# Tap 201- 4: Flying in a side wind

## Relative velocities and displacement

In these questions, you have to find the velocity and the displacement of a bird relative to the ground, when it is actually flying relative to the wind.

## Flying in a side wind

A bird flies at a steady speed of 3 m $s^{-1}$ through the air. It is pointing in the direction due north. However, there is a wind blowing from west to east at a speed of 2 m $s^{-1}$.

1. What is the velocity of the bird relative to the ground?

2. What is the displacement of the bird, relative to its starting point, after it has flown for 20 seconds?

3. In what direction should the bird point if it is to travel in a northerly direction?

## Practical advice

These questions reinforce ideas about vector addition and relative velocity. In addition, the connection between velocity and displacement is tested.

## Alternative approaches

There are many similar questions in standard texts.

## Social and human context

Aeroplane flight, boats crossing rivers, etc. All deal with vector components explicitly or implicitly.

## Hints

1. Velocity is a vector, and has both magnitude and direction.
2. How is velocity defined in terms of displacement?
3. To fly due north requires the bird not to move in an easterly direction. What must the east–west component of its velocity be?

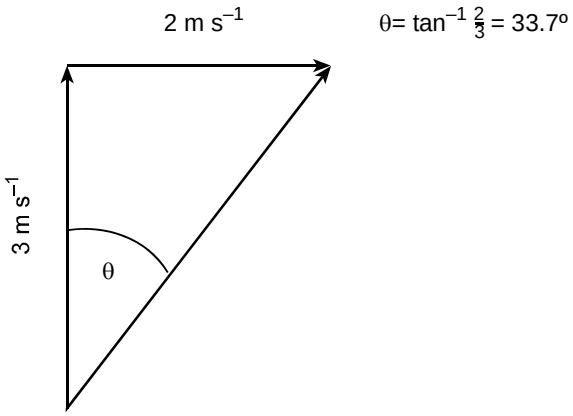
## Answers and worked solutions

1. The magnitude of the resultant velocity is found using Pythagoras' theorem as the two vectors to be added are at right angles.

   Hence: magnitude of velocity relative to the ground.

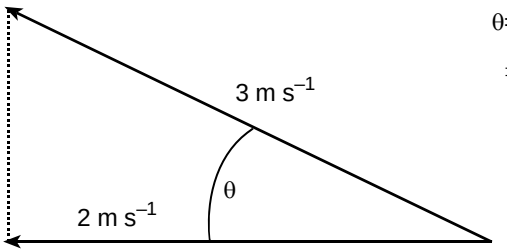
   $= \sqrt{3^2 + 2^2}\ \text{m s}^{-1} = 3.6\ \text{m s}^{-1}.$

   The direction is found by drawing a vector diagram.




2. After 20 s, the displacement of the bird is found from displacement = velocity $\times$ time. The direction of displacement is as for velocity if the velocity is constant. The magnitude of the displacement is simply 3.6 m s$^{-1}$ $\times$ 20 s = 72 m.

3. To fly due north, the bird has to fly in such a direction that it has a component of its velocity that cancels out the velocity of the wind. This means that it has to have a component of velocity equal to 2 m s–1 west. The diagram shows how this is done.




$\theta = \cos^{-1}\frac{2}{3} = 48^{o}$

$\Rightarrow$ bearing = $270^{o} + 48^{o} = 318^{o}$

## External references

This activity is taken from Advancing Physics Chapter 8, 70S