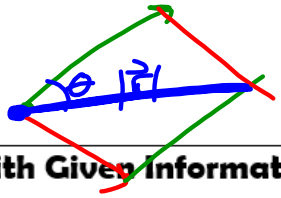
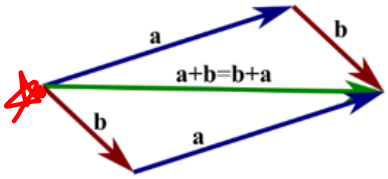
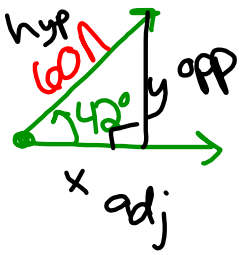
Vector Applications

p.71



Sketch a Picture & Label with Given Information		
Parallelogram Method	**OR**	**Component Form Method**
Turn the vectors into a parallelogram & find missing angles. Then draw a diagonal (the resultant) from the initial point. 	Write each vector in component form & add. $\langle \lvert u\rvert \cos\theta, \lvert u\rvert \sin\theta \rangle$ $+ \langle \lvert v\rvert \cos\theta, \lvert v\rvert \sin\theta \rangle$ $\langle \lvert r\rvert \cos\theta, \lvert r\rvert \sin\theta \rangle$ a b
Magnitude: Use law of cosines		Magnitude: $\lvert r\rvert = \sqrt{a^2 + b^2}$
Amplitude: Use law of sines		Amplitude: $\tan\theta = \frac{b}{a}$ *You may need to add 180° or 360° to get θ in the correct quadrant

1. Construction: Roland is pulling a crate of constructions materials with a force of 60 Newtons at an angle of 42° with the horizontal. Find the magnitude of the horizontal & vertical components.



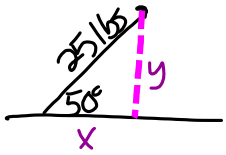
$\langle |v|\cos\theta, |v|\sin\theta \rangle$

$\langle 60\cos 42°, 60\sin 42° \rangle$

$\langle 44.5, 40.1 \rangle$

Nov 2-6:47 AM

2. Yardwork: Nadia is pulling a tarp along level ground with a force of 25 lbs directed along the tarp. If the tarp makes a 50° angle with the ground, find the horizontal & vertical components. ~~What is the magnitude & direction of the resultant?~~

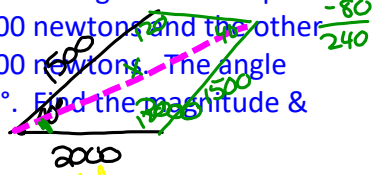


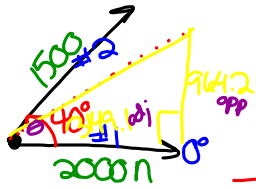
$\langle 25\cos 50, 25\sin 50\rangle$

$\langle 16.1, 19.2\rangle$

3. Farming: Two tractors are removing a tree stump. One tractor pulls with a force of 2000 newtons and the other tractor pulls with a force of 1500 newtons. The angle between the two tractors is 40°. Find the magnitude & direction of the resultant.

360 − 80 = 240





add

#1 $\langle 2000\cos 0, 2000\sin 0\rangle$

#2 $\langle 1500\cos 40, 1500\sin 40\rangle$

$\langle 3149.1, 964.2\rangle$ components of resultant

$\langle a, b\rangle$

magnitude

$c = \sqrt{a^2+b^2}$

$c = \sqrt{(3149.1)^2+(964.2)^2}$

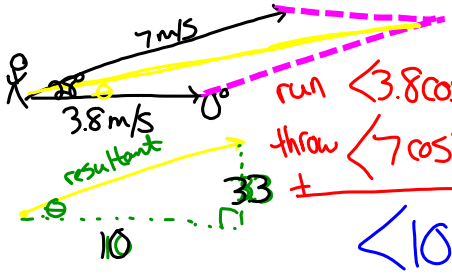
$|\vec{r}| = 3293.4$ N

amplitude (direction)

$\tan\theta = \frac{b}{a}$

$\theta = \tan^{-1}\left(\frac{964.2}{3149.1}\right)$ $\theta = 17°$

4. Football: With time running out in a game, Rodney runs with the football at a speed of 3.8 meters per second and throws the ball at a speed of 7 meters per second at an angle of 28° to the horizontal. What is the resultant speed and direction of the ball?



run $\langle 3.8\cos 0°, 3.8\sin 0°\rangle$

throw $\langle 7\cos 28°, 7\sin 28°\rangle$

$\langle 10, 3.3\rangle$

$\langle a, b\rangle$

speed

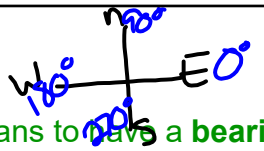
$|\vec{r}| = \sqrt{(10)^2+(3.3)^2}$

$|\vec{r}| = 10.5$ m/s

direction

$\theta = \tan^{-1}\left(\frac{3.3}{10}\right)$

$\theta = 18.3°$



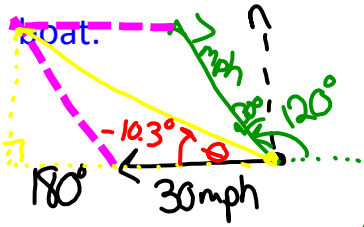
Bearings:

Let's first talk about what it means to have a **bearing** of a certain degree, since this is typically used in navigation. First of all, think of north as going up (positive ***y*** axis), south as going down (negative ***y*** axis), east as going to the right (positive ***x*** axis), and west as going to the left (negative ***x*** axis).

Unless otherwise noted, **bearing** is the measure of the **clockwise angle** that starts **due north** or **on the positive *y* axis** (initial side) and terminates a certain number of degrees (terminal side) from that due north starting place. (This is also written, as in the case of a bearing of 40° as "40° east of north", or "N40°E").

Note: Sometimes, you'll see a bearing that includes more directions, such as 70° west of north, also written as N70°W. In this case, the angle will start due north (straight up, or on the positive ***y*** axis) and go counterclockwise 70° (because it's going west, or to the left, instead of east). Similarly, a bearing of 50° south of east, or E50°S, would be an angle that starts due east (on the positive ***x*** axis) and go clockwise 50° clockwise (towards the south, or down). Also, if you see a bearing of southwest, for example, the angle would be 45° south of west, or 225° clockwise from north, and so on.

5. Sailing: A boat travels 30 mph due west. If there is a 7mph current at N30°W, find the actual speed and direction of the boat.



boat $\langle 30\cos 180, 30\sin 180 \rangle$

current $\langle 7\cos 120, 7\sin 120 \rangle$

$+$

$\langle -33.5, 6.1 \rangle$ (a, b)

magnitude (speed)

$|\vec{r}| = \sqrt{(-33.5)^2 + (6.1)^2}$

34.1 mph

amplitude (direction)

$\theta = \tan^{-1}\left(\frac{6.1}{-33.5}\right)$

$\theta = -10.3°$ bc it's in QII

$+180°$ add 180°

$\theta = 169.7°$

or 10.3° North of West