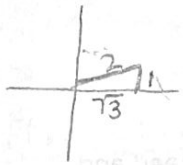
Pre-Calculus Name Key

Notes 6.4 Applications of Vectors

- If a vector represents the speed & direction of an object, it is called the velocity vector.
- If a vector represents the amount of force acting on an object & direction of an object, it is called the Force vector.
- Magnitude = Speed & force
- Direction = the direction angle (in standard form)

Ex 1) A ball is thrown with an initial speed of 25 mph at an angle 30° to the horizontal. Find the vector to model this situation.

magnitude standard position



$\langle 25\cos 30°, 25\sin 30° \rangle$

$\left\langle \frac{25\sqrt{3}}{2}, \frac{25}{2} \right\rangle$ or $\frac{25\sqrt{3}}{2} i + \frac{25}{2} j$

Ex 2) A child pulls a wagon with a force of 40 pounds. The handle of the wagon makes an angle of 30° with the ground. Find the force vector F in terms of i and j.

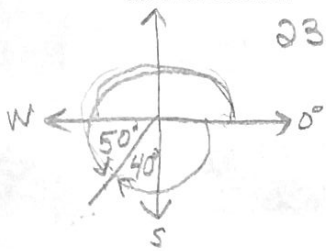
magnitude

$40\cos 30° i + 40\sin 30° j$

$\frac{40\sqrt{3}}{2} i + \frac{40}{2} j = \boxed{20\sqrt{3} i + 20 j}$

convert to S.P.

Ex 3) A car is heading 40° west of south at a speed of 72 mph. Find a vector to model the cars speed and direction.



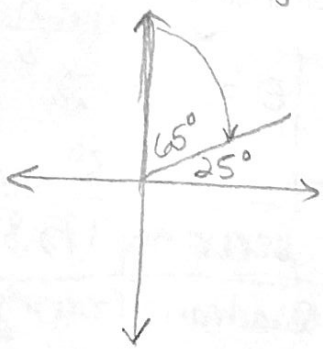
230° or −130°

$\langle 72\cos 230°, 72\sin 230° \rangle$

$\approx \langle -46.28 i, -55.15 j \rangle$

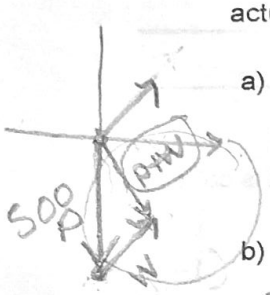
Ex 4) A jet is flying on a bearing of 65° at 500 mph. Find the component form of the velocity of the ~~plane~~. jet.

convert to S.P.



$\langle 500\cos 25°, 500\sin 25° \rangle$

Ex 5) A Boeing 737 aircraft maintains a constant speed of 500 miles per hour in the direction due south. The velocity of the jet stream is 80 miles per hour in a northeasterly direction. Find the actual speed and direction of the aircraft relative to the ground.



a) Find vector for the plane (P) and the jet stream (W). $\vec{p} = \langle 500\cos -90^\circ, 500\sin(-90^\circ)\rangle$

$\vec{p} = \langle 0, -500\rangle$

b) Find the resultant vector. $+\ \vec{W} = \langle 80\cos 45^\circ, 80\sin 45^\circ\rangle$

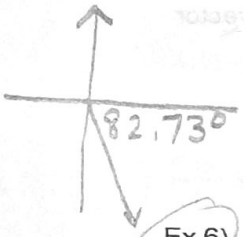
$\overrightarrow{p+w} \approx \langle \overset{A}{56.57}, \overset{B}{-443.43}\rangle$

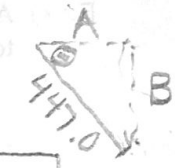
ground (actual) $\rightarrow p+w$

c) Find the actual speed of the aircraft. $\|\overrightarrow{p+w}\| = \sqrt{A^2 + B^2}$

magnitude

$\approx$ 447.0 mph



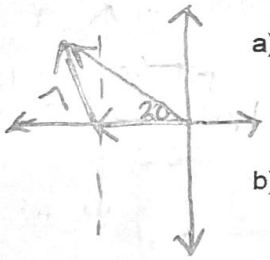


d) Find the direction (angle) of the aircraft? $B = \|p+w\|\sin\theta$ or $\tan\theta = \frac{B}{A}$

S7.3°E

bearing S $\approx$ 172.73° $\boxed{\theta = -82.73^\circ}$ S.P.

Ex 6) A boat travels 30mph due west if there is a 7mph current at N30°W. Find the actual speed and direction of the boat?



a) Find the velocity vector of the boat. $b = \langle 30\cos 180^\circ, 30\sin 180^\circ\rangle$

$b = \langle -30, 0\rangle$

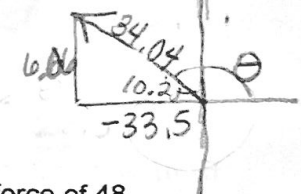
b) Find the velocity vector of the current. $c = \langle 7\cos 120^\circ, 7\sin 120^\circ\rangle$

c) Find the actual velocity vector. $\overrightarrow{b+c} = \langle \overset{A}{-33.5}, \overset{B}{6.06}\rangle$

d) Find the actual speed of the boat. $\|\overrightarrow{b+c}\| = \sqrt{33.5^2 + 6.06^2}$ or $\sqrt{A^2+B^2}$

$= \boxed{\overset{C}{34.04}\text{mph}}$

e) Find the actual direction of the boat.



$\boxed{N\ 79.7^\circ W}$ $\boxed{\text{bearing } 280.3^\circ}$ $\boxed{\theta = 169.7^\circ}$ $\frac{-33.5}{34.04} = \cancel{34.04}\cos\theta$

Ex 7) A force of 36 newtons pulls on an object 20° from standard position. A second force of 48 newtons pulls on the same object at S48°W. Find the magnitude and the direction of the resultant force.

$F_A = \langle 36\cos 20^\circ, 36\sin 20^\circ\rangle$

$F_B = \langle 48\cos(-132^\circ), 48\sin(-132^\circ)\rangle$

$F_A + F_B = \langle \overset{A}{1.171}, \overset{B}{-23.358}\rangle$

$\|F_A + F_B\| = \boxed{23.42\text{N}}$

Standard Post.

$\boxed{\theta = -85.8^\circ \text{ or } 274.8^\circ}$

$\boxed{\text{Bearing } 175.8^\circ}$

$\boxed{\text{Quadrant Bearing } S\ 4.2^\circ E}$