Before we begin, are there any questions from last day's work?
5.7.3 or 5.7.4

1d

7a

Today's Learning Goal(s):

By the end of the class, I will be able to:

a) use trig ratios to determine the horizontal and/or vertical **component(s)** of a vector.

5.8.1: Let the Force be with You

Date: May 8/17

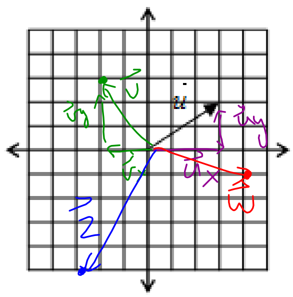
Every vector, $\vec{F}$, can be broken down into two parts:

- One vector with magnitude in the x-direction (e.g., $\vec{F_x}$ read "F sub x")
- One vector with magnitude in the y-direction (e.g., $\vec{F_y}$ read "F sub y")

Note that $\vec{F_x}$ and $\vec{F_y}$ may be either positive or negative (based on its direction from the origin), but the **magnitude** (or length) of the vector **is always positive**.

Warm up:

Draw and label the vectors. The tail of each vector should be at the origin.
Complete the information in the table.

vector	x-component and its magnitude	y-component and its magnitude	
$\vec{u}=[3,2]$	$\vec{u_x}=3$, $\lvert\vec{u_x}\rvert=3$	$\vec{u_y}=2$, $\lvert\vec{u_y}\rvert=2$	
$\vec{v}=[-2,3]$	$\vec{v_x}=-2$, $\lvert\vec{v_x}\rvert=2$	$\vec{v_y}=3$, $\lvert\vec{v_y}\rvert=3$	
$\vec{w}=[4,-1]$	$\vec{w_x}=4$, $\lvert\vec{w_x}\rvert=4$	$\vec{w_y}=-1$, $\lvert\vec{w_y}\rvert=1$	
$\vec{z}=[-3,-5]$	$\vec{z_x}=-3$, $\lvert\vec{z_x}\rvert=3$	$\vec{z_y}=-5$, $\lvert\vec{z_y}\rvert=5$	

A common use of vectors involves forces.

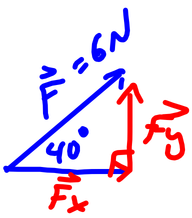
Part A - The Billiard Ball

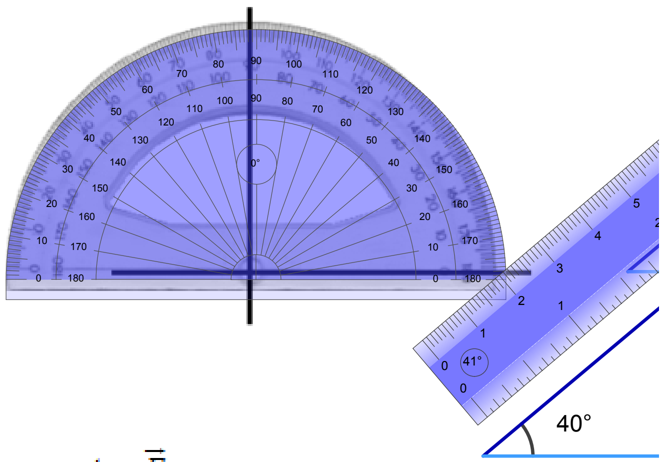
1. Suppose you hit a billiard ball with a force of 6 Newtons (N) and direction of E40°N.

- Draw a diagram for this force vector using a scale 1 cm = 2 N.

  ∴ 3cm = 6N

- Label the vector $\vec{F}$ = 6 N. Include the angle in your vector diagram.

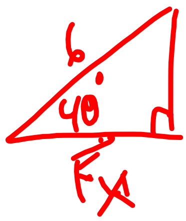




2. Label the two components, $\vec{F_x}$ and $\vec{F_y}$, for the force vector, $\vec{F}$.

3. Circle the **correct** trigonometric ratio to calculate the $\vec{F_x}$ component of the vector representing the force of the billiard ball.

A) $\sin 40° = \frac{\vec{F_x}}{6}$ B) $\sin 40° = \frac{6}{\vec{F_x}}$ C) $\cos 40° = \frac{\vec{F_x}}{6}$ D) $\cos 40° = \frac{6}{\vec{F_x}}$



$\vec{F_x} = 6\cos 40°$

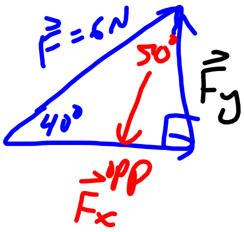
4. Use the trigonometric ratio selected in #3 to determine the horizontal component of the force. Show all of your work and include correct units. (Round to 3 decimal places)

$\vec{F_x} = 6\cos 40^\circ$

$\doteq 4.5962$

∴The horizontal force applied to the billiard ball is 4.596 N.

5. What other trigonometric ratio could you have used to determine the $\overrightarrow{F_x}$ component?



$\sin 50^\circ = \frac{\vec{F_x}}{6}$

6. Circle the **correct** trigonometric ratio to calculate the $\overrightarrow{F_y}$ component of the vector representing the force of the billiard ball.

A) $\sin 40° = \frac{\overline{F_y}}{6}$ B) $\sin 40° = \frac{6}{\overline{F_y}}$ C) $\cos 40° = \frac{\overline{F_y}}{6}$ D) $\cos 40° = \frac{6}{\overline{F_y}}$

7. Use the trigonometric ratio selected in #6 to determine the magnitude of the vertical component. Show all of your work and include correct units. (Round to 3 decimal places).

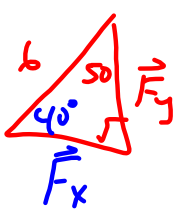
$\vec{F_y} = 6\sin 40^\circ$

$\doteq 3.8567$

$\doteq 3.857$ N

∴The vertical force applied to the billiard ball is 3.857 N.

8. What other trigonometric ratio could you have used to determine the $\overrightarrow{F_y}$ component?



$\cos 50^\circ = \frac{\vec{F_y}}{6}$

$\tan 40^\circ = \frac{\vec{F_y}}{\vec{F_x}}$ or $\tan 50^\circ = \frac{\vec{F_x}}{\vec{F_y}}$

9. Show work to verify that this ratio will produce the same result.

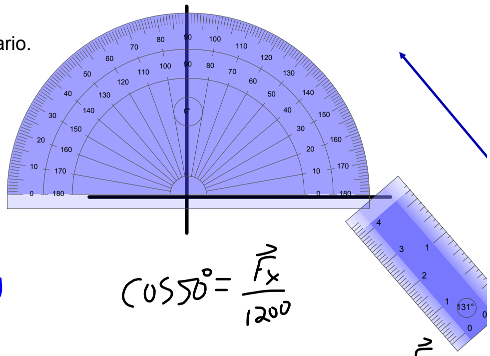
Part B - "Forcing" you to cut the lawn

A lawn mower is pushed with a force of 1200 N directed along its handle. The angle with the ground made by the handle is 50°.

a) Construct a scale diagram to represent this scenario. Provide a scale for your diagram.

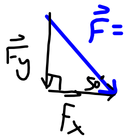
b) Use your knowledge of trigonometric ratios to calculate the vertical and horizontal components of the force required for the lawn mower to maintain a constant velocity.

Show your work.



1 cm = 400 N

∴ 3 cm



$\cos 50° = \frac{\vec{F_x}}{1200}$

$\sin 50° = \frac{\vec{F_y}}{1200}$

$\vec{F_x} = 1200 \cos 50°$

$\doteq 771.3451$

$\doteq 771.345\ N$

$\vec{F_y} = 1200 \sin 50°$

$\doteq 919.2533$

$\doteq 919.253\ N$

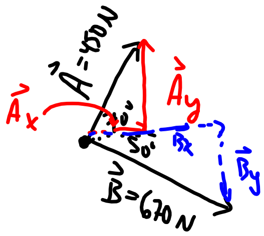
* BUT acting DOWN ∴ $\vec{F_y} = -919.253\ N$

Part C – Net Force

Finding the net force, [or resulting force (or resultant, $\vec{R}$)] on an object depends on several separate forces acting on the same object.

Two people each pull a rope that is connected to a boat. Andy, $\vec{A}$, pulls with a force of 450 N at an angle of 70° from the horizontal. Billy, $\vec{B}$, pulls from the **other side** of the boat with a force of 670 N 50° from the horizontal. Determine the net force on the boat. (*Note: The bearings are 020° and 140° respectively.*)

Hint: construct a diagram with the boat at the origin.



$\vec{A_x} = 450 \cos 70°$

$\doteq 153.9090$

$\doteq 153.909\ N$

$\vec{A_y} = 450 \sin 70°$

$\doteq 422.8616$

$\doteq 422.862\ N$

$\vec{B_x} = 670 \cos 50°$

$\doteq 430.6677$

$\doteq 430.668\ N$

$\vec{B_y} = -670 \sin 50°$

$\doteq -513.2497$

$\doteq -513.250\ N$

x-direction

$\vec{A_x} + \vec{B_x}$

$\doteq 153.909 + 430.668$

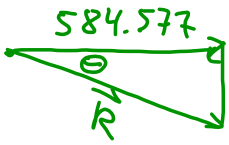
$\doteq 584.577$

y-direction

$\vec{A_y} + \vec{B_y}$

$\doteq 422.868 - 513.250$

$\doteq -90.388$



$|\vec{R}| \doteq \sqrt{584.577^2 + 90.388^2}$

$\doteq 591.524N$

$\tan\theta = \frac{90.388}{584.577}$

$\doteq 8.789$

$\doteq 8.79°$

Answer: 591.524 N, at an angle of 8.79° below the horizontal (or E8.79°S, or bearing 098.79°)