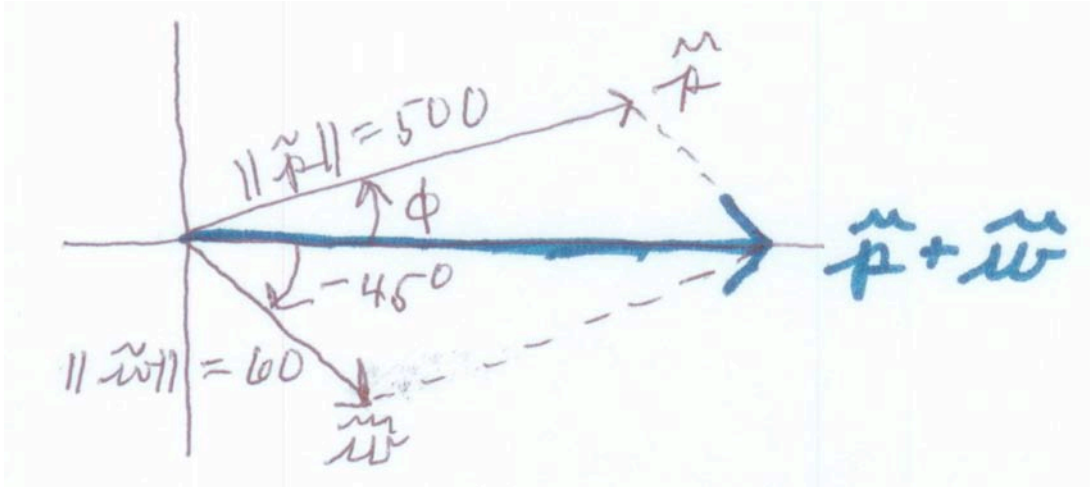


EXAMPLE. A plane is flying at 500 km/hr. The wind is blowing at 60 km/hr toward the SE. In what direction should the plane head to go due east? What is the plane's speed relative to the ground?

Solution

Let \mathbf{p} = the motion vector for the plane and \mathbf{w} = the wind vector.



Find ϕ and $\|\mathbf{p} + \mathbf{w}\|$.

$$\begin{aligned}\mathbf{w} &= \|\mathbf{w}\| \cos(-45^\circ)\mathbf{i} + \|\mathbf{w}\| \sin(-45^\circ)\mathbf{j} \\ &= 60 \frac{\sqrt{2}}{2}\mathbf{i} - 60 \frac{\sqrt{2}}{2}\mathbf{j} = 30\sqrt{2}\mathbf{i} - 30\sqrt{2}\mathbf{j} = 42.43\mathbf{i} - 42.43\mathbf{j}.\end{aligned}$$

Since the \mathbf{j} -component of $\mathbf{p} + \mathbf{w}$ is 0,

$$\mathbf{p} = x\mathbf{i} + 30\sqrt{2}\mathbf{j}$$

where x is the \mathbf{i} -component of \mathbf{p} . Since $\|p\| = 500$,

$$\begin{aligned}500 &= \sqrt{x^2 + (30\sqrt{2})^2} \implies 500^2 = x^2 + 1800 \implies \\ &x^2 = 250,000 - 1800 = 248,200 \implies x \approx 498.20.\end{aligned}$$

Thus

$$\mathbf{p} = 498.20\mathbf{i} + 42.43\mathbf{j} \implies \tan \phi = \frac{42.43}{498.20} = .085 \implies \phi = \arctan .085 = 4.86^\circ,$$

and since $\mathbf{p} + \mathbf{w} = 540.63\mathbf{i} + 0\mathbf{j}$, $\|\mathbf{p} + \mathbf{w}\| = 540.63$ km/hr.