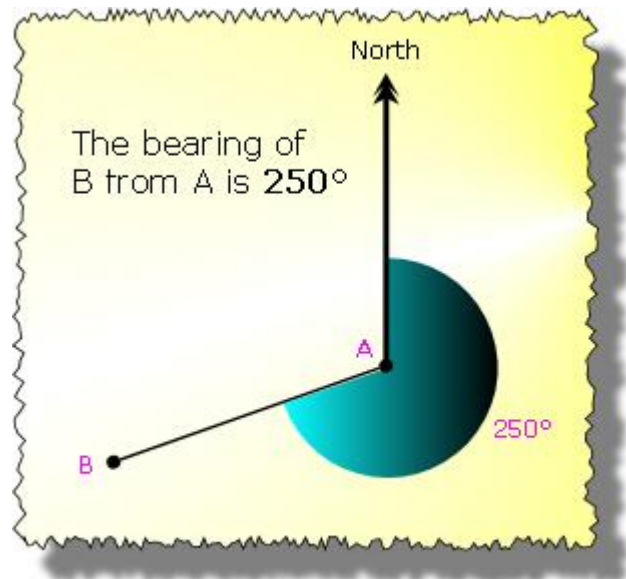
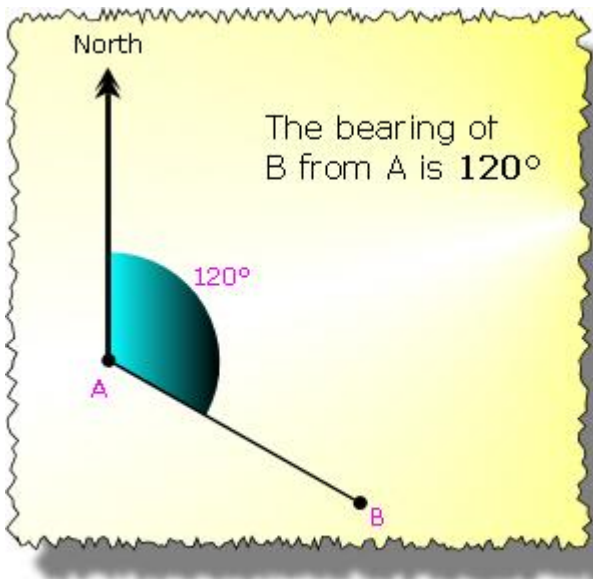
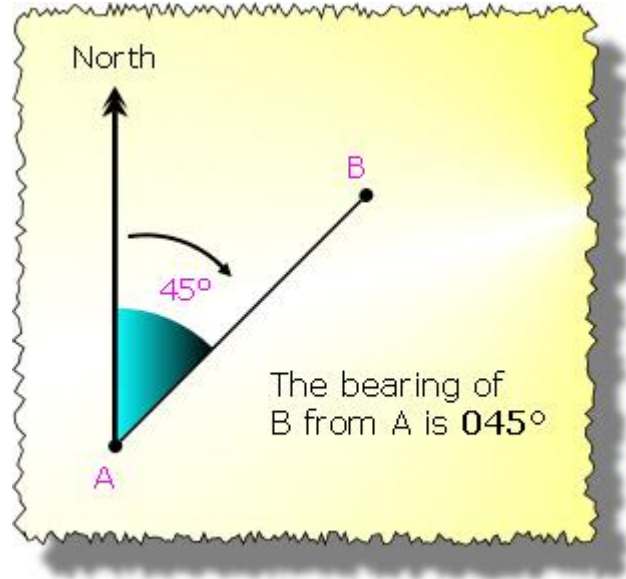
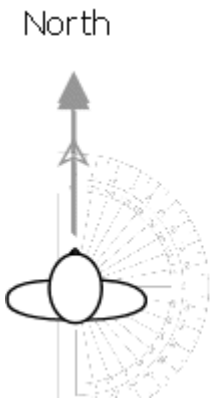


**BEARINGS**

- A bearing is an angle, measured from North, between two points.
- Bearings are widely used in Navigation (ships, aircraft, walkers etc.)
- Bearings are always given as 3 figures.

To give the bearing from point A to point B

- Imagine standing at A facing North.
- Turn clockwise until you are facing B.
- The angle that you have turned is the bearing.



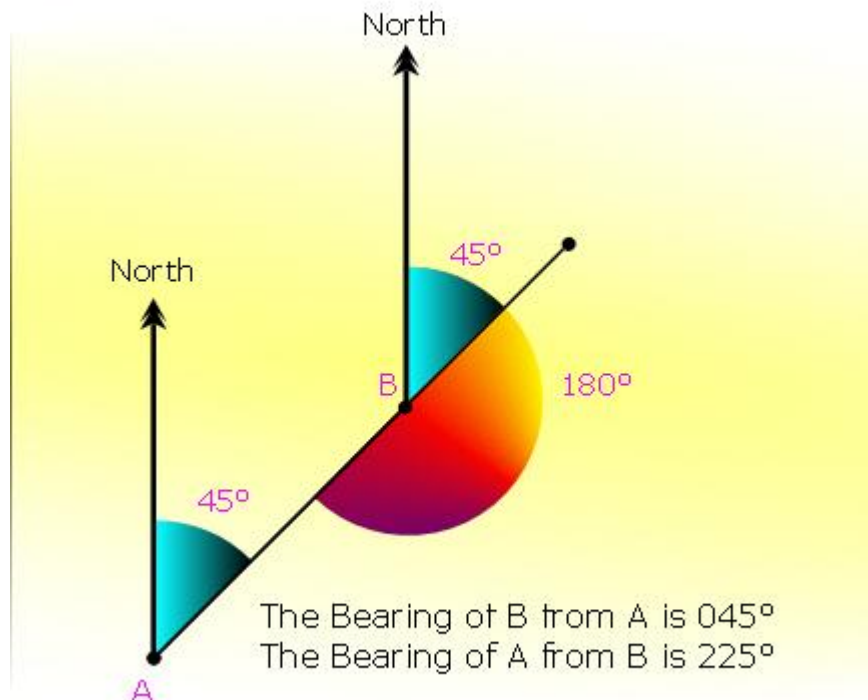
- The bearing of **B from A** is not the same as the bearing of **A from B**.
- The **"from"** word is important.
- To find the **back bearing**, use a simple diagram and basic angle facts.

**Example 1**

The bearing of B from A is  $045^\circ$ .

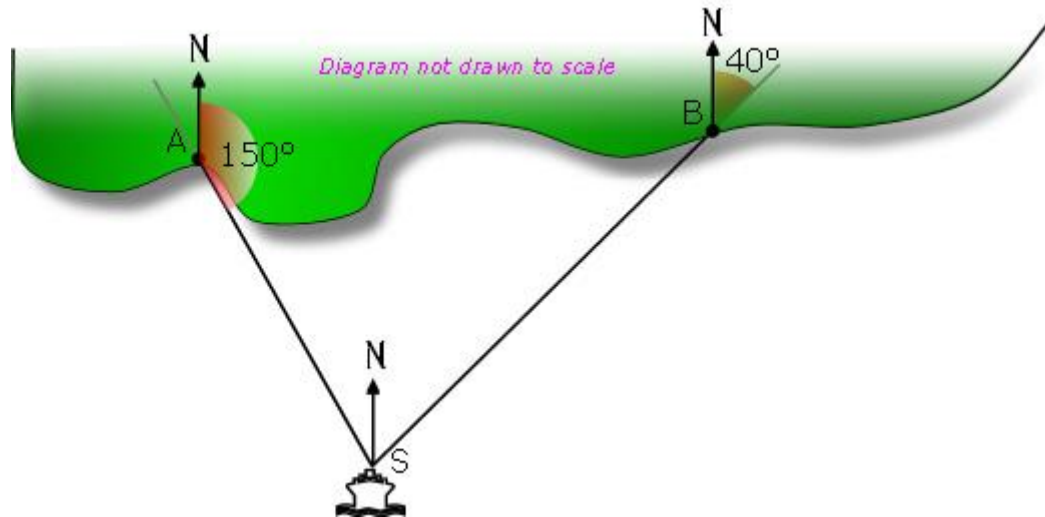
Since the North lines are parallel, the two acute angles are the same.

Using the fact that angles on a straight line add up to  $180^\circ$ ,  
the bearing of A from B is  $45^\circ + 180^\circ = 225^\circ$



**Example 2**

A ship at sea (S) sees two ports (A and B).



The bearing of B from S =  $040^\circ$

The bearing of S from B =  $220^\circ$

The bearing of A from S =  $330^\circ$

The bearing of S from A =  $150^\circ$

**BEARINGS AND SCALE DRAWINGS**

- Scale drawings are very useful for finding angles and lengths.

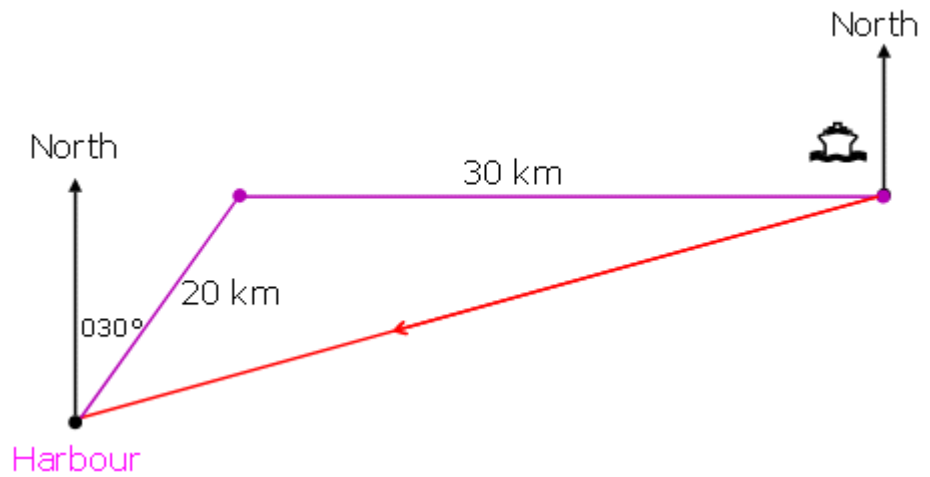
**Example**

A ship leaves harbour on a bearing of  $030^\circ$ . She sails for 20 km and then turns due East. She sails for 30 km.

What is the bearing of the shortest route back to harbour and what distance will she have to sail ?

**Solution**

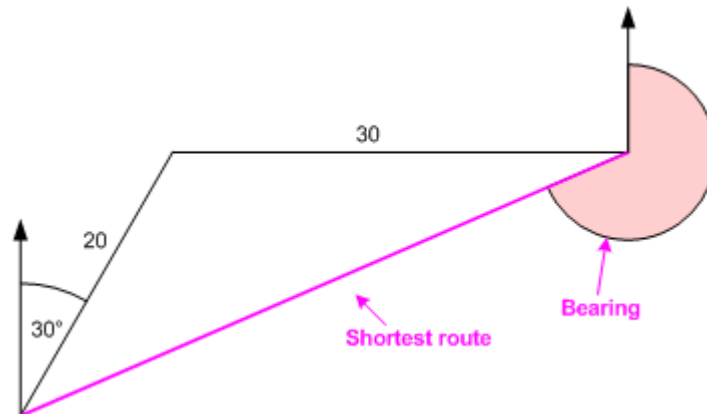
Make a sketch of the journey.



Now draw this accurately, use a good scale.

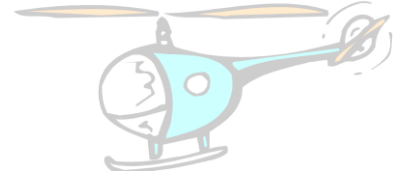
Measure the shortest route: **43.6 km**

Measure the bearing for the return:  **$247^\circ$**



## BEARINGS AND RIGHT ANGLED TRIANGLES

- To solve problems involving bearings you might need to use
  - Pythagoras' Theorem and
  - Sine, Cosine and Tangent (**SOHCAHTOA**)



### Example 1

A helicopter leaves the airport and travels due East for 30 km then due North for 40 km. The pilot then returns to the airport by the most direct route.

What is the bearing and the distance of the most direct route ?

### Solution

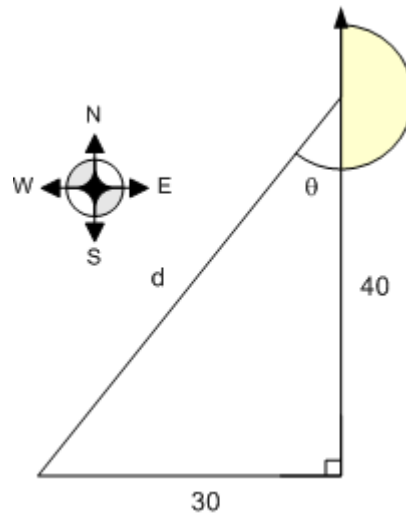
#### To find $\theta$

$$\begin{aligned}\tan \theta &= \frac{30}{40} \\ &= 0.75 \\ \theta &= \tan^{-1}(0.75) \\ &= 37^\circ \text{ (2 s.f.)}\end{aligned}$$

$$\text{Bearing} = 180^\circ + 37^\circ = 217^\circ$$

#### To find $d$

$$\begin{aligned}d^2 &= 30^2 + 40^2 \\ &= 900 + 1600 \\ &= 2500 \\ d &= \sqrt{2500} \\ &= 50 \text{ km}\end{aligned}$$



The pilot will fly on a bearing of  $217^\circ$  for 50 km to return to the airport.

## BEARING AND NON RIGHT ANGLED TRIGONOMETRY

- At Higher Tier, you may have to use the Sine and Cosine Rule to solve practical problems.
- A diagram helps.

### Example 1

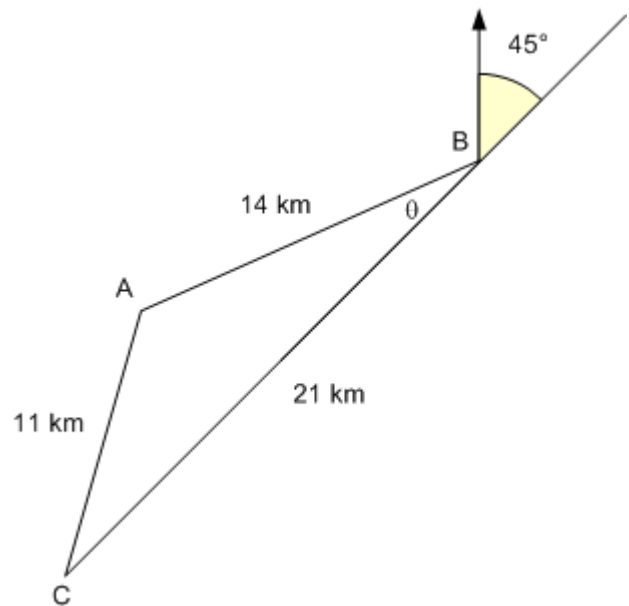
At 1500 hrs, three ships A, B and C are in the positions shown in this diagram.  
Ship B is North East of ship C.

Find the bearing of A from B.

### Solution

To find B, use the cosine rule.

$$\begin{aligned}
 \cos B &= \frac{c^2 + a^2 - b^2}{2ca} \\
 &= \frac{14^2 + 21^2 - 11^2}{2 \times 14 \times 21} \\
 &= \frac{196 + 441 - 121}{588} \\
 &= \frac{516}{588} \\
 &= 0.8776 \\
 B &= \cos^{-1}(0.8776) \\
 &= 29^\circ \text{ (nearest degree)}
 \end{aligned}$$



$$\text{Bearing of A from B} = 45^\circ + 180^\circ + 29^\circ = 254^\circ$$

**Example 2**

A boat steaming due North is 2 km away in a direction  $070^\circ$ . 5 minutes later the bearing of the boat is  $040^\circ$ . Find the speed of the boat.

**Solution**

To find  $d$ , use the Sine Rule.

$$\begin{aligned}\frac{d}{\sin 30^\circ} &= \frac{2}{\sin 40^\circ} \\ d &= \frac{2}{\sin 40^\circ} \times \sin 30^\circ \\ &= 1.56 \text{ km}\end{aligned}$$

To find the speed,

$$\begin{aligned}\text{speed} &= \frac{\text{distance}}{\text{time}} \\ &= \frac{1.56}{\left(\frac{5}{60}\right)} \\ &= 18.72 \text{ km/h}\end{aligned}$$

