## Question

An aeroplane has velocity $\mathbf{v}_{A}$ relative to still air. If it flies in a wind with velocity $\mathbf{v}_{W}$ what is the velocity of the aeroplane relative to the ground?
An aeroplane moves in a northwesterly direction at $500 \mathrm{kmh}^{-1}$ due to the fact that there is an easterly wind (i.e. from the east) of $50 \mathrm{kmh}^{-1}$. Determine how fast and in what direction the aeroplane would have traveled if there was no wind.

## Answer

$\mathbf{v}=\mathbf{v}_{A}+\mathbf{v}_{W}$ as $\mathbf{v}_{A}$ is relative to still air; when there is a wind the plane has $\mathbf{v}_{A}$ relative to the wind.

cosine rule:

$$
\begin{aligned}
\mathbf{v}_{A}^{2} & =500^{2}+50^{2}-2 \times 50 \times 500 \cos \frac{\pi}{4} \\
\Rightarrow \mathbf{v}_{A} & =466 \mathrm{kmh}^{-1}
\end{aligned}
$$

sine rule:

$$
\begin{aligned}
\frac{50}{\sin \alpha} & =\frac{466}{\sin \frac{\pi}{4}} \\
\Rightarrow \sin \alpha & =\frac{25 \sqrt{2}}{466} \\
\Rightarrow \alpha & =0.076 \mathrm{rads}
\end{aligned}
$$

