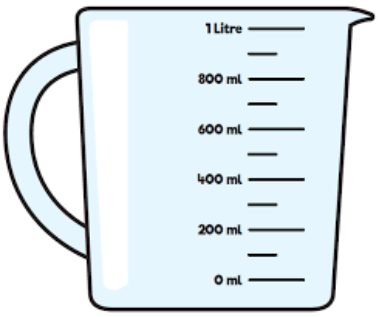
Numeracy (H225 74/75) and Geometry & Measure (H224 74/75)

Scales and Scale Drawing

Reading/Interpreting Scales

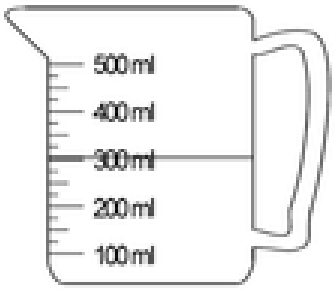
It is more common now for households to have digital weighing scales. Whether they are for weighing ingredients for a recipe or your own personal weight.



However, for measuring liquids, it is almost always a measuring jug that has a scale with values missing that can be found in most kitchens. Other measuring devices such as a thermometer also tend to use a scale.

You will be required to identify what the missing values on the scale represent and use this information to answer a follow up question.

Some Scales are easy to interpret, hopefully you can see that in the example **above** each line represents an increase of 100ml? Others are less obvious though, have a look at the jug on the **right**?

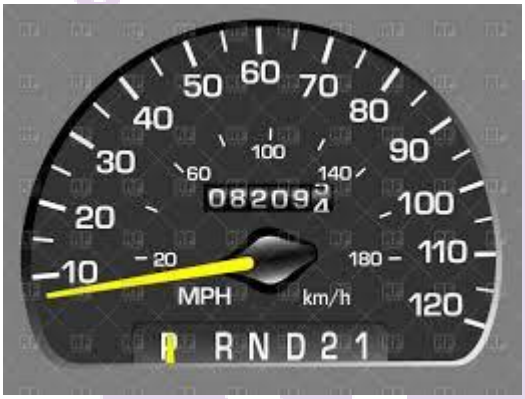


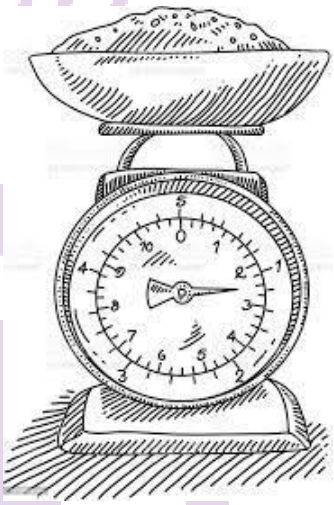
The procedure outlined below works for any scale and you should learn it:

1. **Subtract any two marked values. For the example above:** $200 - 100 = 100ml$
2. **Divide this value by the number of spaces (not lines!!) between these endpoints: 4 spaces so each line represents** $100 \div 4 = 25ml$
3. **Your answer can be repeatedly added on as required:** $100 + 25 = 125ml,\ 125 + 25 = 150ml, 150 + 25 = 175ml,\ etc$

Scales with more than one Unit of Measure

We also use measuring devices that include more than one unit of measure. The speedometer on a car might have both miles per hour (mph) and kilometres per hour (km/h), a weighing scale with kilogrammes (kg) and pounds/ounces (lb/oz), etc.

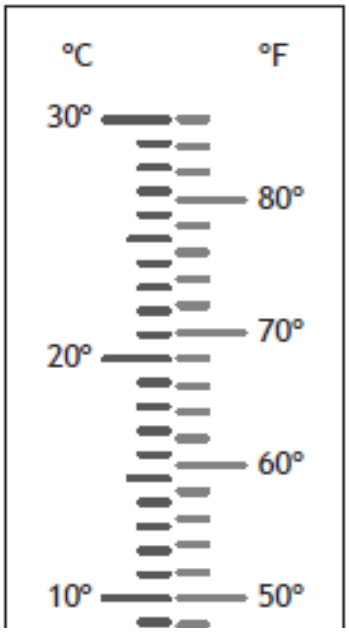




The diagram on the right shows part of a thermometer that displays both °C and °F.

The °C side has end points that have a difference of 10 and there are 10 spaces between each end point. Dividing $(10 \div 10 = 1)$ tells us that it is going up in 1's.

The °F side has end points that also have a difference of 10 but there are 5 spaces between each end point. Dividing $(10 \div 5 = 2)$ tells us that it is going up in 2's.

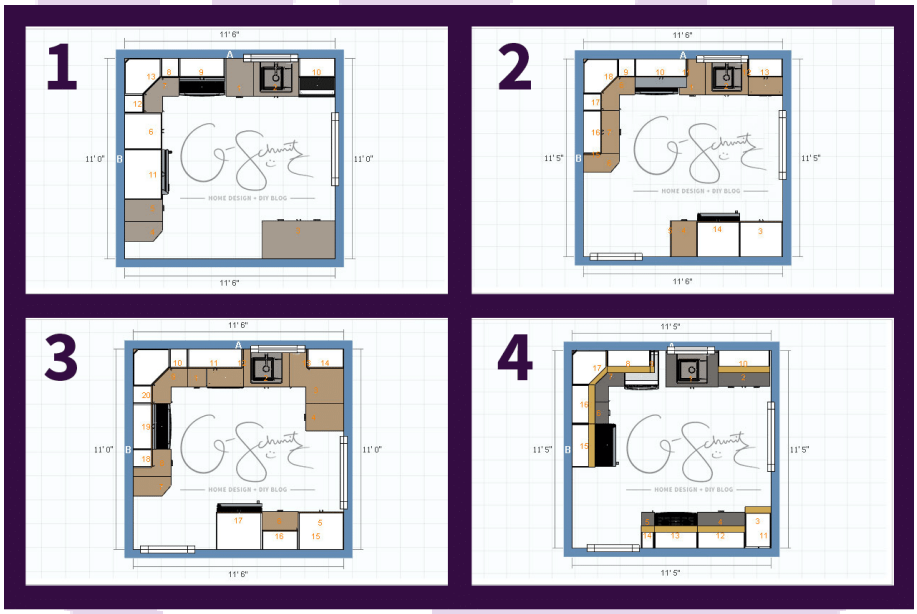


Can you use the thermometer to work out what 11°C would be in °F ?

Constructing/Interpreting Scale Drawings

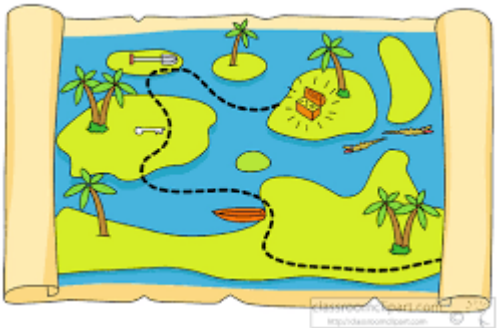
Scale drawings of rooms, buildings and other engineering models are a useful way of planning and designing before creating/building.


In the example below, a kitchen design company has created 4 different designs by computer for a particular customer's kitchen.



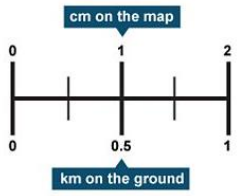
This use of a scale drawing helps the buyer to choose their preferred design before having it installed.

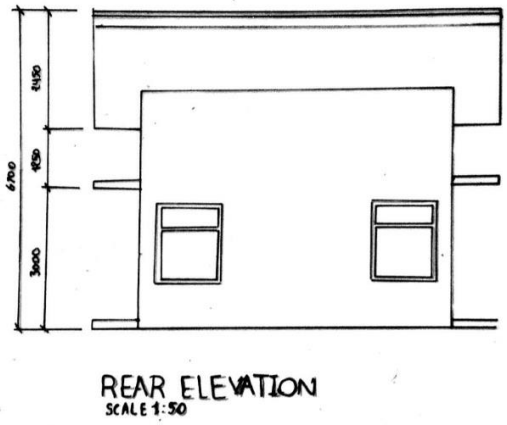
Another common use of scale drawing is found in maps:



Like a map, it is vital that any scale drawing has its scale clearly labelled:

Maps, floor plans, models, etc use different methods/notation for scale:



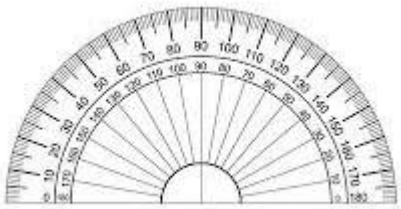


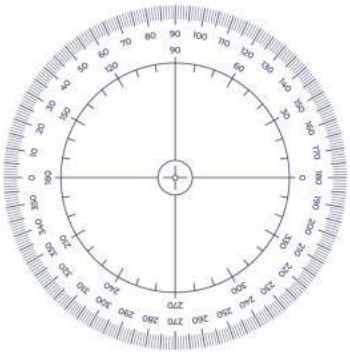
In most cases, the Applications of Maths course uses the notation below:

1cm = 0.5km **1cm to 18cm** **1cm = 50cm or 1cm = 0.5m**

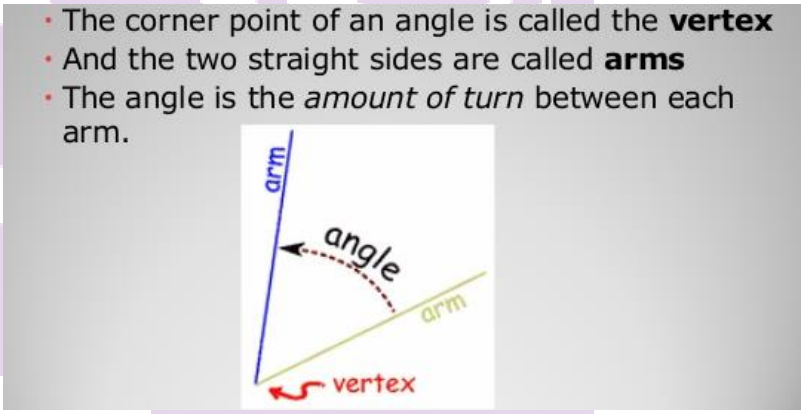
NB – the units will not always be the same!

Applications of Mathematics courses do not have angle calculations in their course requirements but drawing and measuring angles (including Bearings) are required as part of this topic on Scale Drawing. You will have the option of using a protractor or an angle measurer for this purpose:

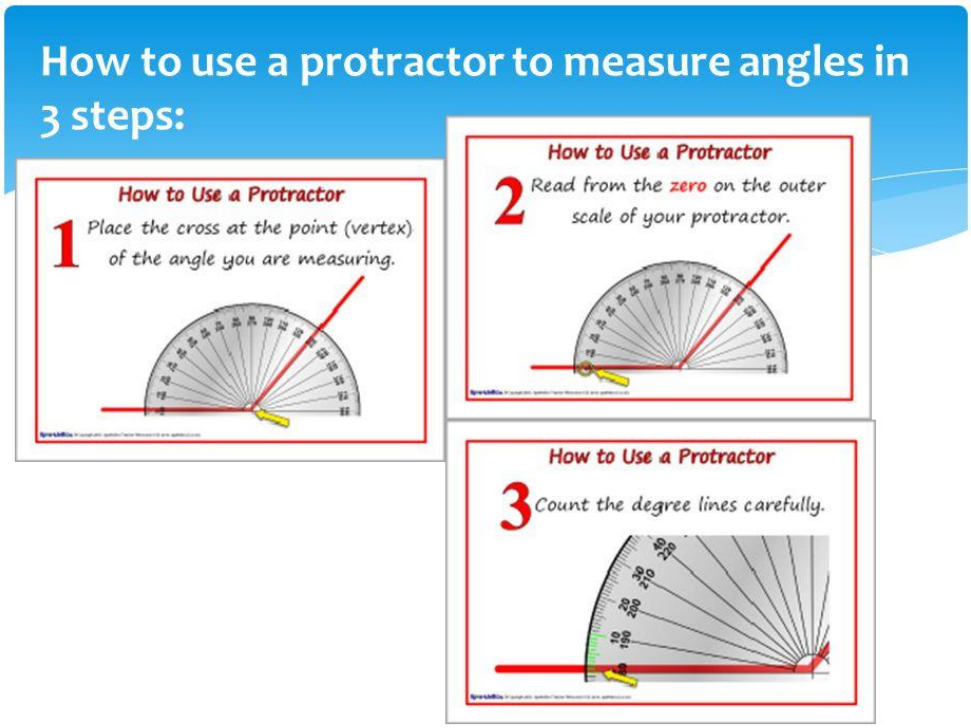




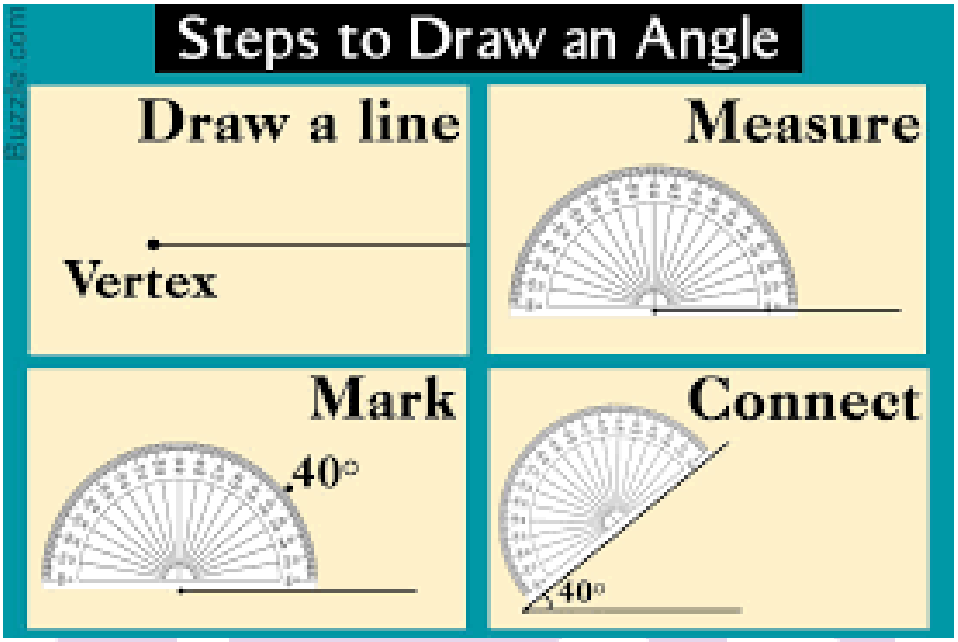
To give you notes and/or instructions as to how to measure and/or draw an angle, it will be helpful to know the names of the parts of an angle:



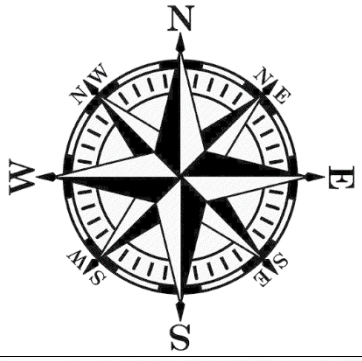
Measuring Angles:

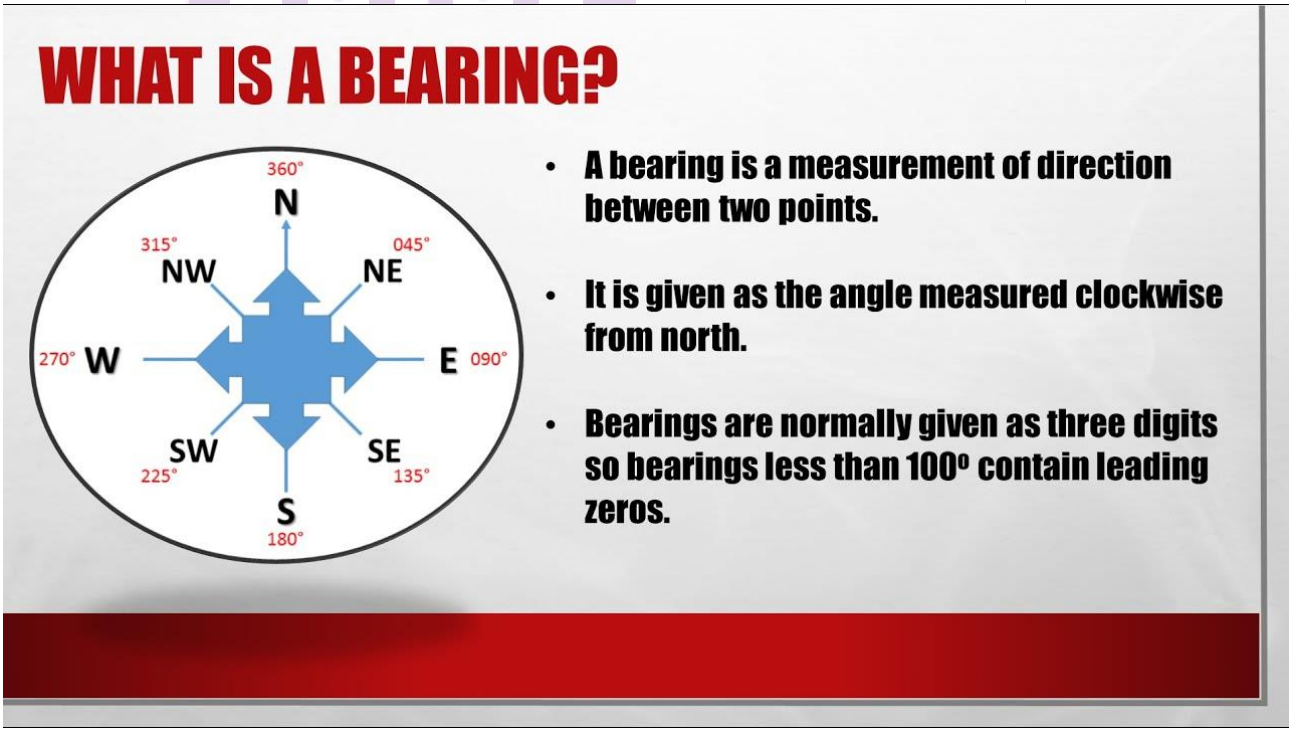


Drawing angles:



With the involvement of Maps, you will also be required to measure/draw a Bearing:



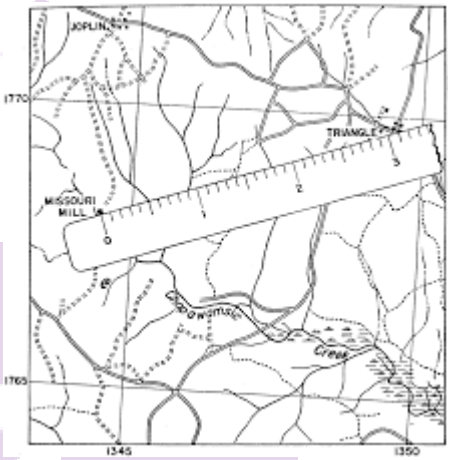


There are 3 possibilities for this type of question:

Scale drawing given and you are required to calculate real lengths

Measure the distance with your ruler then multiply this length by the scale of the drawing.

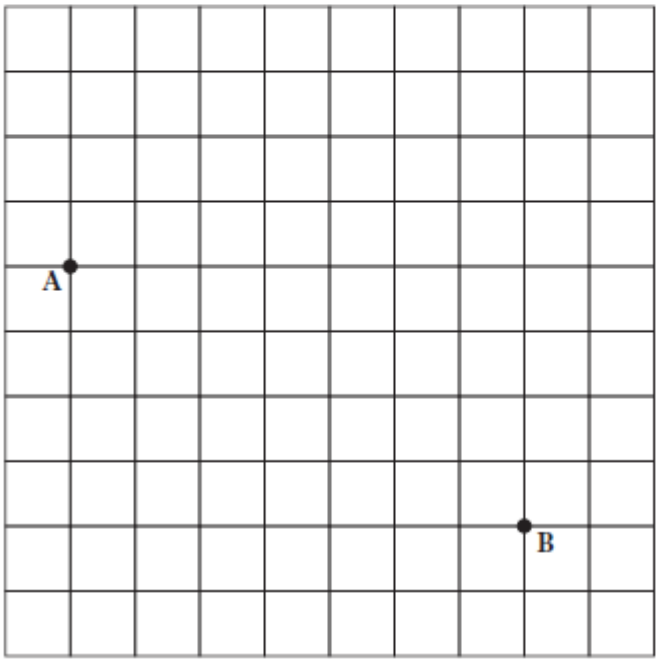
3 x 20 = 60 miles



1 inch = 20 miles

Example ❶:

The scale drawing shows the positions of two wind turbines, A and B. The scale of the drawing is **1 centimetre represents 50 metres**.



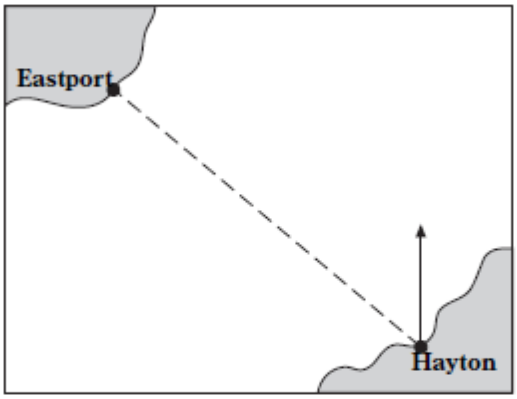
Once you have measured the direct distance from A to B with a ruler, you would multiply the distance by 50 and write your answer in metres. Note the change of unit from cm to m

6·9cm x 50 = 345m

NB – the SQA allow for an error of 2mm when measuring and drawing lengths.

Example ❷:

The scale drawing shows the route taken by a ferry from Hayton to Eastport. Use the scale drawing to find the distance and bearing of Eastport from Hayton.



Scale: 1 cm to 250 m

As with the first example, you would measure the distance from Hayton to Eastport with a ruler (in centimetres). This value would be multiplied by 250 and the answer written in metres.

5·3cm x 250 = 1325m = 1·325km

Using an angle measurer or protractor with the zero on the North line, we would measure the bearing (clockwise) in degrees.

309 degrees

We recommend the use of an angle measurer as tis bearing is over 180 degrees making it more challenging to use a protractor. You would need to measure the angle anti-clockwise from North then subtract this vale from 360 degrees

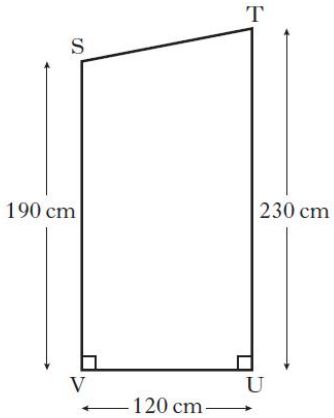
360 – 51 = 309 degrees

NB – <u>Similar to length, the SQA permit an error of 2 degrees when measuring or drawing angles.</u>

Measurements of real object given, and you are required to create a scale drawing

Example ❶:

Maggie has bought a garden shed.
The dimensions for one side of the shed are shown in the diagram below:



Using a scale of 1cm to 20cm, make a scale drawing of this side of Maggie's shed.

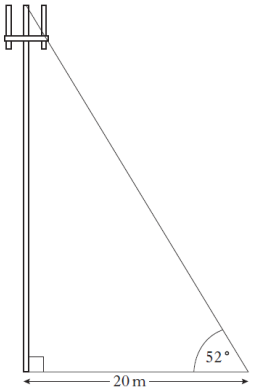
We are required to divide the real lengths by the scale (in this case 20) to calculate the size of our drawing. For the example above:

V *to* U	$120 \div 20 =$	$6\ cm$
V *to* S	$190 \div 20 =$	$9.5\ cm$
U *to* T	$230 \div 20 =$	$11.5\ cm$

We can now draw V to U followed by V to S and U to T. Finish by joining S to T.

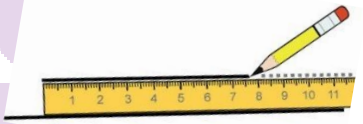
Example ❷:

A surveyor has to calculate the height of a mobile phone mast. From a point 20 metres from the base of the mast, the angle of elevation to the top is 52 degrees. Use a scale drawing to find the height of the mast.



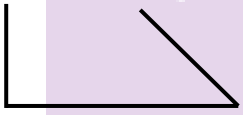
We have not been given a scale this time so we will have to choose one. Make sure you pick a 'friendly' value such as 2, 5 or 10. It must be large enough that the drawing can be used to measure the height of the mast with a ruler and converted into its real height:

- *Start by writing the scale you have chosen* – $1cm = 2m$
- *Divide the 20m by the scale* – $20 \div 2 = 10cm$
- *Draw this line at an appropriate place on your page.*

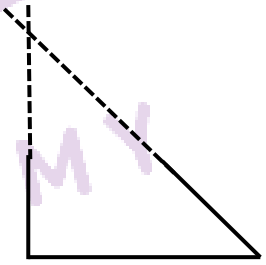


- *From the left-hand side draw an angle of 90 degrees*

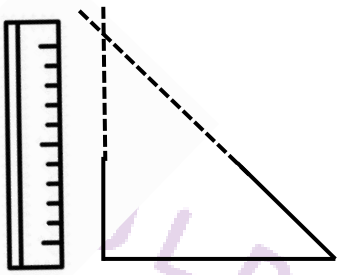
- *From the right-hand side draw an angle of 52 degrees*



- *Extend these lines until they join. The point at which they meet is the top of the mast.*

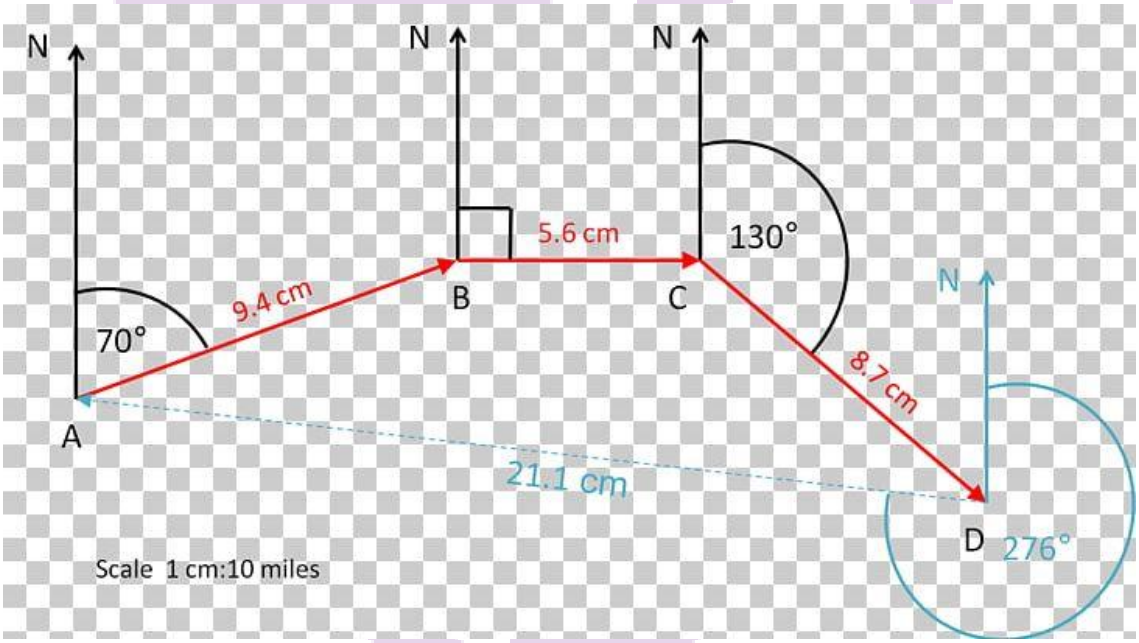


- *Measure the height of the mast on your drawing and multiply it by your scale.*



Below is an example of a scale drawing involving bearings. It denotes a journey of:

- 94 miles on a bearing of 070 degrees from A to B.
- 56 miles East from B to C.
- 87 miles on a bearing of 130 degrees from C to D.
- Finally, the journey back has been measured as 211 miles on a bearing of 265 degrees.



You should note:

- **The scale is clearly visible.**
- **Each time a new point is reached, a new North line is drawn.**
- **The points are labelled so that the teacher/assessor can see which point is which.**

Example ❸:

Jill is taking part in an orienteering competition. She starts at checkpoint A as shown below. She runs due East for 900 metres to checkpoint B.

(a) Show the position of checkpoint B in a scale drawing. Use a scale of 1cm to 100m.

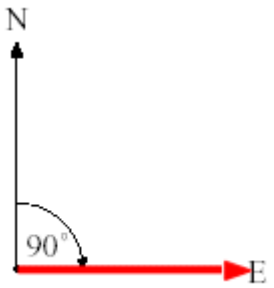
(b) Checkpoint C lies on a bearing of:

- 055° from Checkpoint A
- 320° from Checkpoint B

Complete the scale drawing to show the position of checkpoint C

- *Applications of Mathematics assessments are on plain paper and you will normally be given a 'good' start point for the drawing as in the example above.*
- *If your drawing takes you off the page, then there is a good chance that you have made a mistake!!*

East is 090 degrees, start by drawing this angle:



Using the 1cm to 100m scale, make this line 9cm:

Label the end of this line 'B' and add a new North line:

Draw an angle of 55 degrees at point A followed by an angle of 320 degrees at point B:

Extend these lines if need be until they meet. Label the point where they meet 'C'

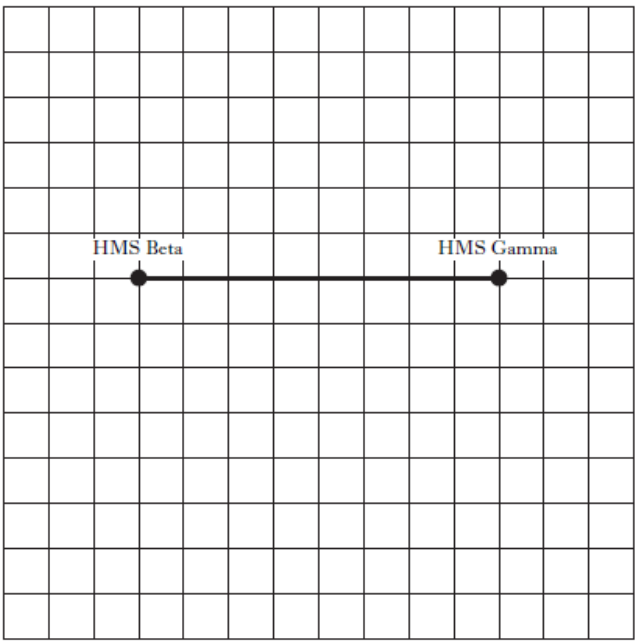
- The marking instructions for the above N5 past paper questions are given on the next page.

11 (a)	**Ans: B shown in correct position**		
	•1 interpret/communicate:	B shown correctly	•1 $(9 \pm 0 \cdot 2)$ cm from A on bearing $(090 \pm 2)^\circ$ **1 mark**
(b)	**Ans: C shown in correct position**		
	•1 interpret/communicate:	direction shown correctly	•1 one bearing shown correctly $(\pm 2^\circ)$
	•2 interpret/communicate:	direction shown correctly	•2 second bearing shown correctly $(\pm 2^\circ)$
	•3 strategy:	know to find point of intersection of two directions	•3 find point of intersection of bearings **3 marks**
NOTES:			
1. If lines AC and/or BC are not drawn (i) C in correct position (ii) C on correct bearing from A or B			award 3/3 award 1/3

Both the scale drawing given as well as the real object and you are required to find the scale used

For this type of question, you will be given the real distance as well as the scale drawing. You will be required to divide the real length by the equivalent length in the scale drawing to find the scale.

Example ❶:
The scale drawing shows the positions of two ships, HMS Beta and HMS Gamma, which are 200 kilometres apart.
Find the scale of the drawing.



Since the dots are 8cm apart and 200/8=25 then the scale is 1cm=25m