SECTION 2:

NAVIGATION TECHNIQUES

Welcome to the second section in my home navigation course. In this section, we will look at techniques to add to your arsenal to develop your navigation.

The techniques we will look at over the next couple of Parts can all be practiced in your local area. As a first-time navigator, this will be the best environment to learn in as you know the area and it will be a more comfortable learning environment. Start with practicing these techniques on footpaths before heading into more remote environments. The theory you will learn here will set you up well before heading on to a navigation course to put this into practice.

This section is split into 6 Parts:

2.1: Setting the Map
2.2: Measuring Distances
2.3: Timings
2.4: Bearings
2.4.1: Following a Bearing
2. 5: Advanced Compass Work

We will start by looking at how to utilise our map whilst out on the ground before introducing the compass.

Setting the Map

Setting the map, or orientating the map, is a key skill that you should learn and continue to practice whilst navigating. Setting a map helps you to visualise the area around you by relating features on the ground to features on the map and turning the maps so they line up and correspond with each other.

Think of it this way and try this task:

Open Google Maps on your phone. Tap the location icon. This should centre the map on your location. Hold the phone flat in front of you and move your body around to face in different directions. Notice how the map doesn't move and the top of the phone is always 'north'. Now tap the location icon again. Notice now how the map turns and the top of the phone is now the direction you are facing. Again, hold the phone in front of you and turn your body to face different directions. The map should move with your body and the features around you stay in their actual locations in relation to the ground.

This is how setting a map works. Orientating the map to match the position of features around you. There are two ways in which we can do this:

- **Using features**
- **Using a compass**

Using Features

We have looked at the three types of features in this Part. It is usually easier to set the map to linear features as we can align them so they are parallel.

To use features:

- First, look at the map and identify where you are.
- Then look at all the features around you that you can also identify on the map. As mentioned above, linear features are the easiest to identify but also look at area features and finally spot features to help you gather information.
- Stand still and turn the map so the features on the ground line up with their representative features on the map. For example, if you are stood on the road and there is a stream to your left and a woods to you right, align the map so the stream is on the left, the woods on the right and the road on the map is parallel with the road on the ground.

Take a look at the two images below from Mountain Training's publication: **Navigation in the Mountains**

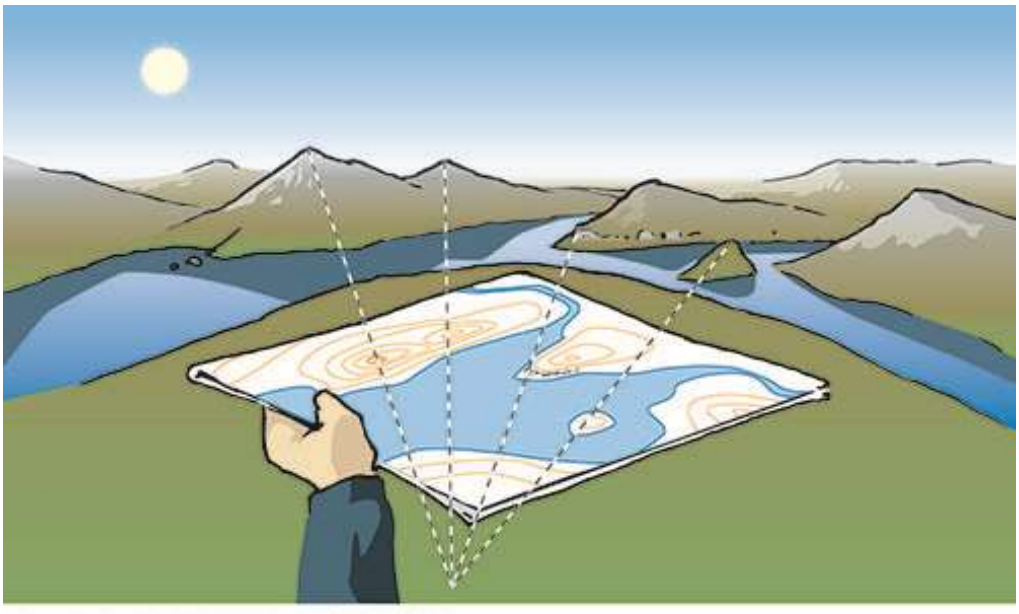


Illustration from 'Navigation in the Mountains' © MTUK/VG 2012

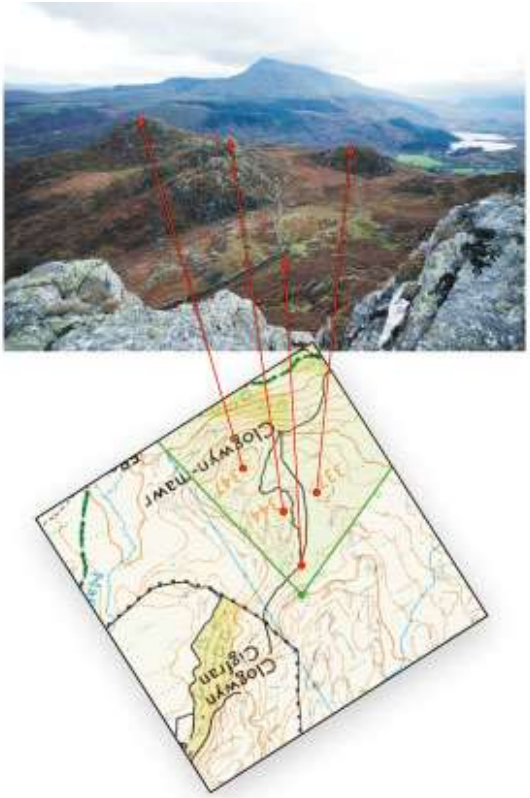


Illustration from 'Navigation in the Mountains' © MTUK/VG 2012

Using a compass

The last Part in the section Introduction to Maps looked at the compass. To set a map with a compass all we require is the magnetic needle and the grid lines on a map. Using a compass to set the map is the easiest and quickest way, especially at night or in poor visibility if you cannot see many, if any, features.

To use a compass:

- First, we place the compass on the map. It doesn't matter how or where.
- Hold the map and compass together and rotate them together until the magnetic needle is parallel to the grid lines. Ensure the red north needle is pointing to the top of the map (Grid North)

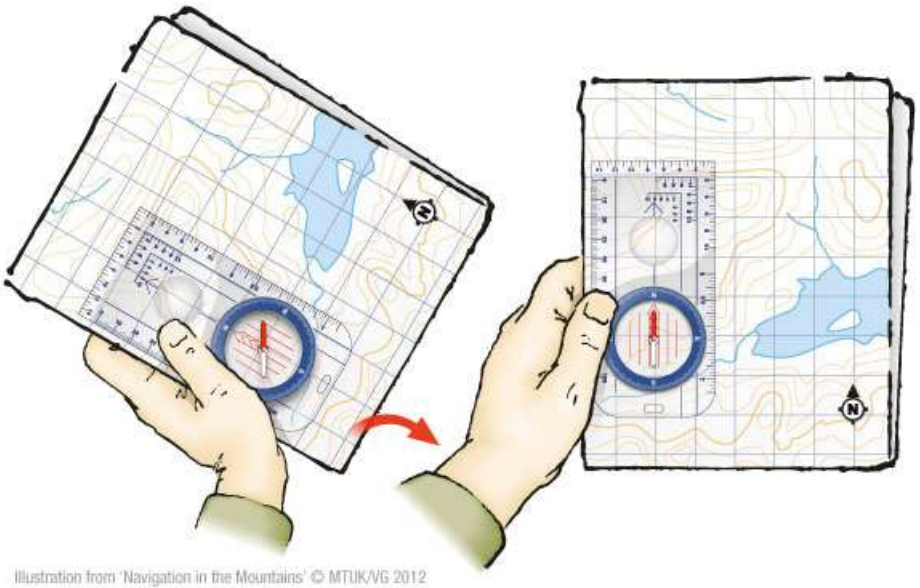
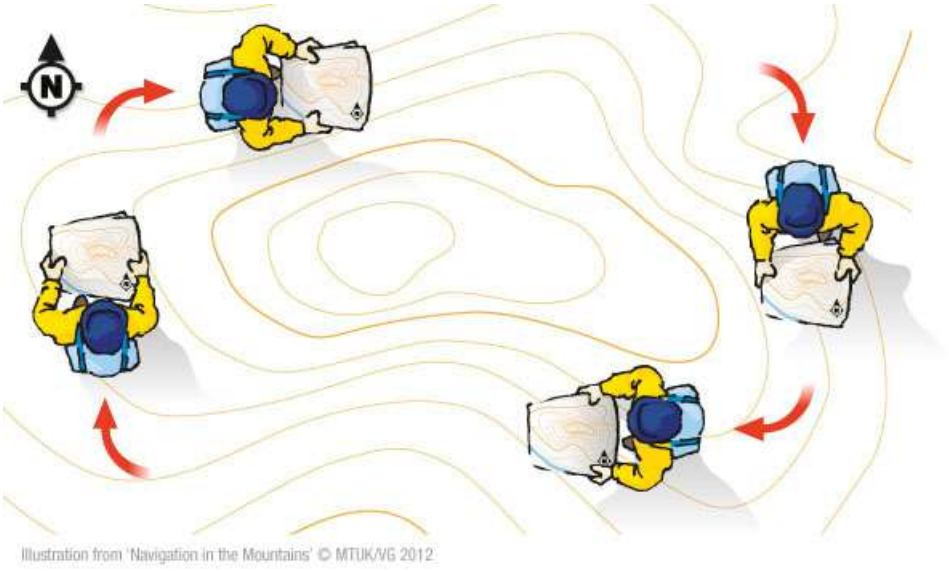


Illustration from 'Navigation in the Mountains' © MTUK/VG 2012

Your map is now set to your surroundings. Use this time to look at features on the map and relate them to the ground and vice versa.

Top Tips for setting a map:

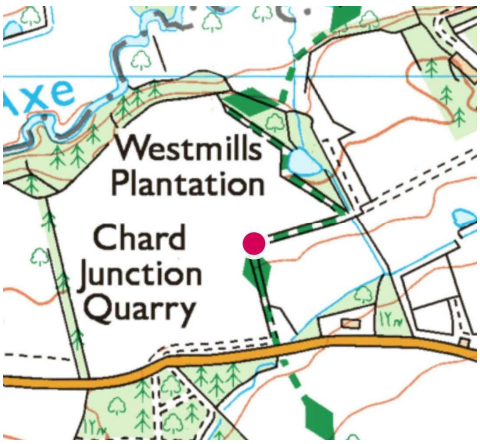
- Use your thumb or a stick on pointer to mark your location on the map before setting the map.
- Practice setting the map at any point when you check the map. This will force you to look at the area around you and can minimise errors in navigation.
- When walking with the map, try to keep the map orientated as you walk.



Practice setting a map in your local area first and then develop this technique by going to different areas. Try to use all types of features first and then confirm with a compass.

Be aware that there may be inaccuracies in maps when looking for features. Field boundaries can move, forests can be cut down, footpaths may be moved, and buildings knocked down or built. A map is only truly accurate the day it is printed and there may still be slight inaccuracies. Take a look at some examples below in my local area:

I am at the red dot on the map looking back up the road (North west). Look at the map and look at the picture. Notice the large building (Factory) on the map is no longer present in the image.



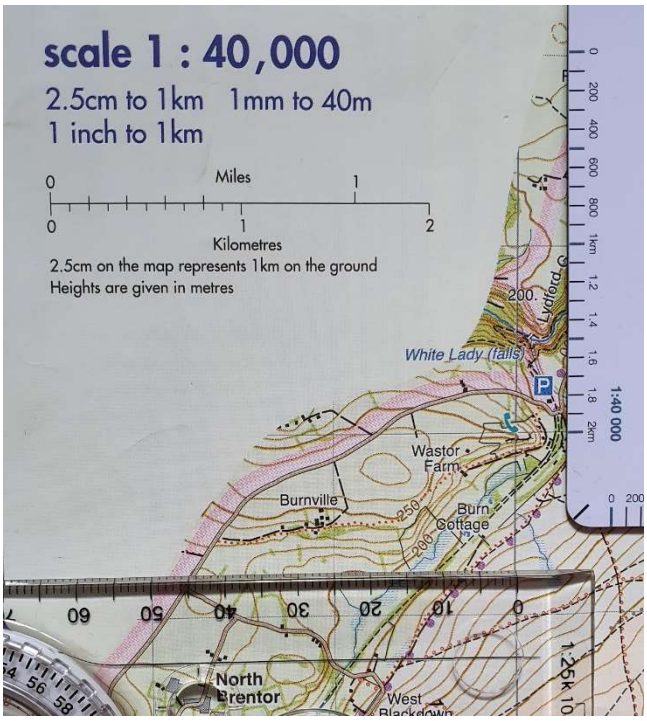
In this example, I am stood at the red dot in **image 2** looking North. Notice how the lake does not show on the map in **image 2** *(do not confuse the small pond in image 2 for the lake)*

Image 3 is from a map that is 15 years old. Notice the changes to the landscape and how this map is no longer accurate. This stresses the importance of having up to date maps.

End of Part

MEASURING DISTANCES – PART 2.2

Part 2 of my **Navigation Techniques** section will look at measuring distances and how we can use this technique to help us find features and plan a route.



Measuring Distances

We use distance measuring to calculate how long a navigational leg or whole route will take and to minimise errors in navigation. We can judge and estimate distances through sight, time, using measuring devices and even through pacing.

Judging Distances using sight:

The most basic form of distance judging is done using sight. We do this fairly regularly in our every-day life. How often have you said: "Oh, the pub is about half a mile down the road" or "There's a shop about 200m that way". The easiest way we can judge distance is by relating distances by using set distances we know of in normal life. For example:

- A football pitch is 100m from goal to goal and 50m wide
- A standard swimming pool is 25m long

Using these measurements, we can roughly judge the distance of features whilst out on a walk. For example, if we can see a footbridge in the distance and it looks to be further than a football pitch away, we can use our judgement to determine its approximate distance, by saying it is 'x' amount of football pitches away for example, and use that information to gauge where we are on the map.

One issue we do have in the UK is our mixture of units (and not the alcoholic type!). Our maps are scaled in kilometres and metres. Distances on our road signs are marked in miles and yards. This can present problems when judging distance as we are so used to seeing 'miles' and 'yards' (in three quarters of a mile, turn right) yet want to measure map distances in kilometres and metres (the summit is 300m away from the track junction). And miles and kilometres do not convert easily.

1 mile = 1.6km

1km = 0.62 miles

It is worth taking time to go outside and judge distances to get a feel for how far things are away from you. By the end of this Part, you will be able to measure distances on a map. Use this technique to measure features on a map from your position and see how they compare in terms of distance. Find an open space, mark your position on the map and find features that are:

- 50m away
- 100m away
- 250m away
- 500m away
- 1km away

This will help you gain a better understanding of judging distances using sight. Be aware though that it will not be accurate but serves as a rough guideline and that 'dead ground*' can cause errors in your judgement.

** dead ground is a term used to describe an area of ground hidden from view. For example, undulating ground, tree lines and valleys may hide whole areas of ground that you have not accounted for in you distance judgement.*

Using measuring devices on a map:

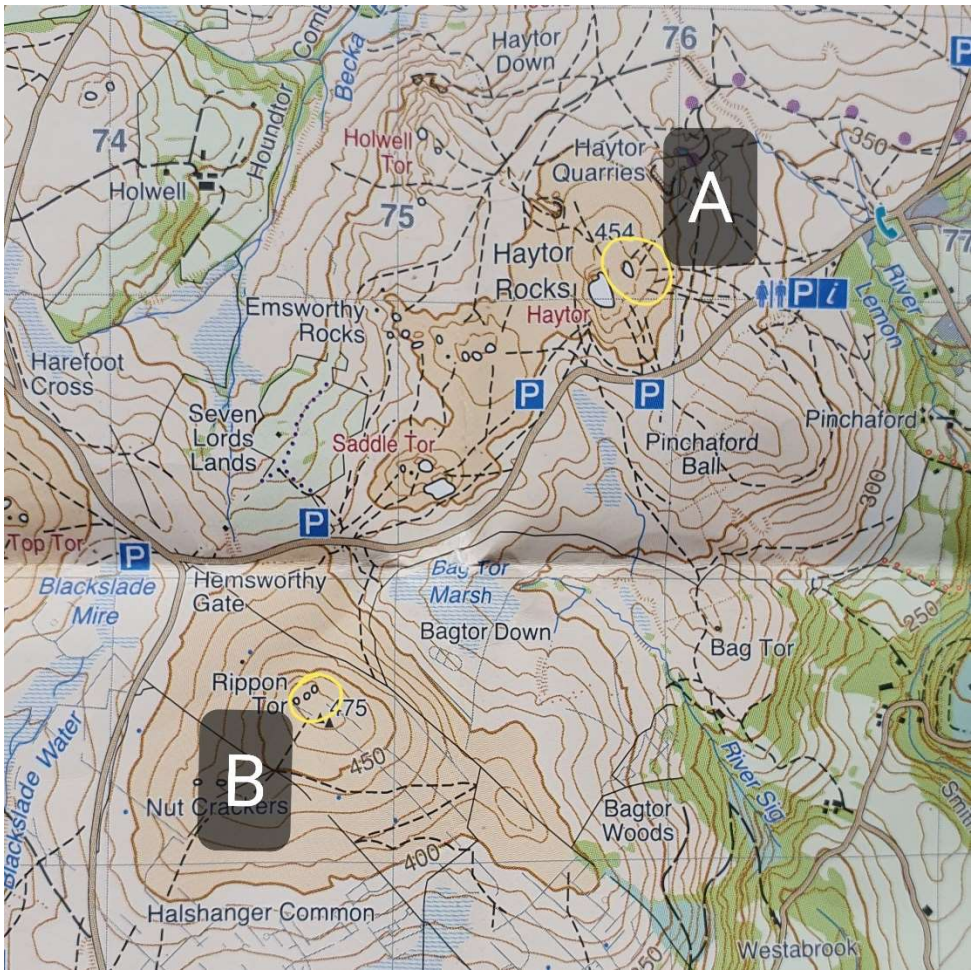
For more accurate measurements of distance, we can use measuring devices on maps to work out distances. In the Part Introduction to Maps Part 4: Resources and Care of Maps we looked at different resources available to us to help measure distances. Take time now to familiarise yourself and read the Part again if need be.

Below is a list of items and resources we can use to measure distance on a map:

- **Compass roamer**
- **Distance Cards**
- **Ruler** *(with millimetre increments)*
- **String**
- **Paper and pen/pencil**
- **Opisometre**
- **Technology**

I will come onto these resources in a bit, however, the most basic form of measuring distances on a map is by using grid squares.

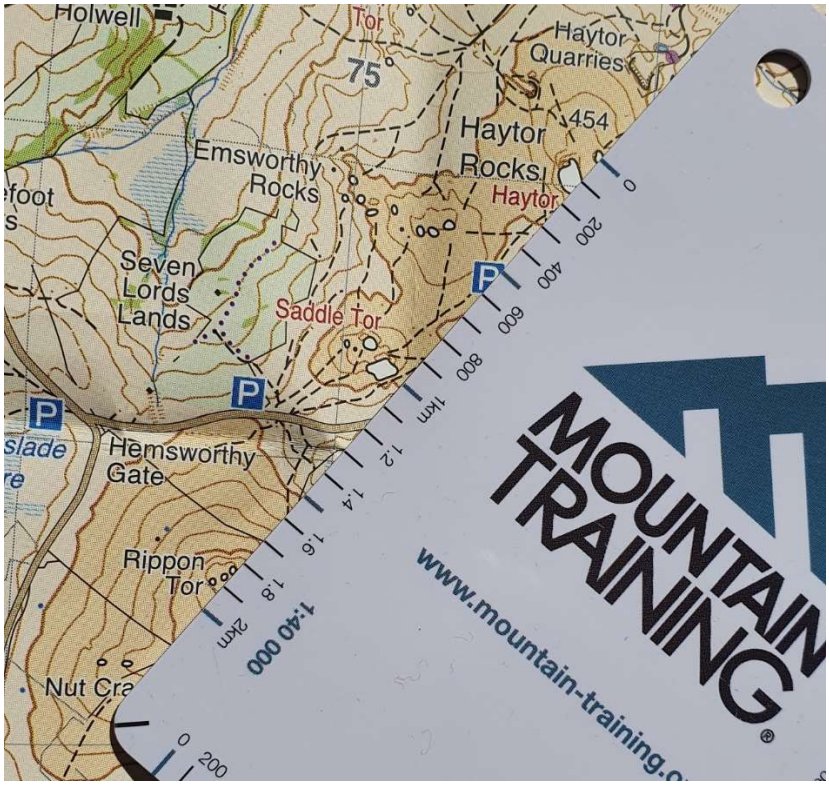
As we already know, a grid square is 1km x 1km and roughly 1.4km across the diagonal. Knowing this, we can roughly estimate distances by looking at the grid squares. Take a look at the example below. Estimate the distance from Haytor (point A, circled in yellow) to Rippon Tor (point B, circled in yellow) in a straight line:



At first glance, it would appear to be about 2km. But how can we work out the distance more accurately?

Compass roamer and Distance Cards

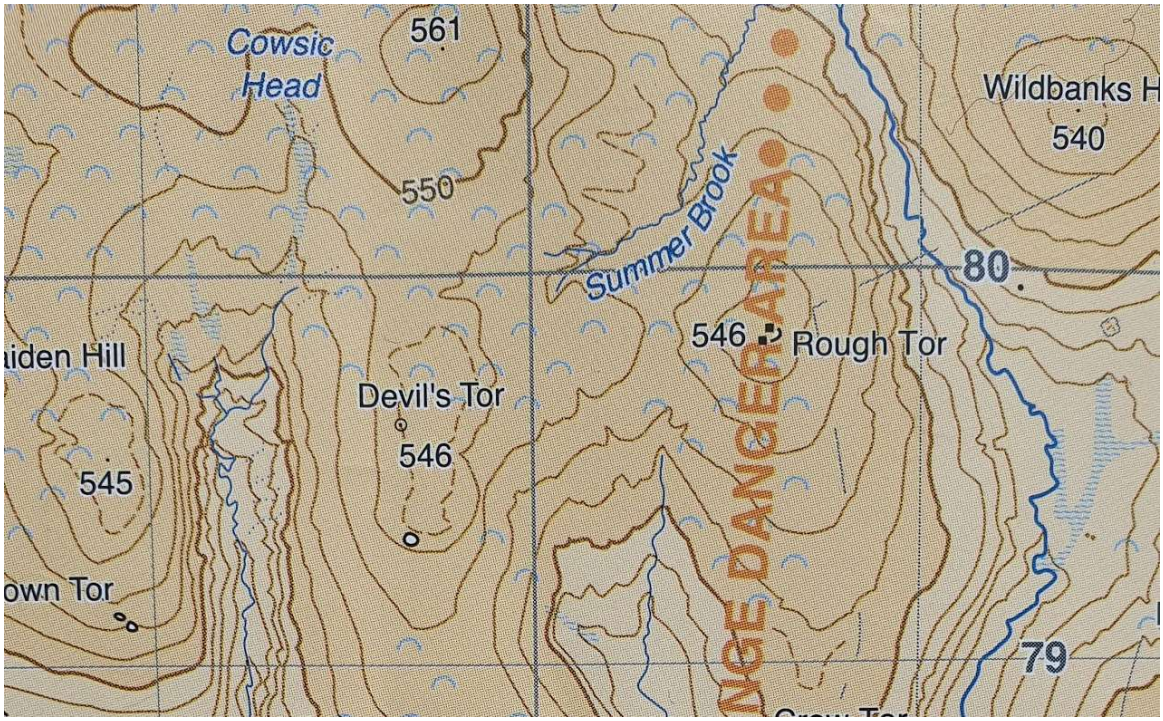
We can use the roamer on a compass or a dedicated distance card to help us gain better accuracy when measuring distances. It is important you know the scale of the map, so you know which scale to use on roamers and distance cards. Dependent on scale, we can be accurate up to roughly 50m. Using the image above, we can confirm as to whether our estimation of 2km was accurate or not:



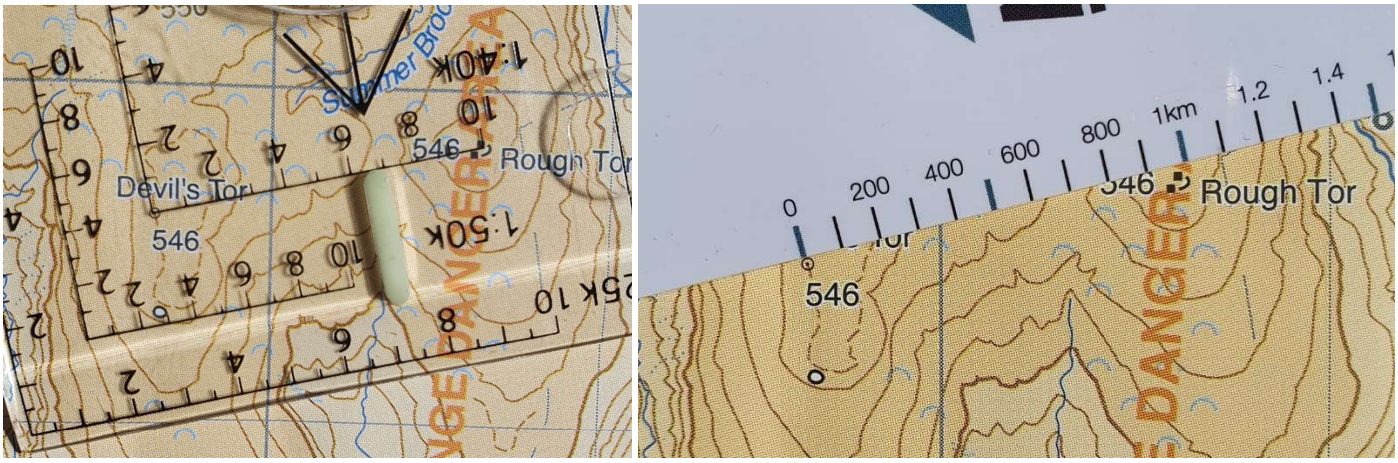
Using a distance card, we can see in the above image that the actual distance was between 1.8km and 1.9km. That gives us an error of roughly 10%. This level of error is acceptable, and we can adjust accordingly, however we will aim to improve this.

See below for another example looking at measuring distances with roamers and cards:

First, estimate the distance from Devil's Tor to the middle of the buildings on Rough Tor:



Now see below to see how you did. Were you within 10 percent?



In image 1, notice how the compass is being used: The correct scale roamer has been used (1:40k) as this is a Harvey 1:40,000 British Mountain Map. The corner of the roamer has been put accurately on *Devil's Tor* and the roamer positioned so that it accurately sits over *Rough Tor.*

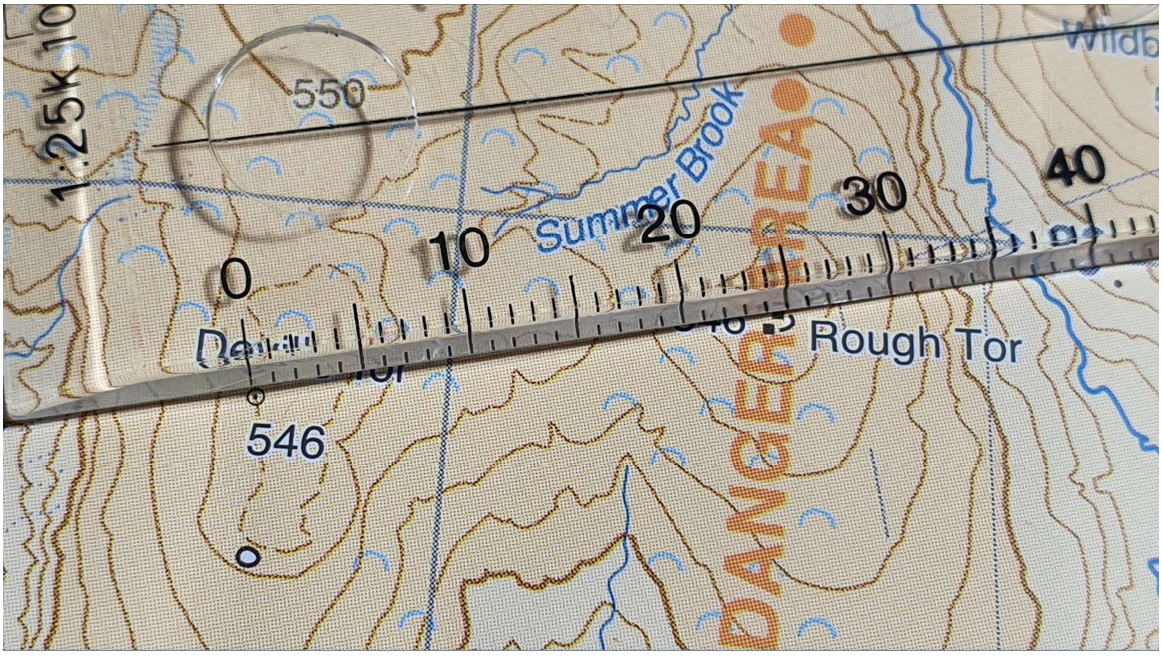
Using rulers

Rulers with millimetre increments give us the greatest level of accuracy when it comes to measuring distances. On a 1:25,000 scale map, 1mm measured on the map is 25m on the ground.

Distance Metres	Scale		
	1:25,000	1:40,000	1:50,000
25m	1mm	-	0.5mm
40m	-	1mm	-
50m	2mm	-	1mm
100m	4mm	2.5mm	2mm
200m	8mm	5mm	4mm
300m	12mm	7.5mm	6mm
400m	16mm	10mm	8mm
500m	20mm	12.5mm	10mm
1000m	40mm	25mm	20mm

Most base plate compasses have a millimetre ruler printed on the base. We can use this to get a better level of accuracy when measuring distances on the map.

Let's use the map example from above:

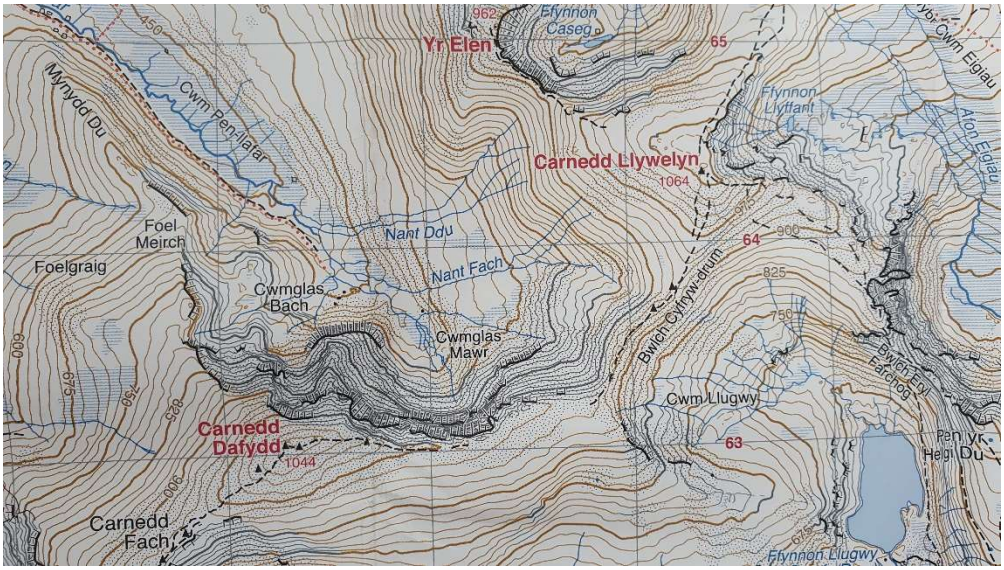


The distance to the middle of the two buildings is 24mm. Using the table above and knowing this is a 1:40,000 scale map, we can calculate the distance to be 960m. If you said they were 1km apart, you are well within the 10% tolerance.

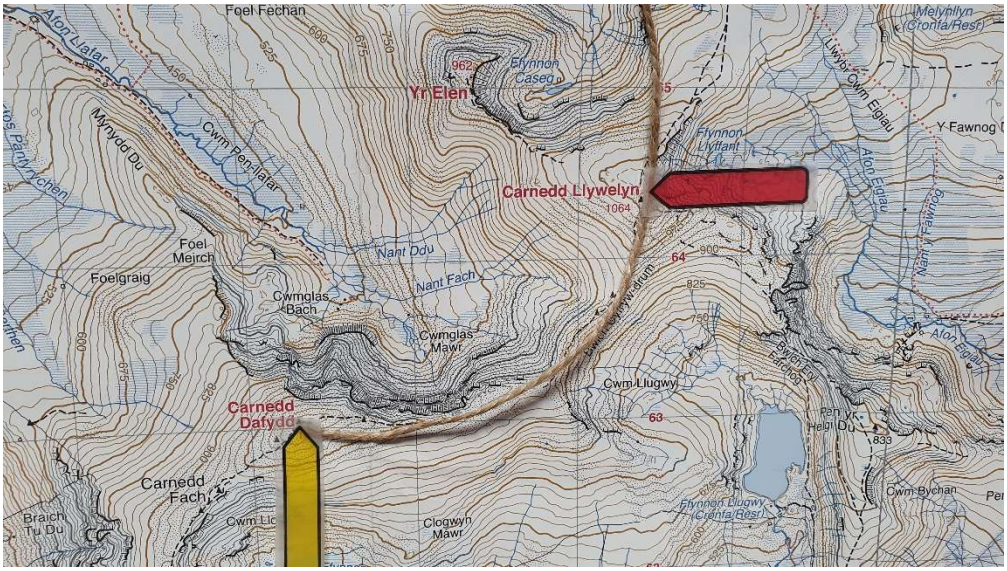
Using string

We don't always measure distances in a straight line. We usually follow paths or use other features to navigate to and from and these are rarely in a straight line. If we want a more accurate distance of our route or leg, we can measure along the route using string. The age-old question of 'how long is a piece of string?' is about to be answered!

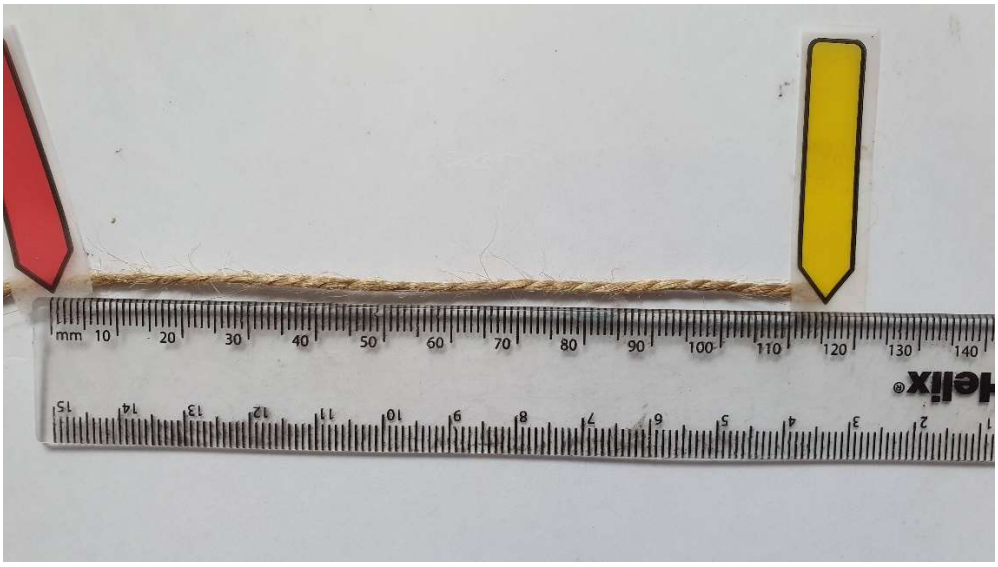
Look at the map below. We can use string to work out the distance between Carnedd Llywelyn and Carnedd Dafydd as a straight-line distance would be inaccurate and impossible for us to walk in, mainly due to the cliffs.



We use string to follow the path SW off Carnedd Llywelyn, across Bwlch Cyfrym drum and then West to Carnedd Dafydd. I have used sticky pointers to hold the string down and act as reference points on the string for when I come to measure it.

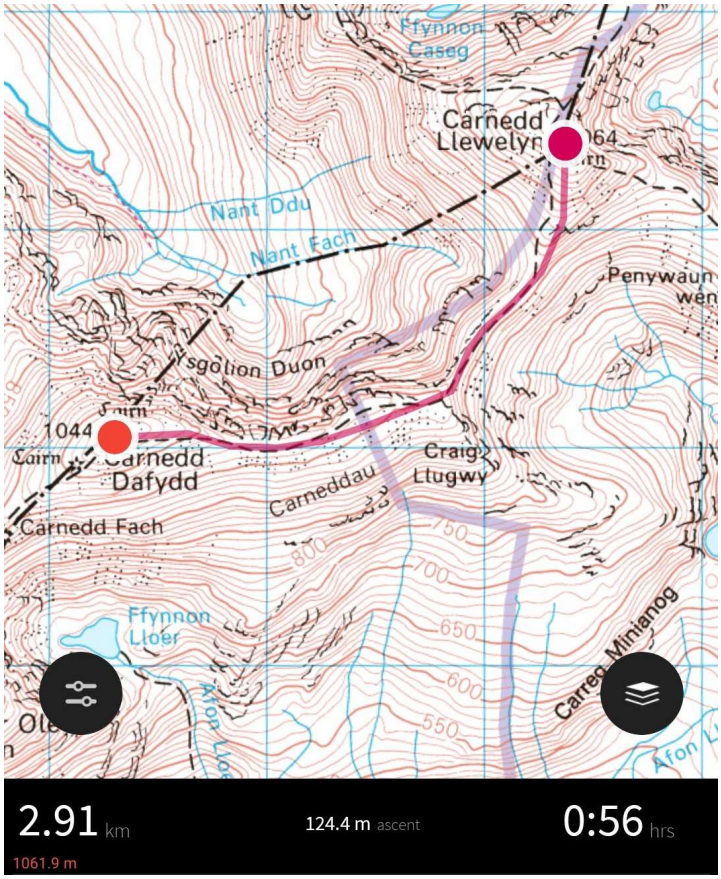


Notice how it is not 100% accurate but not far off. However, it gives us much greater accuracy of actual walking distance than a straight line from summit to summit. Using the sticky pointers as our references, we can then measure the distance using a ruler or the scale on the map.



My ruler measures 116mm. This is a 1:25,000 scale map so we can work out that the distance is 2.9km.

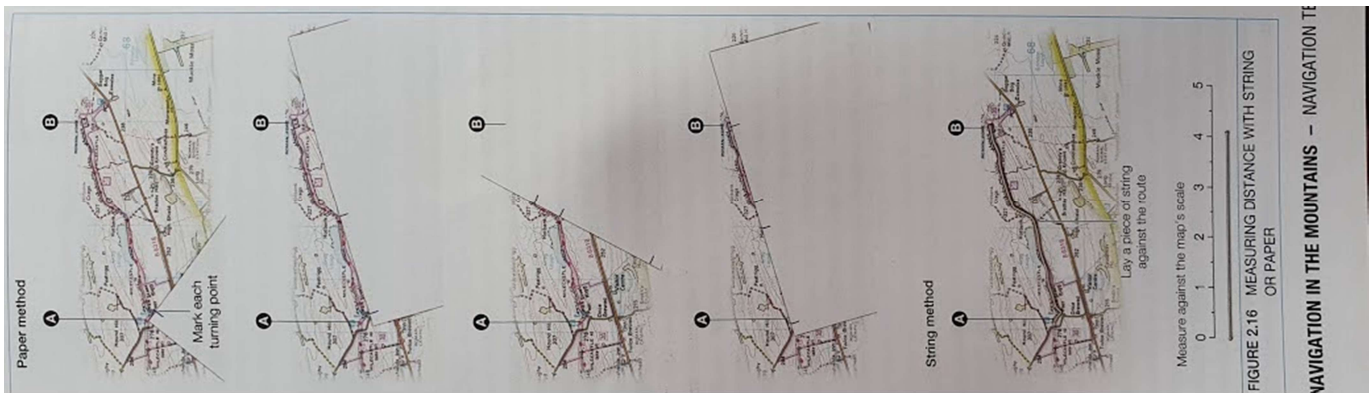
And just to confirm that we are correct, I have used the OS Maps App and plotted the route (*more on this later*):



String can be difficult to use and in untrained hands, it can present a greater degree of inaccuracy. It takes practice and if in doubt, use other measuring methods to confirm or clarify.

Paper and pen/pencil

Another option which is similar to using string is to use the edge of a blank piece of paper and a pen to mark turning points on the leg. The Mountain Training publication: Navigation in the Mountains has a good example of this method:



Starting with the corner of the paper, lay the edge along the route and mark each turning point. Continue to turn the paper and mark the turning points along the route until you get to your intended checkpoint. You can then measure the distance on the paper against the scale of the map or a ruler.

Using an Opisometre

An opisometre is a measuring wheel you can use to trace the route with on the map. It will then give you an accurate distance travelled. Be aware to reset the device to '0' every time you use it and to ensure you use the correct scale on the device compared to the map.

Technology

We can measure distances using mapping software on our laptops and tablets or phone apps such as OS Maps and Viewranger. I'm not going to go into too much detail about apps etc, but only to point out how they can be used to measure distance.

Above, when talking about using string to measure distances, I mentioned how I can confirm the distance by using an app and plotting the route. We can zoom right into the map on a screen and plot routes to a high degree of accuracy by following the route by every turn.

I only ever use technology like this to CONFIRM another method. The reason being is I don't want to rely on technology and become lazy.

Links to where you can download OS Maps and Viewranger can be found in my DOWNLOADS and RESOURCES tab under MOUNTAINEERING RESOURCES on my website

Measuring Distance on the Ground

After we have measured a distance on the map, we can then measure this on the ground. This is useful for us to work out how long it is going to take to get to our destination by using timing (more on this in the next Part) and also to find features in poor visibility.

The technique we use is called Pacing, commonly referred to as Double Pacing.

Pacing

We can use our natural stride length to measure distances on the ground with a bit of knowledge about it and practice.

Everyone's stride length is different, so it is important that you conduct the following test to determine your own number of double paces per 100m:

You will need to head to a standard sized football pitch or 100m running track. Failing this, you will need to measure out a 100m long strip on flat, even ground. You can do this by using a 50m rope or by finding an area on a map that you can easily measure 100m between two points.

Starting with a clear start and end point spaced 100m apart, step off with your right foot and count every left foot (or vice versa). Walk naturally, as if you are walking down the street. Once you have crossed the 100m point take a note of your number. The average pace for an adult is roughly 64 double paces per 100m.

Once you have this number, turn around and do it again. Your number may or may not be the same. If you have the same number, excellent! If not, find the average by adding the two numbers together and dividing by 2.

For example, if you walked the 100m distance twice and got 60 and then 64, add these numbers together to get 124. Divide it by 2 (the number of times you walked 100m) to get 62. This is then your double pace number per 100m.

I would advise you continue to practice this from time to time as your number may change. Once you have your double pace number for flat even ground, try doing the same exercise but this time with a heavy rucksack and see how your pacing changes.

Another point to note: When going uphill you tend to take smaller paces. Likewise, in rough terrain. With this in mind, your paces will vary and going up a steep hill on rough terrain, your paces may even double, going from 62 paces per 100m to possibly 124! If you have a steep hill near you and the ability to measure out 100m on that hill, practice pacing and see how your number differs to the flat.

See the example below from Mountain Training: Navigation in the Mountains:

Double paces per 100m	Conditions underfoot		
	Good	Moderate	Poor
Flat	60	70	90
Uphill	80	100	120
Downhill	65	70	90

Illustration from 'Navigation in the Mountains' © MTUK/VG 2012

A word on pacing: Pacing is a very effective way of finding features in poor visibility, however it does limit your ability to converse with other members of you group. It is usually best to pace short distances, typically less than 1km at most. To keep track of pacing, you can use pacing beads, which I mentioned in Part 4 of my Introduction to Maps Section. Another way we can measure distances on the ground and a way in which we can partially take our mind off measuring the distance is Timing.

End of Part

MAP for questions: 2.2

Questions for Part 2.2:

In these questions the prefix 'GR' stands for Grid Reference and does not correspond to the two-letter map prefix (for this area it is 'SX' for those who are interested)

For the set of questions to follow, you will need the following:

- The OS Map attached
  OR
- OS Explorer map – The English Lakes South Western Area – OL6
- A ruler with millimetre increments and/or a compass base plate with ruler
- Distance timing card (Found in the Appendices of this course)
- A distance measuring card (Found in the Appendices of this course)
    - You will need to print this out but **ENSURE** your print it **ACTUAL SIZE** and not FIT/FILL TO PAGE. Take a look at and check your **printer settings** before printing and then **check the measurements** with a ruler using the table in the PDF. You will need to cut the distance card. You can then laminate it for use on the hills and mountains!

Q1: Using a roamer or a distance card, how far is it from Hart Tor (GR 581,720) to Black Tor (GR 573, 717) to the nearest 100m?

……..

Q2: Using a ruler, how far is it from South Hessary Tor (GR 597, 723) to the Trig Point (GR 592, 712) to the nearest 50m?

……

Q3: From where the bridleway meets the road (GR 590, 734) to where the bridleway meets the end of the embankment (GR 582, 702) follow this bridleway and measure the distance to the nearest 100m.

……

Q4: In straight lines measure the following distances to the nearest 25m and work out the total distance:

- **Footbridge (GR 583, 705) to Cramber Tor (583, 711) ……**
- **Cramber Tor (GR 583, 711) to small pond (GR 589, 711) ……**
- **Small Pond (GR 589, 711) to Small Pond (GR 596, 716) ……..**
- **TOTAL DISTANCE: ……**

Q5: Using any way to measure distances, measure the following distances to the nearest 25m and work out the total distance:

- **Where the bridleway meets the road (GR 590, 734) to where the footpath meets the road (GR 580, 728)**

  ……..
- **Where the footpath meets the road (GR 580, 728) to Hart Tor (GR 581, 720) ……..**
- **From Hart Tor (GR 581, 720) to the Trig Point (GR 592, 712) ……..**
- **TOTAL DISTANCE: ……**

Feel free to email me any questions you may have if you are unsure:

info@attheedgemountaineering.co.uk

TIMING – PART 2.3

Part 3 of my Navigation Techniques section will look at Timing and how we can use it to measure distances and plan routes in the hills and mountains.

Timing

As mentioned in the previous Part, we can use time to measure distance. In school, you may have learnt the equation: Speed = Distance/Time.

If we know how far away something is, and we know how fast we are walking, we can work out how long it is going to take to get there. The average walker's pace is roughly 4km per hour. This means an average walker can cover 1km in 15 minutes or 100m in one and a half minutes.

However, our walking speed changes depending on terrain, fitness and conditions. Walking up hill generally slows our pace. Boulder fields, scree and boggy ground will also reduce our speed. Even walking into a head wind and carrying a heavy rucksack affect how quickly we can walk.

Getting accurate at timing is a case of trial and error. Especially on variable terrain and going up-hill.

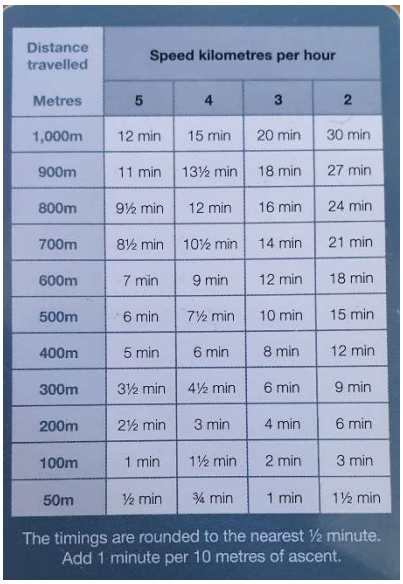
Practice measuring a distance on a map and then walk between the two points you have measured and time how long it takes you. Do the same over and over again, but on variable terrain, going up-hill and/or wearing a heavy rucksack.

Another option is to use a standard sized football pitch and pace your 100m. Time how long it takes and practice walking the same 100m at different speeds. Multiply this 100m time by 10 to get how long it will take you to walk 1km.

Get a feel for different walking speeds and over time, with practice, you will develop a natural sense of how fast you are walking, and you can plan a route accordingly.

Every time I start a walk in the hills and mountains, I make a note of the distance of my first leg and time it. This gives me a good indication of my walking speed and I can re-calculate my timings accordingly.

Take a look at the example of a timing card below. These take away the need to do maths! We use them from the initial planning stage at home to using them out on the hill to work out small legs.



Distance travelled	Speed kilometres per hour			
Metres	5	4	3	2
1,000m	12 min	15 min	20 min	30 min
900m	11 min	13½ min	18 min	27 min
800m	9½ min	12 min	16 min	24 min
700m	8½ min	10½ min	14 min	21 min
600m	7 min	9 min	12 min	18 min
500m	6 min	7½ min	10 min	15 min
400m	5 min	6 min	8 min	12 min
300m	3½ min	4½ min	6 min	9 min
200m	2½ min	3 min	4 min	6 min
100m	1 min	1½ min	2 min	3 min
50m	½ min	¾ min	1 min	1½ min

The timings are rounded to the nearest ½ minute.
Add 1 minute per 10 metres of ascent.

Using the card above, we can work out that walking at 3kph and that we want to cover a distance of 5km, it will take us 100 minutes or 1 hour and 40 minutes.

Timing is also a useful way to measure distance on the ground whilst walking. In conjunction with pacing, we can work out the distance on the map and then, based on our walking speed, time that leg. We can use a stopwatch and check it regularly or set a timer with an alarm function.

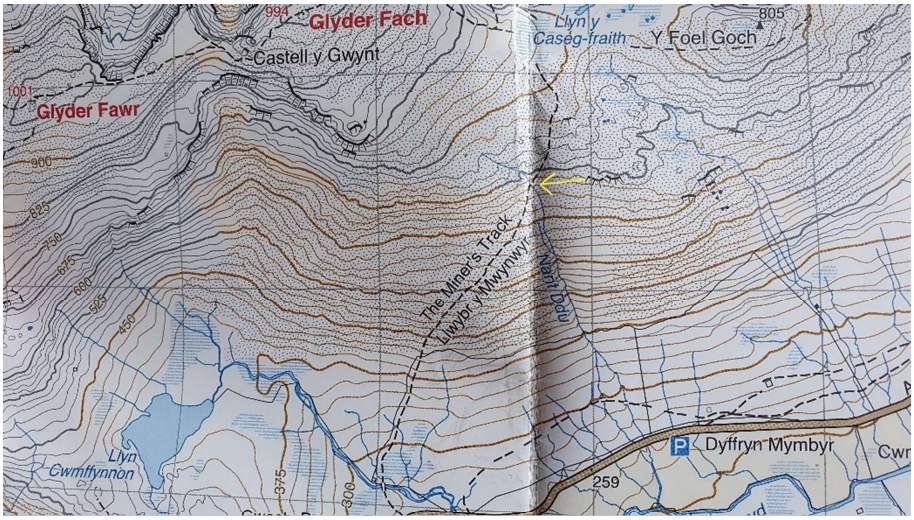
Timing is best used over longer distances, over 400m for example, so long as you keep a regular pace. Counting paces over large distances can become inaccurate and boring!

When timing, it is important to stop the clock if you stop! And that means EVERY TIME you stop on that timed leg. Otherwise your timings will be inaccurate.

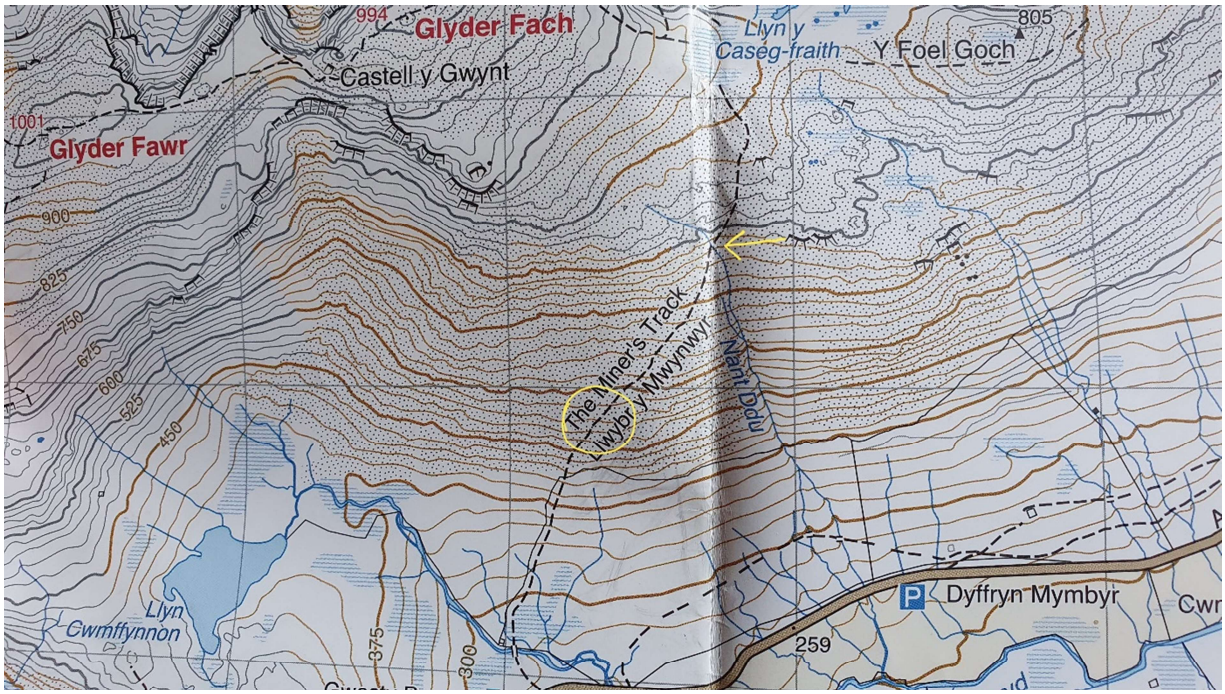
Timing is often used as a rough estimation but with practice, you can become more and more accurate. Practice pacing AND timing together to get the feel of how they both relate with each other.

Even without actually timing a leg, you can use rough times to help find your position on the map. See the example below:

I left the marked stream on the Miners track, traveling south west, about 15 minutes ago and I am walking at 3kph. Roughly where is my position on the map?



Using the timing card above we can see that in 15 minutes, walking at 3kmh, I can travel 750m. Using this information, we can measure 750m along the footpath South of the stream and find out roughly where are:

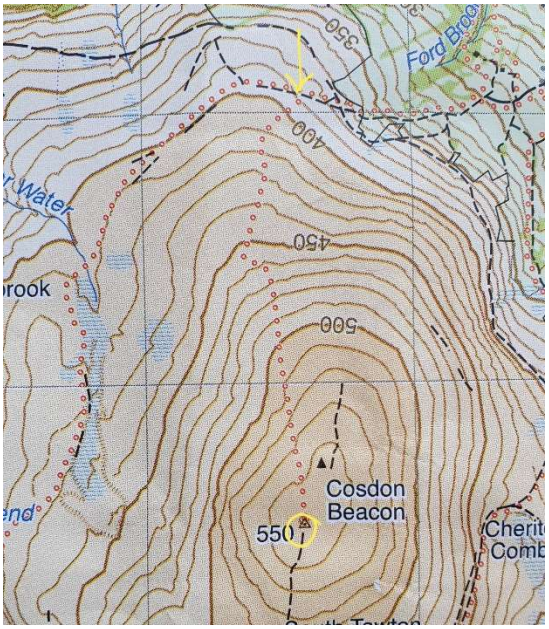


When doing this, we need to ensure we know how fast we are walking to get an accurate location. It is generally best to under-estimate our walking speed and accept a tolerance of 10%. With the example above, we can expect to be anywhere from 675m to 825m away from the stream.

Naismith's Rule

As a general rule of thumb, we use a rule called Naismith's rule to calculate time taken when walking up hill. This rule considers the time taken to climb 10m in ascent, or one contour line on OS maps and some Harvey Maps.

At a basic level, and the one we will adopt here, we add 1 minute for every 10 metres in height gained. On maps with 10m contour intervals, we can do this by adding up all the contour lines we cross on our route going up-hill. See the example below:



The distance from the marked point on the map to the Trig Point on Cosdon Beacon is roughly 1.6km in a straight line. Walking at 4kmh it would take 24 minutes. However, if we use Naismith's Rule and add one minute for every 10 metres in height gained, we would have to add 15 minutes to our time, making a total time of 39 minutes.

End of Part

MAP for questions: 2.3

Question Sheet for Part 2.3:

For the set of questions to follow, you will need the following:

- The OS Map attached
  OR
- OS Explorer map – The English Lakes South Western Area – OL6
- A ruler with millimetre increments and/or a compass base plate with ruler
- Distance timing card (Found in the Appendices)
- A distance measuring card (Found in the Appendices)
    - You will need to print this and the map out but **ENSURE** your print them **ACTUAL SIZE** and not FIT/FILL TO PAGE. Take a look at and check your **printer settings** before printing and then **check the measurements** with a ruler using the table in the PDF. You will need to cut the distance card out. You can then laminate it for use on the hills and mountains!

Q1: You are walking along the Cumbria way. It is a good, flat footpath and you are averaging 4kmh. You have just crossed the footbridge at GR 261, 073 heading SE. It is now 21:00 in the evening and last orders at the Old Dungeon Ghyll bar (GR 285, 061) is called at 22:00. Will you get to the bar in time?

- **Work out distance to the nearest 100m**
- **Work out time to the nearest minute**

……..

Q2: You left Three Tarns (GR 248, 060) at 14:15 in the afternoon and are descending the footpath down 'The Band' to the East. You are walking at 3kmh and it is now 14:49. Roughly where are you on The Band?

- **Within 10% allowance either way (Time and Distance)**

……..

Q3: The distance from the footbridge (GR 261, 073) to the small Tarn (GR 264, 087) is 1.9km. Walking at 2kmh, how long will it take you to walk there?

- **Consider Naismith's rule**
- **Within 10% allowance (Time)**

……

Q4: No map needed for this Question: You are planning a brisk circular walk for the morning but have to be home by midday. You plan to walk at 5kmh. If you were to leave at 09:30, how far can you plan to walk?

……..

Q5: No map needed for this Question: I have planned a walk which is 9.6km long with height gained of 340 metres. If I average 4kmh, how long will this walk take (assuming I take no breaks)?

……

Feel free to email me any questions you may have if you are unsure:

info@attheedgemountaineering.co.uk

BEARINGS – PART 2.4

Bearings

Part 4 of my Navigation Techniques section will look at Bearings and how we can use them to check the direction of handrails, sight distant features and head in the right direction on our routes.

Learning to take a bearing is a fundamental stepping-stone in navigation. Bearings are used to help us with the following:

- Checking the direction of a handrail
- Sighting a feature
- Point us in the right direction
- Taking the aspect of a slope
- Aiming off
- Boxing
- Relocation

The last four points will be covered later in this course. The two types of bearing we need to learn before we can use all these techniques are:

- Sighting a bearing or magnetic bearing (taken from the ground and transferred to the map)
- Grid bearing (taken from the map and transferred to the ground)

First, we will look at sighting a bearing.

Sighting a bearing

Taking a bearing from the ground is particularly good for checking the direction of a handrail, taking an aspect of slope and to help relocate yourself by transferring the bearing back to the map (more on this later in the course).

In poor visibility, you may get a glimpse of a feature or your checkpoint in the distance during a break in the cloud. Sighting a bearing on that feature is a great way to ensure you stay on track and can help you relocate.

How to sight a bearing:

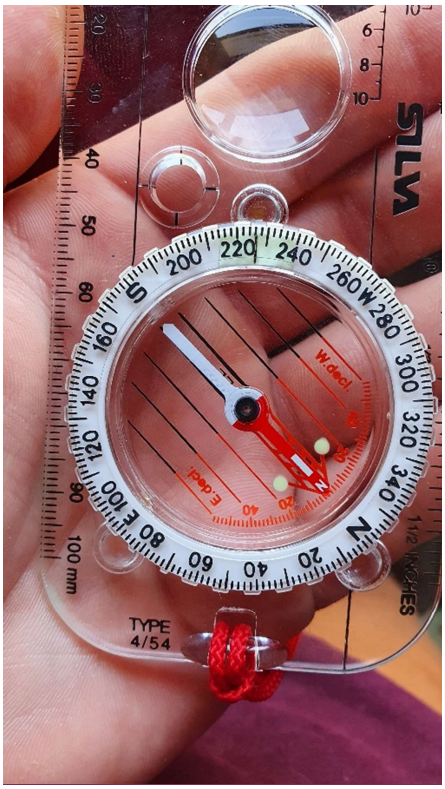
- Hold the compass in front of you and point the direction of travel arrow at your intended feature (if it's a spot feature) or along the feature (if it is a linear feature).

- Hold the compass still whilst still fixed on the feature and rotate the compass housing until the red orienting arrow is underneath the North magnetic arrow.

Common phrases used are '**red in the shed**' or '**mouse in the house**'

- A bearing can now be read along the index line.

In the below images I am sighting a bearing off a telegraph pole (#stayhome and all that!)



Notice how the direction of travel arrow is fixed on the pole (image 1)

I then rotate the base plate to align the orienting arrow and the north magnetic needle (image 2).

I can now read the bearing along the index line. In this example it is 226 degrees

It is important to include magnetic variation to get an accurate bearing. If you are transferring this bearing to a map, remember to 'subtract' the Grid Magnetic Variation'.

Grid to Mag, ADD

Mag to Grid, GET RID

In this example, my magnetic bearing is 226 degrees. Assuming the magnetic variation is 1 degree, To transfer this to a map, I would have to subtract 1 degree from 226 to make it 225 degrees.

Taking a grid bearing

We can take a grid bearing from a map to allow us to check the direction of handrails and to point us in the right direction. When planning a route, we take grid bearings from one checkpoint to another to give us a rough idea of what direction we should be travelling in. It is not uncommon to then take several more bearings whilst walking this leg to ensure we are travelling in the right direction.

How to take a grid bearing:

To take a grid bearing, first we estimate the bearing from our position to our next checkpoint:

- North = 0/360 degrees
- East = 90 degrees
- South = 180 degrees
- West = 270 degrees

The reason we do this is to ensure we don't accidentally do a back bearing (more on this later in the course) and so there are no surprises when reading the bearing. For example, if you know you are travelling NE from your checkpoint, you can expect a bearing between 0 and 90 degrees. If our bearing is outside of this parameter, we can expect an error in our measurement.

We can now use a line on the compass or the edge of the compass to link our position on the map to our next checkpoint, ensuring the direction of travel arrow is pointing towards your next checkpoint on the map.

Keeping the compass fixed on the map, rotate the compass housing so the orienting arrows are parallel to the Easting grid lines (North - South lines) and the orienting arrow is pointing grid north.

Remove the compass from the map. Hold the compass flat in-front of you with the direction of travel arrow facing away from you. Rotate your body until both the orienting arrow and the north magnetic arrow align (as with sighting a bearing a bearing).

Once the arrows are aligned, the direction of travel arrow is now pointing you in... your direction of travel!

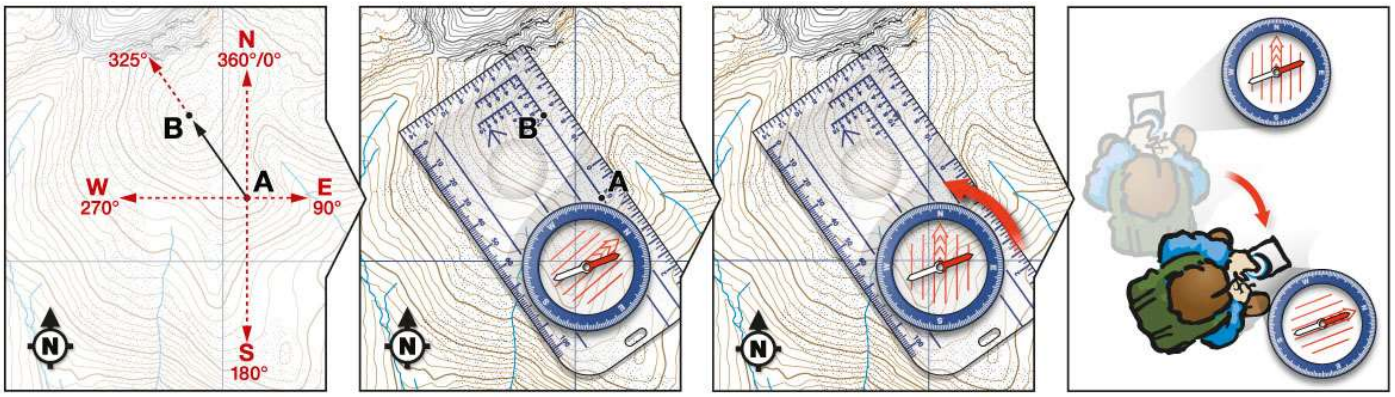
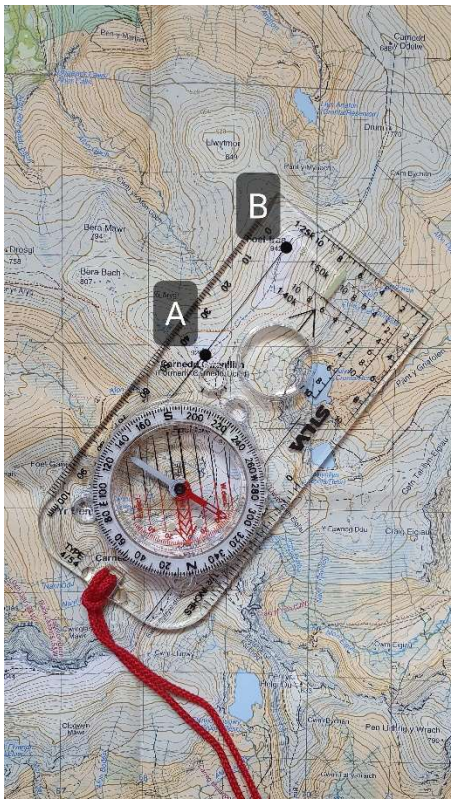


Illustration from 'Navigation in the Mountains' © MTUK/VG 2012

You can now read the bearing from the index line and note this down in case you either forget or you accidentally move the compass housing.

See the example below for further learning:



Checking the direction of handrails

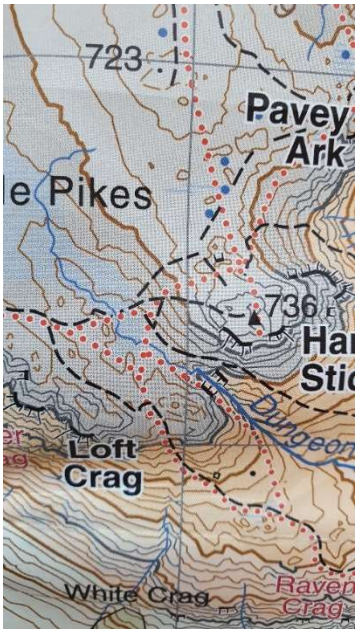
A mentioned above, we can use bearings to check the direction of handrails. We can use both sighting a bearing and a grid bearing.

Sighting

We can sight along a linear feature to help confirm our position along that feature. Sight the bearing along the linear feature and transfer the bearing to the map. By knowing what linear feature you are on, you can move the compass along that feature on the map until the bearing lines up.

Grid bearing

Having planned our route and knowing what footpath we are on; we may come across a track junction with multiple footpaths leading off in several directions. If we are unsure which footpath to take, we can take a grid bearing on the map from our position on the track junction, down the footpath we want on the map. We can then transfer this grid bearing to a magnetic bearing and sight which footpath our bearing points down.



Look at all those footpaths and junctions! Confusing? Checking the direction of handrails here is important to stay on the right track!

Points to consider when taking bearings:

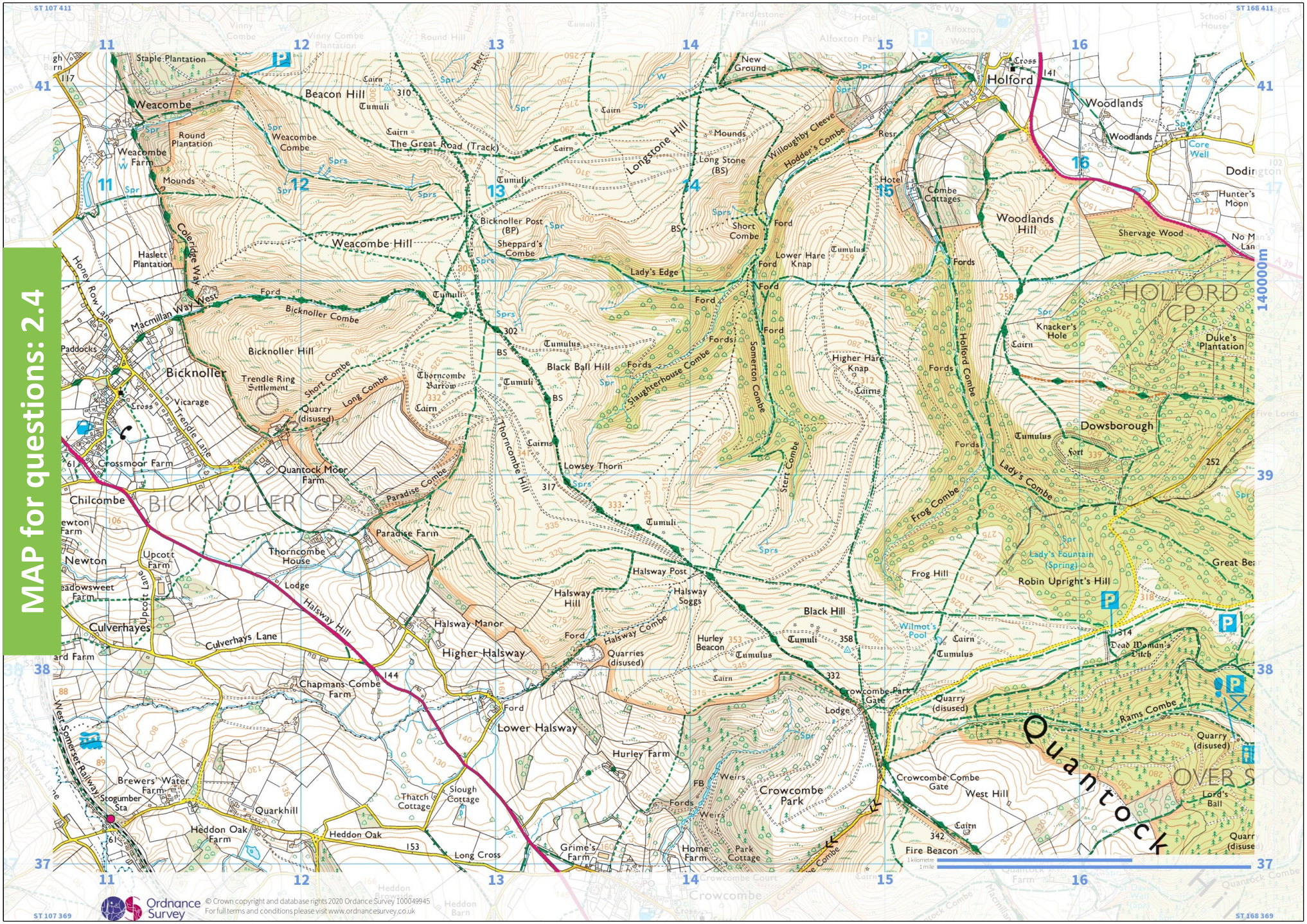
When taking a bearing ensure you do not hold the compass too close to the following:

- Metal zips on your jacket
- Metal water bottles
- Mobile phones, cameras or any electrical device.
- Magnetic clips used on some water bladders to attach the hose to a rucksack strap
- Walking poles

Remember: Grid to Mag ADD, Mag to Grid, GET RID. (this is accurate as of 2020, with magnetic north moving East of grid north in the next few years, this saying will soon become inaccurate)

End of Part

MAP for questions: 2.4



Questions for Part 2.4:

For the set of questions to follow, you will need the following:

- The OS Map attached
    - You will need to print this out but **ENSURE** you print **ACTUAL SIZE** and not FIT/FILL TO PAGE. Take a look at and check your **printer settings** before printing and then **check the measurements** with a ruler (1km = 4cm)

Q1: What is the bearing from the southern end of Wilmot's Pool (GR 152, 381) to the Trig point (GR 148, 381)

……..

Q2: I have reached the track junctions at GR 128, 398 and I am unsure which track to take. I have taken a bearing on my map down the path I want to use. The bearing is 338 degrees. Which track will I take? (Highlight on you map)

Q3: I am walking up Bicknoller Combe. I am in grid square 12, 39 and have checked the direction of the path using a magnetic bearing to see where I am on the track. My bearing is 59 degrees. Roughly, where am I? (Highlight on your map)

Q4: I am stood at the Tumuli at GR 131, 405. I have spotted my next checkpoint through a break in the clouds. I took a sight bearing and it was 309 degrees. What feature did I see?

……

Q5: What is the bearing from the Tumulus at GR 147, 401 to Higher Knap at GR 148,395?

……

Q6: Check the direction of the handrail from GR 132, 379 to GR 135, 381

……

Feel free to email me any questions you may have if you are unsure:

info@attheedgemountaineering.co.uk

FOLLOWING A BEARING – PART 2.4.1

Part 2.4.1 of my Navigation Techniques section will look at How to follow a Bearing and the techniques we can use to minimise errors.

Following a bearing

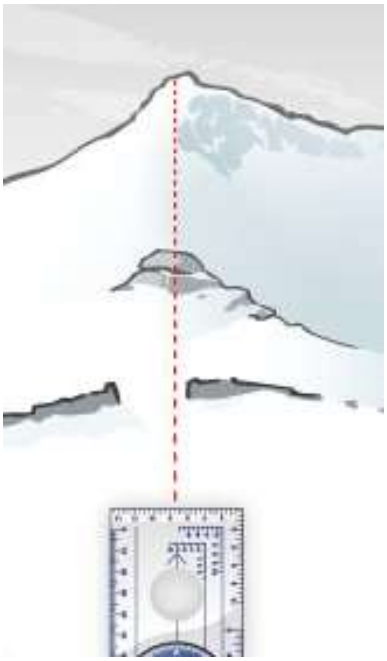


Image 3Mountain Training Navigation in the Mountains Publication Image

Being able to follow a bearing accurately is an important skill to learn in navigation. I have seen it all too often, when someone sets a bearing and follows it, only to walk off the bearing and veer off left or right, which ultimately leads to errors and missing their feature. In poor visibility or at night, this could end in getting lost, or worse.

Once you have set a bearing, hold the compass flat in-front of you with the direction of travel arrow pointing away from you. Rotate your body, keeping the compass fixed to your body, until the north magnetic needle and the orienting needle align. The compass is now set and the direction of travel arrow points in your direction of travel. Make sure you do not move the compass housing as this will change the bearing.

Pointing in the right direction and with the compass set, look ahead and see if there are any fixed objects that fall on the bearing (not sheep, they move!). Once you have a fixed object that falls on the bearing line, you can now put the compass away and walk to this object.

These objects could be anything in the middle ground that doesn't move. For example, rocks, tufts of grass, trees and bushes. So long as the object doesn't move and it is not too far away so to disappear in the cloud, these act as reference points for you to walk to.

Once you have arrived at your object, or just before you get to it, you can continue the process by sighting another fixed object on the bearing to walk to.

By having these set objects to walk to, we can walk around obstacles without the need for advanced compass techniques or losing our bearing. See the image below:

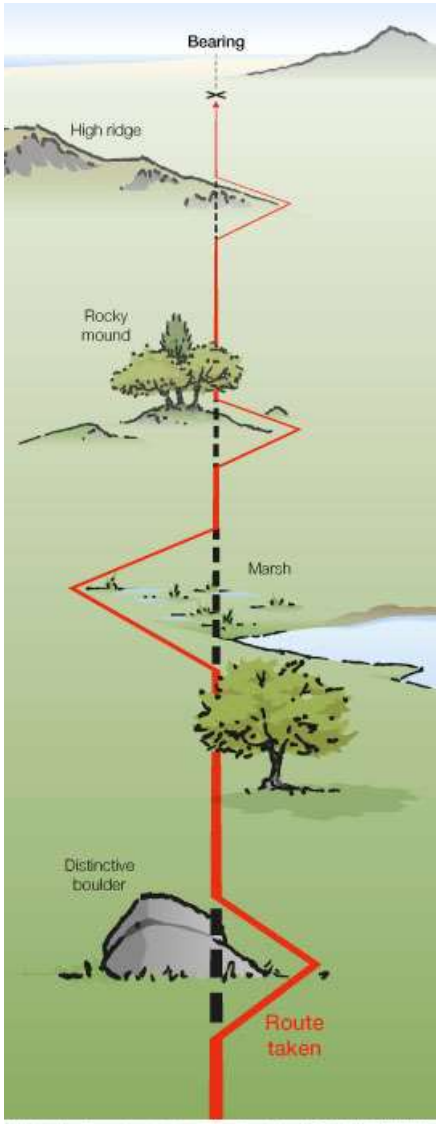


Illustration from 'Navigation in the Mountains' © MTUK/VG 2012

In poor visibility or at night, your field of view is greatly reduced. With this in mind, it is still possible to pick out objects on the ground to walk to. Look for subtle changes on the ground, for example. On Dartmoor, I have used tussocks to walk to on a bearing and even the silhouette of some reeds on a mound. All of which have fallen on my bearing and have been the most obvious reference for me to walk to.

In extreme circumstances, it is possible to use other members of your group to act as these 'objects'. Send a group member out to the limit of communication or sight on your bearing. You still need to be able to see and shout to them. Direct them, left or right and tell them to stop when they are in line with your bearing. They must then remain still, and the group can then walk to them. Repeat the process. This is very time consuming, difficult to maintain timing and pacing and over long distances can become inaccurate. Plus, it separates the group which may compromise the safety of the group.

Transit Points

In good visibility, we can usually sight two points on our bearing that line up. These are called transit points. If walking towards them, they will line up. But if you veer left or right, the two points will move apart and no longer be in line. This is a good method to ensure you walk in a straight line on you bearing. This method enables you to be able to put your compass away and walk on your bearing without having to check it frequently.

Transit points can be any two features that line up perfectly on your bearing line. Examples include (but not limited to):

- Two spot features (A building and a tree / a small pond and a boulder)
- Linear features (A stream or a boundary running directly towards you)
- Spot feature and a linear feature (A stream and a distant rock outcrop)

See below for visual examples:

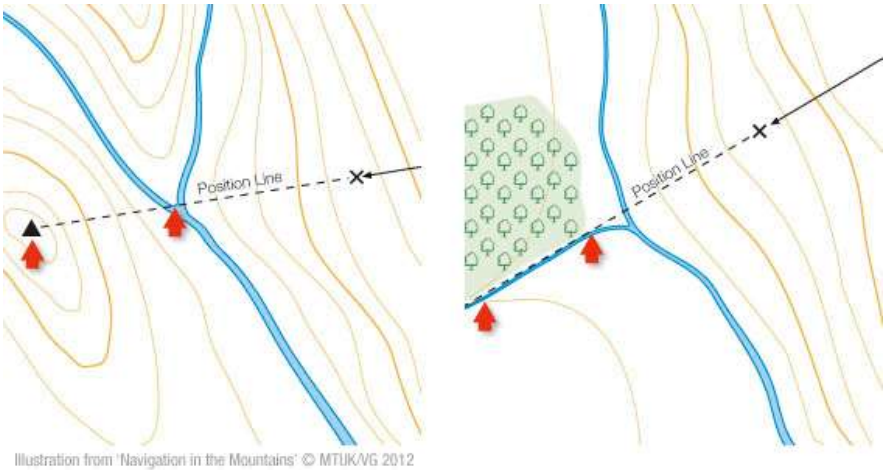
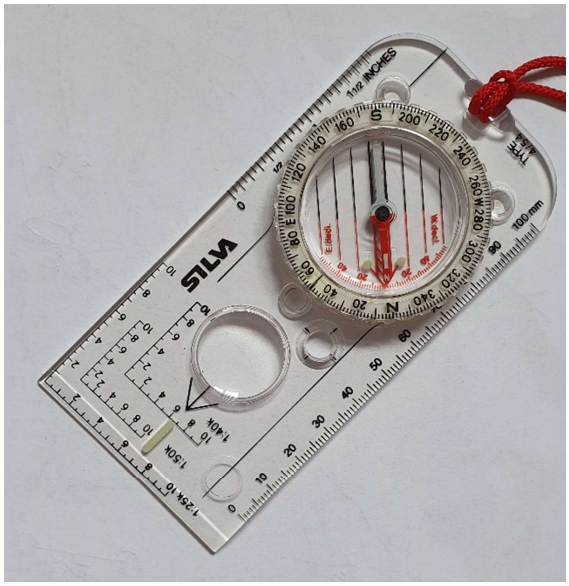


Illustration from 'Navigation in the Mountains' © MTUK/VG 2012

Back Bearings

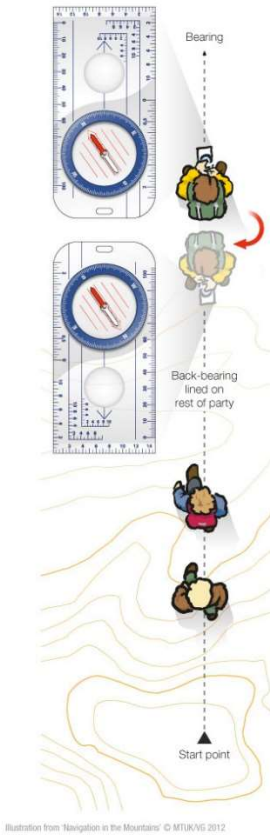
A back bearing can be used to check along the route you have already travelled to ensure you are still walking in a straight line and staying on track. It is useful if you can still see your start point or the last object you walked to on your bearing. For example, if you have just walked from a trig point to a set object on your bearing line, you can do a back bearing on the trig point to see if it is still in-line with your bearing.

The simplest way to take a back bearing is by rotating the compass so that the white south magnetic needle is aligned with the north orienting arrow:



It is possible to add or subtract 180 degrees from you bearing but this involves unnecessary maths and can lead to errors.

If your back bearing doesn't line up with your previous destination, it is possible to turn at a right angle and walk until your bearing lines back up.



There are no questions for this part. The best way to learn walking on a bearing is by practicing outdoors or by attending a navigation course.

End of Part

ADVANCED COMPASS WORK – PART 2.5

Part 5 of my Navigation Techniques section will look at Advanced compass work and how we can use our compass to aid navigation further.

Advanced Compass Work

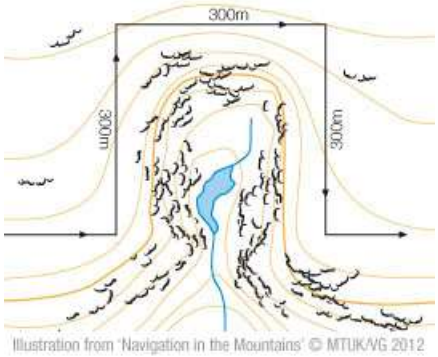


Illustration from 'Navigation in the Mountains' © MTUK/VG 2012

As mentioned before, the compass is a versatile tool for us navigators. Once you have learnt and practiced the basics of compass work, we can then transfer these skills into a more advanced setting, using the compass to aid our navigation further.

The four advanced compass techniques we will look at in this Part are:

- **Aspect of Slope**
- **Aiming Off**
- **Boxing**
- **Attack Points**

Aspect of Slope

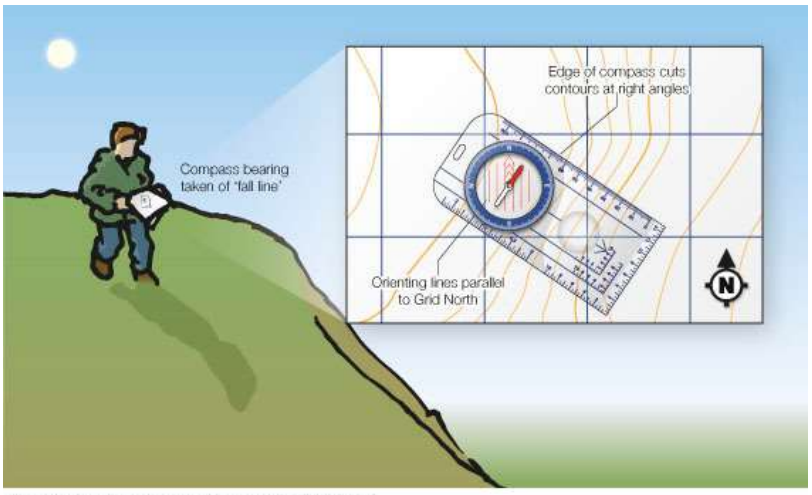


Illustration from 'Navigation in the Mountains' © MTUK/VG 2012

In featureless terrain and in poor visibility, sometimes your only reference is the shape of the slope you are on and the direction it faces. This is known as the slope aspect. Knowing the direction the slope faces can help you relocate your position on the map and pinpoint your position.
To find out the aspect of the slope:

- First, sight a bearing directly down the fall line of the slope. The fall line is an imaginary line that a ball or stone would roll down, straight down the slope.
- The bearing alone will give you an indication of which direction the slope faces. For example, if you sighted a bearing of 210 degrees, you know you are on a slope facing South west. Therefore, you can eliminate all other slope aspects on your map apart from SW facing slopes to help determine your position.
- Once you have taken into account magnetic variation, you can then transfer this bearing to the map.

- Place the compass on the map and rotate the whole compass so the orienting lines line up and are parallel to the Easting grid lines (enduring the north orienting arrow is pointing grid north)
- Making sure you keep the compass in the same position, you can now move the compass across the map.
- When moving the compass across the map, the edge of the compass will cross the contour lines at right angles on any slope with the same aspect as the bearing you have taken. If you know your rough position, for example, if you know what footpath you are on, you can use the aspect of slope to pinpoint your position along this footpath.

When taking the initial bearing down the fall line, you need to ensure that you are taking the bearing down the main slope and not just a small incline as this may confuse the matter.

Aiming off

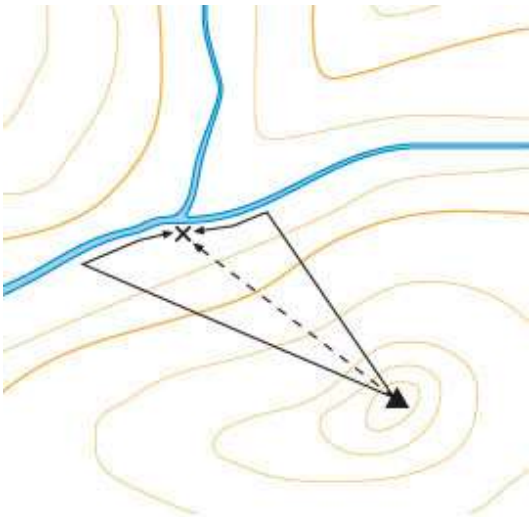
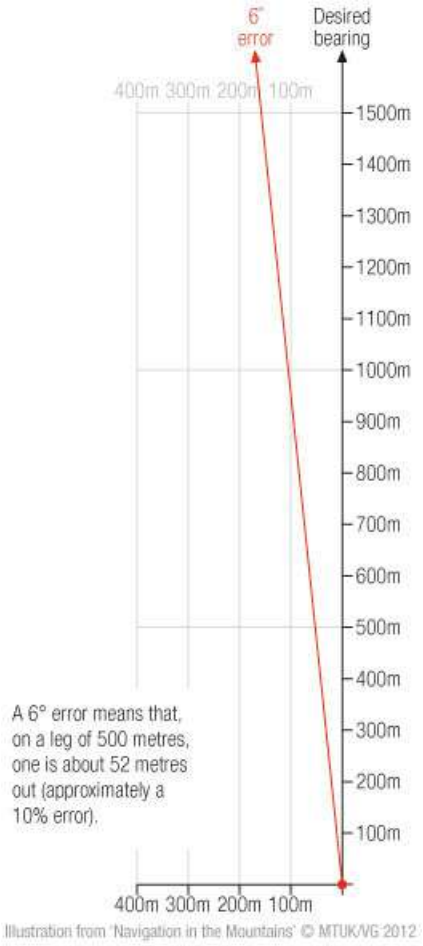


Illustration from 'Navigation in the Mountains' © MTUK/VG 2012

It can be difficult to walk in a straight line on a bearing in poor visibility. With this in mind, if you are walking on a bearing in poor visibility to try and find a footbridge along a stream, it is all too easy to wander off your bearing and miss the footbridge altogether.



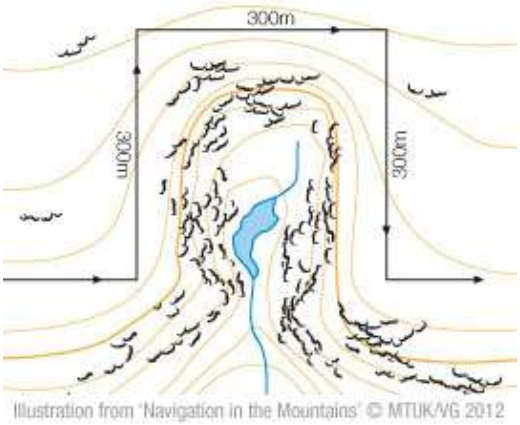
So how do we know whether to walk up or down stream to find the footbridge?

This is where aiming off comes in handy. If we are trying to find a spot feature along a linear feature, we can take a bearing on the spot feature. However, to ensure we can find it and know which way to follow the linear feature in case we miss the spot feature, we aim the bearing slightly off to one side of the spot feature by a few degrees.

In our example, we would aim off a few degrees up stream of the bridge. When we reach the stream, we can then use it as a handrail to walk down stream until we find the footbridge.

Aiming off is useful to find track junctions and other features along a linear feature.

Boxing

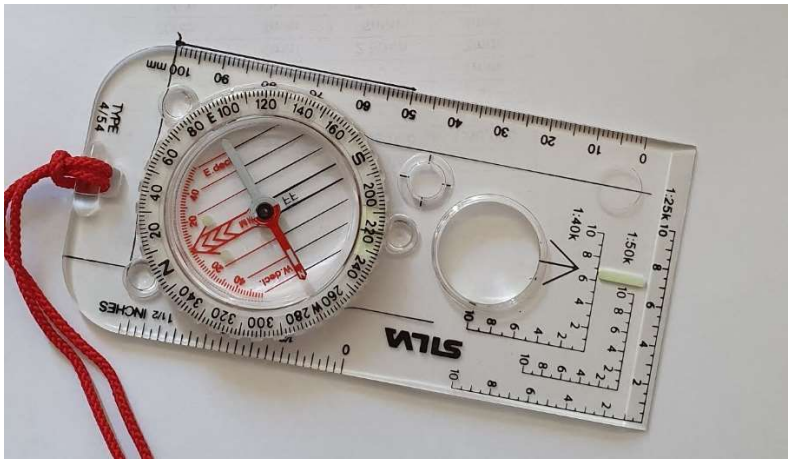


Sometimes, when walking on a bearing, we may encounter obstacles that we have to detour around, such as boggy ground, ponds and lakes or even steep gullies. This detour will take us off our bearing.

Boxing helps us detour around this obstacle but enables us to get back on our initial bearing so as to not to have to change it.

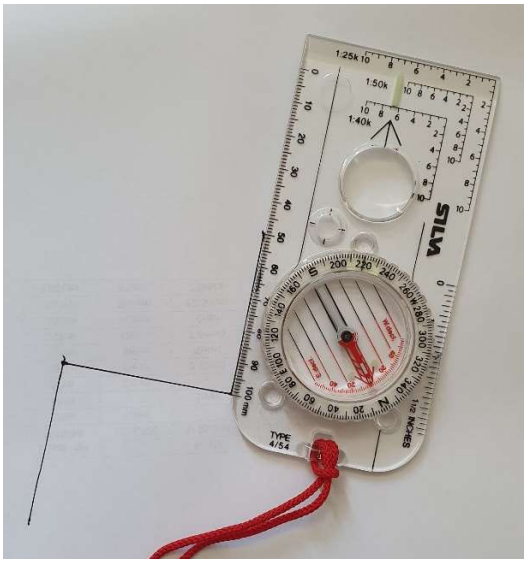
The easiest way to do this is by using 90 degree turns. See the example above.

First, we need to turn at a right angle to our bearing. In the above example, our bearing is 220 degrees. The easiest way to do this without adjusting the bearing is by turning the whole compass so the North-South magnetic needle aligns with the East - West markings on the compass housing. See below:

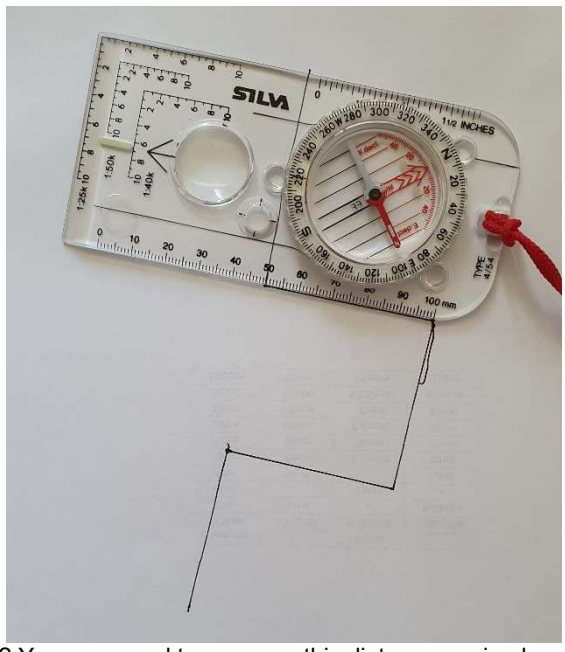


Once we have turned our bearing by 90 degrees, the direction of travel arrow now points us in the direction we need to walk in. We measure the distance along this bearing, using pacing, until we are clear of the obstacle.

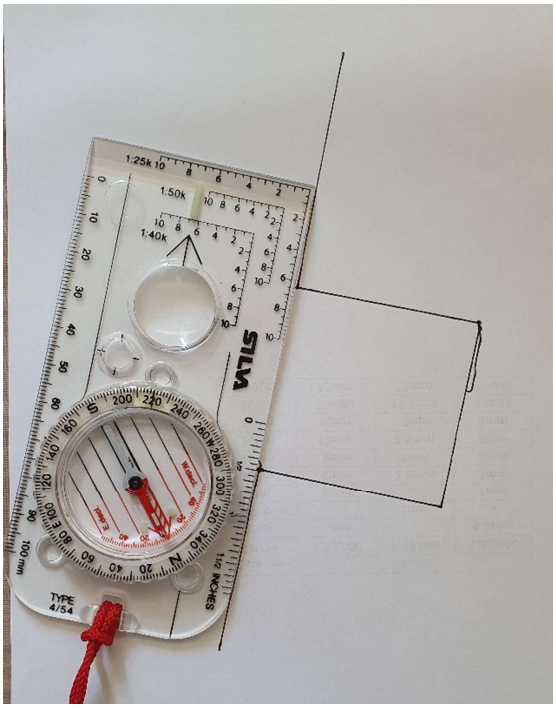
We remember this distance and then continue on our original bearing.



Again, once we are clear of the obstacle, we then turn our bearing 90 degrees using the same method as before. This time in the opposite direction to the first 90 degrees.



Remember the distance you measured? You now need to measure this distance again along this bearing. This will bring you back in line with your original bearing and you can continue along your route.



If you are pacing or timing a distance and you come across an obstacle that you need to box around, you must only add the distance for the side of the box that is parallel to your original bearing, to your total distance. The distances paced on the detours do not count towards your total distance and/or time of your leg. Remember to stop a stopwatch on the detours and restart it when walking only on your original bearing.

Attack Points

When learning navigation techniques, we can refer to two types of navigation styles:

- **Rough Navigation**
- **Fine Navigation**

Rough navigation involves being able to find a large feature easily.

Fine navigation involves lots of micro adjustments and techniques used over a shorter leg to find a feature.

In poor visibility, it may be difficult to find small features, for example a trig point on a large, open summit. It is easier to locate a large, easy to find feature that is close by to the small feature, a few hundred metres away, and use this as an attack point. For example, a boundary or stream junction or a lake/pond.

An attack point uses both rough and fine navigation: Rough navigation to find the attack point, fine navigation to find the actual feature.

See the below example:

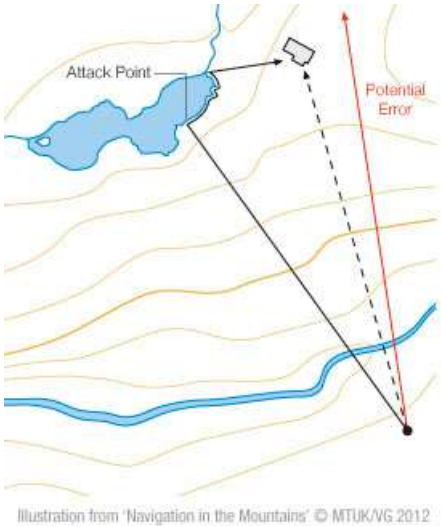


Illustration from 'Navigation in the Mountains' © MTUK/VG 2012

We can use rough navigation to find the lake. A simple bearing to the lake and we walk until we get there. From the lake, we then handrail the shore until we reach the stream that feeds the lake.

We now use fine navigation from this known point to find the small spot feature. We can measure distance, work out timings and take a bearing to this feature.

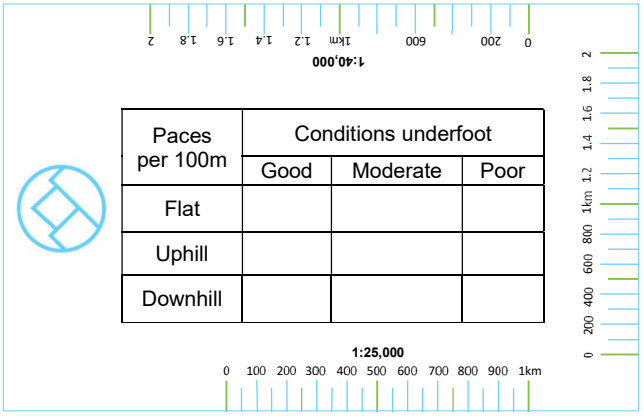
It is important you chose an attack point you can find with rough navigation otherwise it will offer no benefit to you.

End of Part

PRINTABLE RESOURCES

Below are some printable navigation resources to help you answer the questions in this course and to use when out on the ground navigating for yourself. Print this page to ACTUAL SIZE, cut out the resources and laminate them for durability. For the hard copy, cut this page out along the dotted line and cut and laminate the resources.

Speed (kph) (Timings rounded to nearest ½ minute)	2	3	4	5
Distance				
1,000m	30 min	20 min	15 min	12 min
900m	27 min	18 min	13½ min	11 min
800m	24 min	16 min	12 min	9½ min
700m	21 min	14 min	10½ min	8½ min
600m	18 min	12 min	9 min	7 min
500m	15 min	10 min	7½ min	6 min
400m	12 min	8 min	6 min	5 min
300m	9 min	6 min	4½ min	3½ min
200m	6 min	4 min	3 min	2½ min
100m	3 min	2 min	1½ min	1 min
50m	1½ min	1 min	¾ min	½ min



Paces per 100m	Conditions underfoot		
	Good	Moderate	Poor
Flat			
Uphill			
Downhill			

Distance Metres	Scale		
	1:25,000	1:40,000	1:50,000
25m	1mm	-	0.5mm
40m	-	1mm	-
50m	2mm	-	1mm
100m	4mm	2.5mm	2mm
200m	8mm	5mm	4mm
300m	12mm	7.5mm	6mm
400m	16mm	10mm	8mm
500m	20mm	12.5mm	10mm
1000m	40mm	25mm	20mm

RELOCATION PROMPT CARD:

STOP | THINK | OBSERVE | PLAN

1. **WHAT** did I see on the way?
2. **WHAT** can I see around me?
3. **WHAT** can I see if I walk further?
4. **WHAT** other techniques can be used?
5. **WHAT** if I cannot relocate?

THE 4 D's and 5 WHAT's

DISTANCE:……..

DURATION:……

DIRECTION:……..

DESCRIPTION:

WHAT are you going to see en-route?

WHAT are you going to see at the destination?

WHAT will you see if you go too far?

WHAT are the potential hazards?

WHAT are the appropriate skills and techniques to use?