Notes

Pre-Calculus
Sec. 6.6 Vectors
Day 3

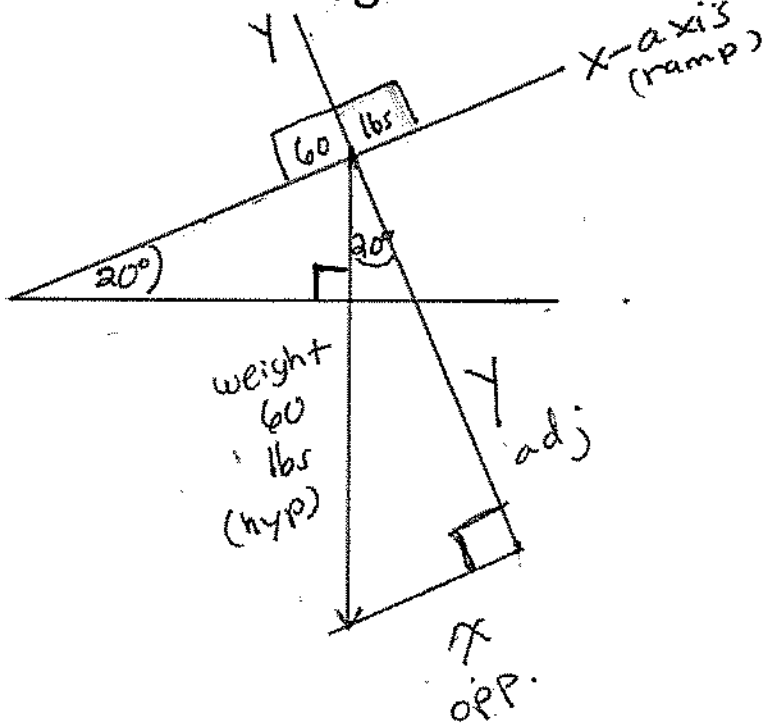
Ramp Problems:

Components of a ramp problem < x, y >

1. x-component: the magnitude of the force parallel to the ramp
   (this pulls the box up or down the ramp)

2. y-component: the magnitude of the force perpendicular to the ramp
   (this holds the box against the ramp)

Ex. 1) A 60lb box sits on a ramp with a 20° incline. What are the components of the force vector holding it there?

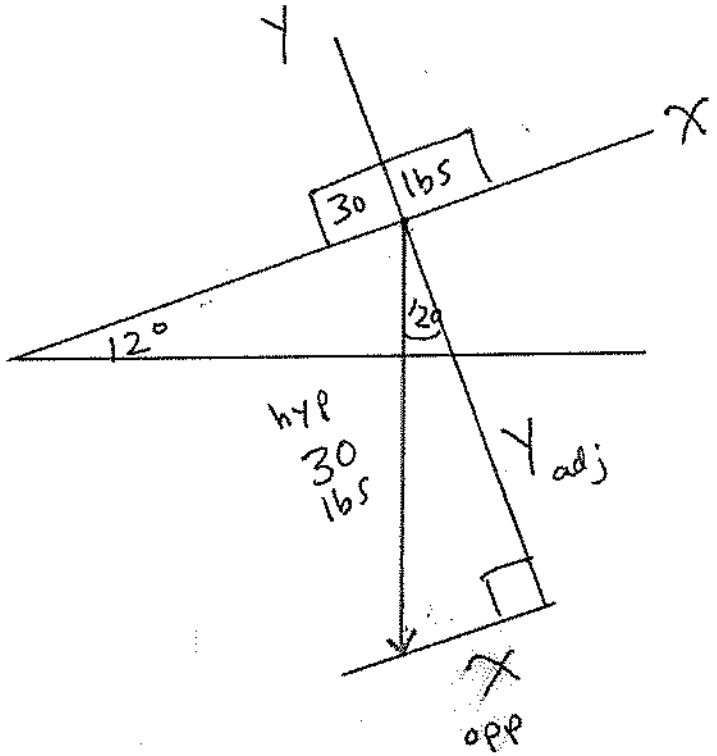


X-component ∥ to ramp	Y-component ⊥ to ramp
SOH	CAH
$\frac{\sin 20^\circ}{1} = \frac{x}{60}$	$\frac{\cos 20^\circ}{1} = \frac{Y}{60}$
$X = 60\sin 20^\circ$	$Y = 60\cos 20^\circ$
$X \approx 20.521$ lbs	$Y = 56.382$ lbs

⊛ Basic right triangle is formed.

Use SOH CAH TOA and/or $a^2+b^2=c^2$

Ex. 2) A 30lb box is sitting on a ramp at a 12°incline from the horizontal. Find the magnitude of the force keeping the box from sliding down the ramp.



X-component

- up/down the ramp (parallel)

SOH

$$\frac{\sin 12^\circ}{1} = \frac{x}{30}$$

$$x = 30 \sin 12^\circ$$

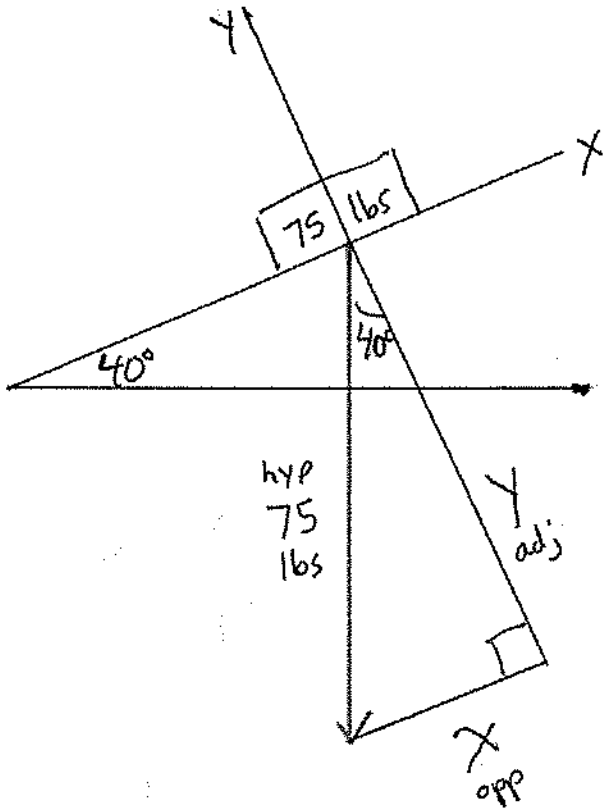
$$x \approx 6.237 \text{ lbs}$$

"RAMP"

Ex. 3) You are standing on top of a hill with a 40° incline. It is a snowy day and you decide to go sledding, but you let your younger sibling go first to test the slope. Your sibling and the sled together are a total of 75lbs.

a) Find the components of the force vector.

b) What is the magnitude of the force keeping the sled from sliding down the hill?



a)

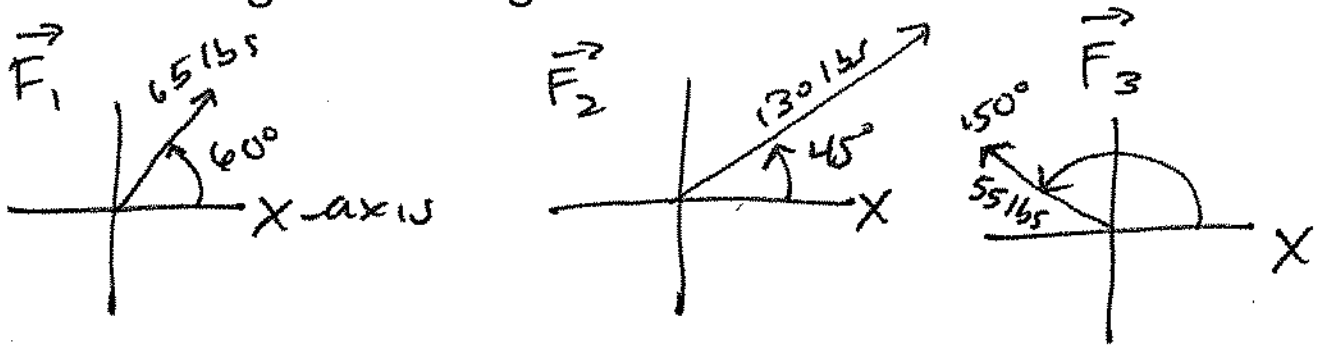
	x	y
	∥ to ramp	⊥ to ramp
	SOH	CAH
	$\sin 40° = \frac{x}{75}$	$\frac{\cos 40°}{1} = \frac{y}{75}$
	$x = 75 \sin 40°$	$y = 75 \cos 40°$
	$x \approx 48.209$ lbs	$y \approx 57.453$ lbs

b) Up/down hill (ramp) → x-component

48.209 lbs

$\vec{F}_1$ $\vec{F}_2$ $\vec{F}_3$

Ex. 4) Three forces of 65 pounds, 130 pounds, and 55 pounds act on the same object at angles of 60°_1, 45°_2, and 150°_3 respectively (same order), with the positive x-axis. Find the direction angle and magnitude of the resultant of these forces.



trig. angle only

$\vec{F}_1 : \langle 65\cos 60^\circ, 65\sin 60^\circ \rangle$

$\vec{F}_2 : \langle 130\cos 45^\circ, 130\sin 45^\circ \rangle$

$\vec{F}_3 : \langle 55\cos 150^\circ, 55\sin 150^\circ \rangle$

$\vec{r} = \vec{F}_1 + \vec{F}_2 + \vec{F}_3$

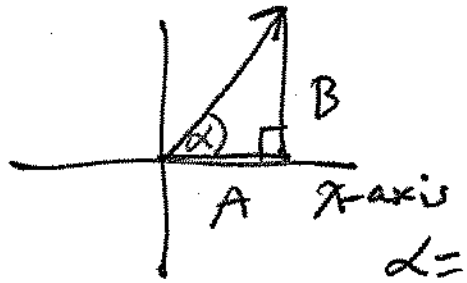
$\vec{r} = \langle 76.7924\ldots, 175.7155\ldots \rangle$ QI

A B

Magnitude $= \|\vec{r}\|$

$= \sqrt{A^2+B^2}$

$\approx$ 191.763 lbs



$\alpha = \tan^{-1}\left(\frac{B}{A}\right)$

$\alpha = 66.393^\circ$

NOT A NAVIGATION QUESTION! NO COMPASS.

Direction: 66.393° from the positive x-axis

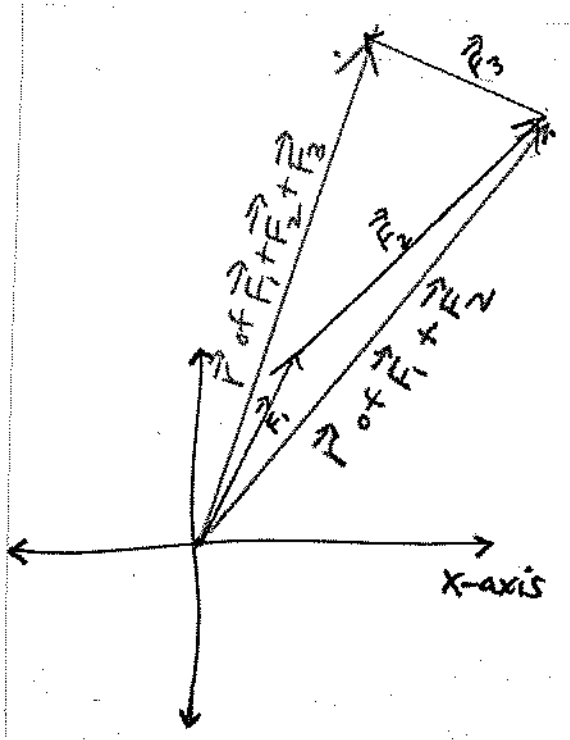
$\vec{F}_1$ $\vec{F}_2$ $\vec{F}_3$

Ex. 4) Three forces of 65 pounds, 130 pounds, and 55 pounds act on the same object at angles of 60°, 45°, and 150° respectively, with the positive x-axis. Find the direction angle and magnitude of the resultant of these forces.

same order

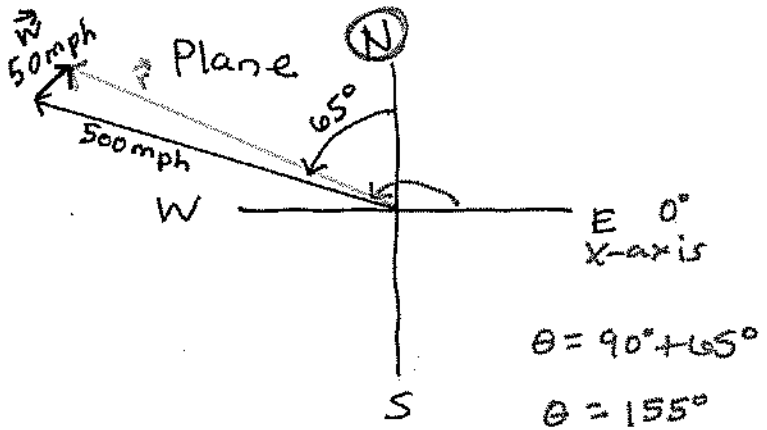
$\vec{r} = \vec{F}_1 + \vec{F}_2 + \vec{F}_3$

Work on previous page.



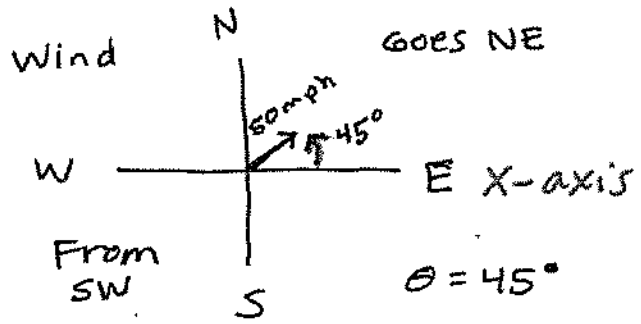
Round to 3 decimal places.

Ex. 5) A plane is at N65°W with the speed of 500 mph. The wind is blowing from (opposite ↗) SW with the speed of 50 mph. Find the resultant speed and direction angle.



$\theta = 90° + 65°$

$\theta = 155°$



$\theta = 45°$

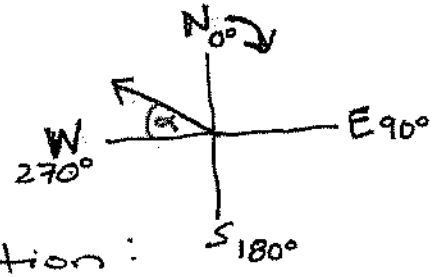
$\vec{P}$: $\langle 500\cos 155°,\ 500\sin 155° \rangle$

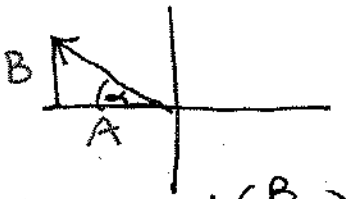
$\vec{w}$: $\langle 50\cos 45°,\ 50\sin 45° \rangle$

$\vec{r} = \vec{P} + \vec{w}$

$\vec{r}$: $\langle -417.7986\ldots,\ 246.6645\ldots \rangle$ QII

A B





$\alpha = \tan^{-1}\left(\frac{B}{A}\right)$

$\alpha = 30.557°$

Speed $= \|\vec{r}\| = \sqrt{A^2 + B^2}$

Speed ≈ 485.179 mph

Direction:

300.557° from North ← $\theta = 270° + \alpha$

or N 59.443° W ← N $90° - \alpha$ W