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## B2 Adding Vectors

Where bearings are given, they are in degrees East of North (so North is  $000^\circ$ , East is  $090^\circ$ , South is  $180^\circ$  and West  $270^\circ$ ). For the purposes of this exercise, assume that the Earth is flat.

B2.1 Work out how far I am from my starting point if I:

- a) walk  $3.0\text{ m}$  East then  $4.0\text{ m}$  North.
- b) drive  $10\text{ km}$  South from the starting point then drive  $5.0\text{ km}$  West.
- c) fly  $80\text{ km}$  South-West from the starting point then fly  $120\text{ km}$  North-West.

B2.2 Work out how fast I am going (relative to a ground-based observer) if:

- a) I row at  $9.0\text{ m s}^{-1}$  (relative to the water) South in a river where the water is flowing  $1.0\text{ m s}^{-1}$  South.
- b) I swim at  $1.0\text{ m s}^{-1}$  (relative to the water) North in a river where the water is flowing  $0.30\text{ m s}^{-1}$  East.
- c) in what direction would a ground based observer think I was swimming in question B2.2b? Give your answer as a number of degrees East of North (a bearing).
- d) I fly at  $100\text{ km h}^{-1}$  North-West (relative to the air) when the wind is blowing from the North-East at a speed of  $20\text{ km h}^{-1}$ .

B2.3 Along which bearing would I have to travel in order to travel North (relative to a stationary observer) if:

- a) I am swimming in a river with a current running  $0.40\text{ m s}^{-1}$  to the East, and I can swim at  $1.5\text{ m s}^{-1}$  relative to the water?
- b) I am flying in a  $15\text{ km h}^{-1}$  wind coming from the West and can fly at  $90\text{ km h}^{-1}$  relative to the air?
- c) How fast do I move Northwards over the ground in question B2.3b?

B2.4 A block is subject to two forces - a  $90\text{ N}$  force downwards and a  $30\text{ N}$  force horizontally to the right.

- a) What is the magnitude of the resultant force on the block?
- b) At what angle, clockwise from the rightward force, does the resultant force on the block act?