|\vec{a}|$.
- For all k values on the interval (-1, 1), the vector is shortened.

"fractions" or values that are $\pm 0.\ldots$

Minds On

Example 1: An airplane is heading due north at 1000 km/h. The airplane's velocity is represented by $\vec{v}$. Draw the vectors $-\vec{v}$, $(-1/2)\vec{v}$, and $(1/2)\vec{v}$ and give an interpretation for each.



Action

Collinear Vectors

Two vectors $\vec{u}$ and $\vec{v}$ are collinear if and only if it is possible to find a nonzero scalar k such that $\vec{u} = k\vec{v}$.

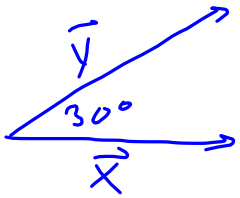
even negative!

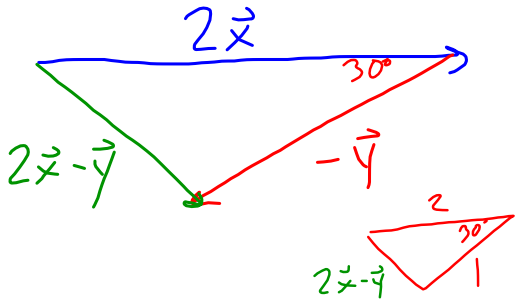
Collinear Vectors are parallel or lie on the same straight line

Action

Example 2: The vectors $\vec{x}$ and $\vec{y}$ are unit vectors (means they have a magnitude of 1) that make an angle of 30° with each other.

a) Calculate the value of $|2\vec{x} - \vec{y}|$.



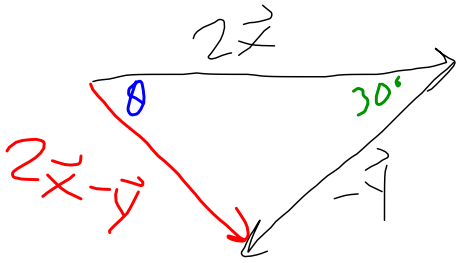


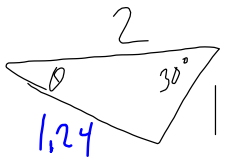
$|2\vec{x}-\vec{y}|^2 = |2\vec{x}|^2 + |-\vec{y}|^2 - 2|2\vec{x}||-\vec{y}|\cos 30°$

$* \quad |2\vec{x}-\vec{y}|^2 = (2)^2 + (1)^2 - 2(2)(1)\cos 30°$

$|2\vec{x}-\vec{y}| = 1.24$

b) Determine the direction of $2\vec{x} - \vec{y}$.





$\frac{\sin\theta}{1} = \frac{\sin 30°}{1.24}$

$\theta = 23.74°$

$\therefore$ the vector $2\vec{x}-\vec{y}$ is at an angle of 23.74° rotated clockwise to $\vec{x}$.

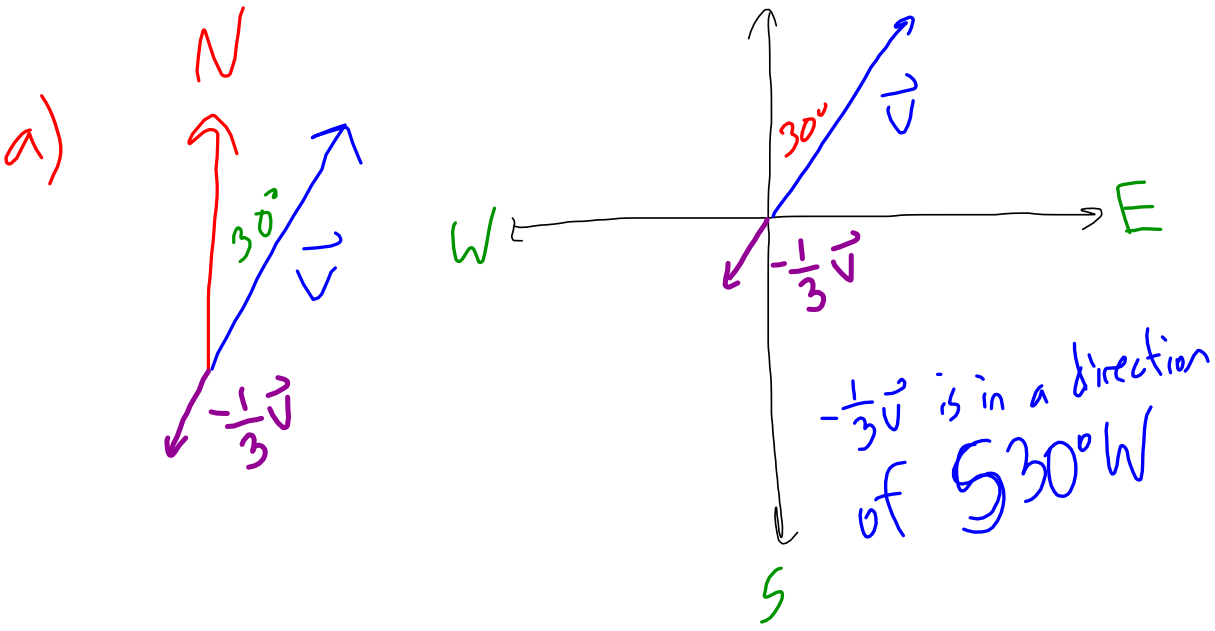
Action

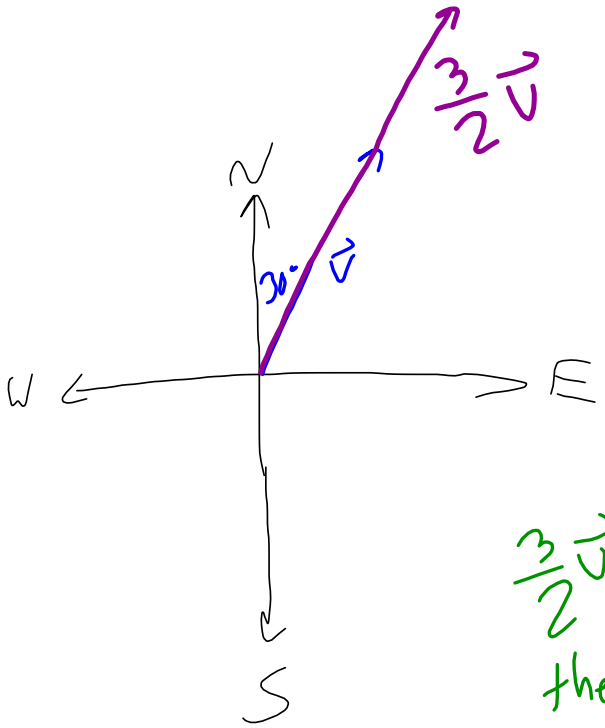
Example 3: An airplane is flying in the direction N30°E (or 030°) at an airspeed of 240 km/h. The velocity vector for this airplane is represented by $\vec{v}$.

or E 60 °N

a) Draw a sketch of (-1/3) $\vec{v}$ and state the direction of this vector.

b) For the vector (3/2) $\vec{v}$, state its direction and magnitude.





direction: N30°E

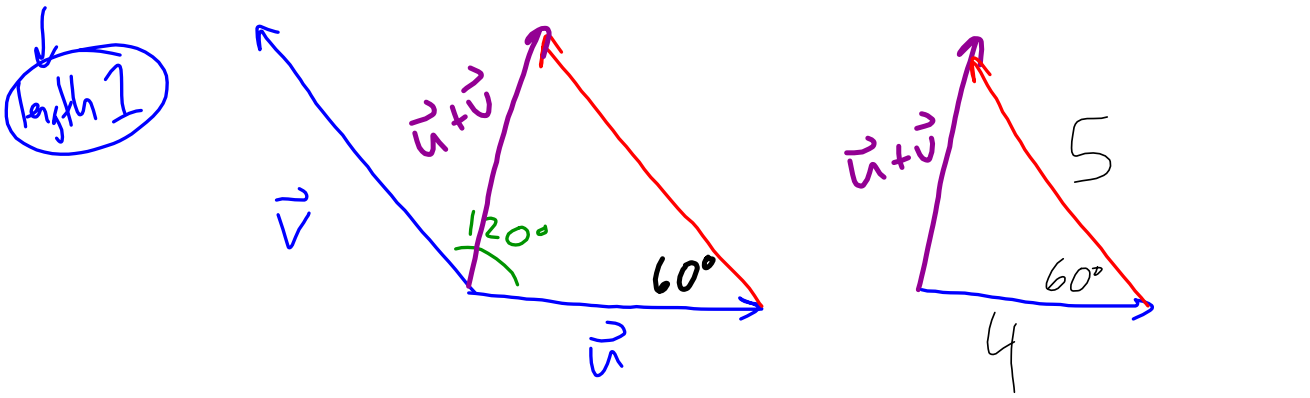
magnitude 360 km/h

$240 \text{ km/h} \times \frac{3}{2} = 360 \text{ km/h}$

$\frac{3}{2}\vec{v}$ is 1.5 times the length

Action

Example 4: Given that $|\vec{u}| = 4$ and $|\vec{v}| = 5$ and the angle between $\vec{u}$ and $\vec{v}$ is 120°, determine the unit vector in the same direction as $\vec{u} + \vec{v}$.



$|\vec{u}+\vec{v}|^2 = (4)^2+(5)^2-2(4)(5)\cos 60°$

$|\vec{u}+\vec{v}| = \sqrt{21}$ exact or 4.58

unit vector, multiply $\vec{u}+\vec{v}$ by $\frac{1}{|\vec{u}+\vec{v}|}$

$\frac{1}{\sqrt{21}} \times \sqrt{21} = 1$ "unit"

$\frac{1}{\sqrt{21}}(\vec{u}+\vec{v}) = \frac{1}{\sqrt{21}}\vec{u} + \frac{1}{\sqrt{21}}\vec{v}$

Consolidation

Given $\vec{u}$ and $\vec{v}$, sketch...