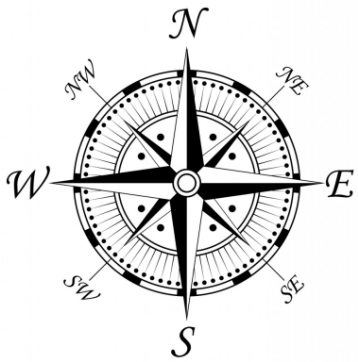
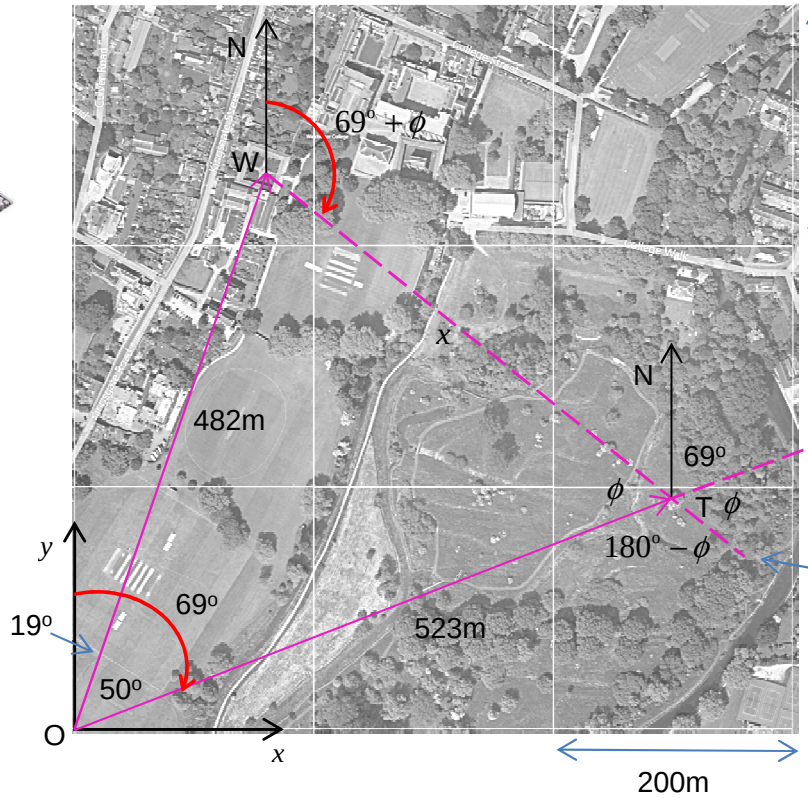
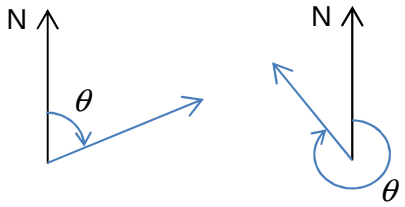
**Bearings** are an angular measure popular in navigational scenarios. To avoid confusion, a ***bearing*** is *defined* as being the **clockwise angle measured from North.** It is common to see a bearing quoted as three integers e.g. "Bearing 042" means 42 degrees clockwise from North.

In a (2D) navigational scenario, *range and bearing* are often more natural coordinates than Cartesian or 'grid' *x,y* as they directly tie in with the use of a compass and a distance measuring device. However, they are of course relative to your previous position! Therefore in general it is a good idea to use *both* range and bearing for inter-waypoint navigational legs, and also grid references as absolute locations of the waypoints themselves.

A walking compass, which points to magnetic North. (In the UK this is close enough to true North for most purposes).


Bearings are measured clockwise from North

**Example:**

A bird flies direct from O to W on a bearing of 19° for 482m. Another bird flies direct from O to T on a bearing of 69° for 523m.

How far apart are T and W?

What is the bearing from T to W?

*To answer this question, **extend** both lines and work out the angles between the extended lines. Then apply basic geometry and trigonometry as appropriate, e.g. cosine and sine rules.*

*Cosine Rule*:

$$x^2 = 482^2 + 523^2 - 2(482)(523)\cos 50^\circ$$

$$x = \sqrt{505,853 - 504,172\cos 50^\circ}$$

$$x = \boxed{426.4\text{m}}$$

Store *x* in calculator memory to increase accuracy of subsequent calculations!

*Sine Rule:*

$$\frac{\sin\phi}{482} = \frac{\sin 50^\circ}{x}$$

$$\therefore \phi = \sin^{-1}\left(\frac{482\sin 50^\circ}{x}\right)$$

$$\phi = \boxed{60^\circ}$$

Bearing from T to W is:

$$69^\circ + 180^\circ + \phi$$

$$= 249^\circ + \phi$$

$$= 249^\circ + 60^\circ$$

$$= \boxed{309^\circ}$$

Note the bearing of T from W is therefore 69° + 60° = 129°