

NAVIGATION

MAP READING WORKBOOK

CANDIDATE DETAILS

Service no.	Rank	Last Name	Initial

**ROYAL
MARINES
CADETS**

PART OF THE SEA CADETS

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My task is to
take you
through this
workbook.

This colour is
for important
reminders

LESSON 1: MAP AWARENESS 1

Maps are a simplified vertical view of the ground reduced in size onto an easily handled piece of paper, showing the outlines of features as they appear from above.

MAP FEATURES:

There are many different types of map, road maps, Hydrographic charts, maps for walkers, aircraft charts, world maps, country maps and street maps. Most military maps are topographic maps.



Topographical maps are general purpose maps showing the shape of the ground and the features on it such as:

Physical Features: These are natural features such as rivers and woods.

Man Made Features: Man made features can be extensive but generally these will be towns and roads.

Relief Information: Relief information shows the shape of the ground, such as hills, valleys, and mountains. The shape of the ground is shown using contours as well as some conventional signs.

TYPES OF MAPS

Royal Marines Cadets are exposed to a wide variety of different maps. The most common map you will encounter will be the 1:25,000 scale Ordnance Survey map:



These maps are used throughout Great Britain by both military and civilians for navigation.

Another type of map that you may come across is the 1:25,000 scale Training Area map:



These maps are only available to the military and are for the sole use of training on specified military training areas. These are larger scale maps that show more detail and include specific information for the conduct of training.

MAP SHEET INFORMATION

Map Identification: Every military map carries a unique method of identification. Military maps are identified by Series, Sheet and Edition. Identification panels are situated in two opposite corners of all military map series.

They contain three elements:

Map Series: Different series are designed to meet different needs in different areas of the world. A series is made up of a number of maps all of the same design.

Sheet Number: Series M726 covers Great Britain and consists of 204 different map sheets.

Edition: Individual maps are updated from time to time. When this happens, the third element, the edition number of the map, is changed. The user should always use the current edition. This is the map with the highest edition number.

To correctly identify a map, quote the Map Series, Sheet Number and Edition.

Important Map Information. Before using any map effectively there are five important pieces of information that you should know. These are known by the acronym **DVAGS**

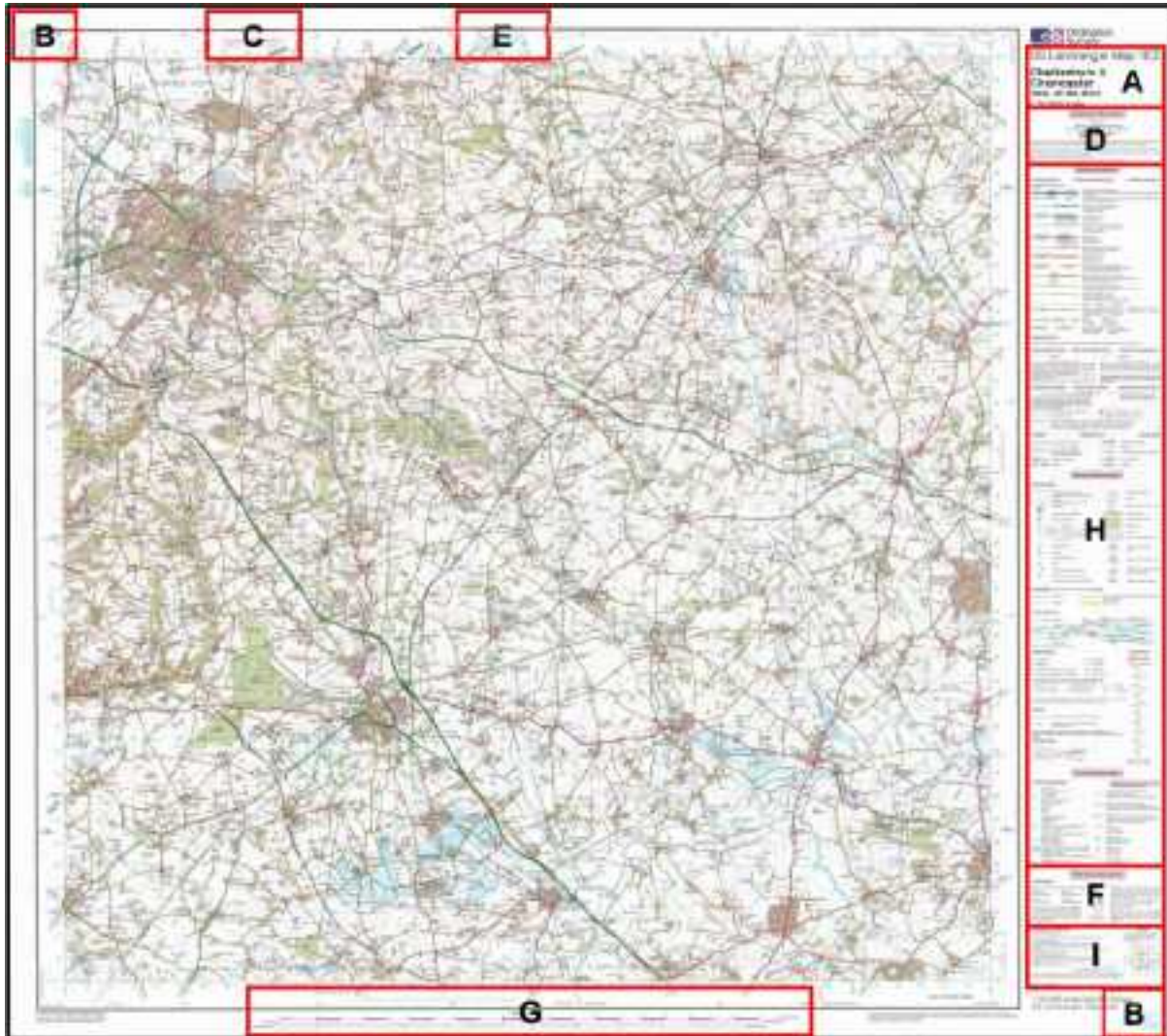
DATUM:	With the increasing use of handheld GNSS receivers as an aide to Land Navigation, it is important to identify both horizontal and vertical datums from the map sheet. This information must be entered/selected on the GNSS receiver in order to use the instrument with the map. For example, on Landranger series of Ordnance Survey Mapping the horizontal datum is the Ordnance Survey of Great Britain 1936 (OSGB36), and the vertical datum is Mean Sea Level (MSL) Newlyn. This information can be found within the marginalia of the map.
VERTICAL INTERVAL:	Also known as the contour interval is the difference in height between successive contours. If the contour interval is high, this usually indicates steep ground. What is the contour interval on your map?
AGE:	If you have an old map you must be aware that some of the features on the ground may have changed: Buildings or tracks shown on your map may not be on the ground any more, or newly constructed buildings or roads may not appear on your map.
GMA:	This is located at the top of the map and is also located in the technical information on the right of the map.
SCALE:	The scale of your map is the ratio of the map to the ground. The most common map used by the RMC has a scale of 1:25,000.

What does this mean to you?
 1cm on the map = 25,000cm on the ground (0.25km)

MAP MARGIN INFORMATION

Important information is contained around the map. However, neither the layout, nor the items of information will always be the same and they may vary with different editions and different series of maps.

The arrangement described and illustrated, is that of the M726 series of the Ordnance Survey 1:50,000 maps of Great Britain.

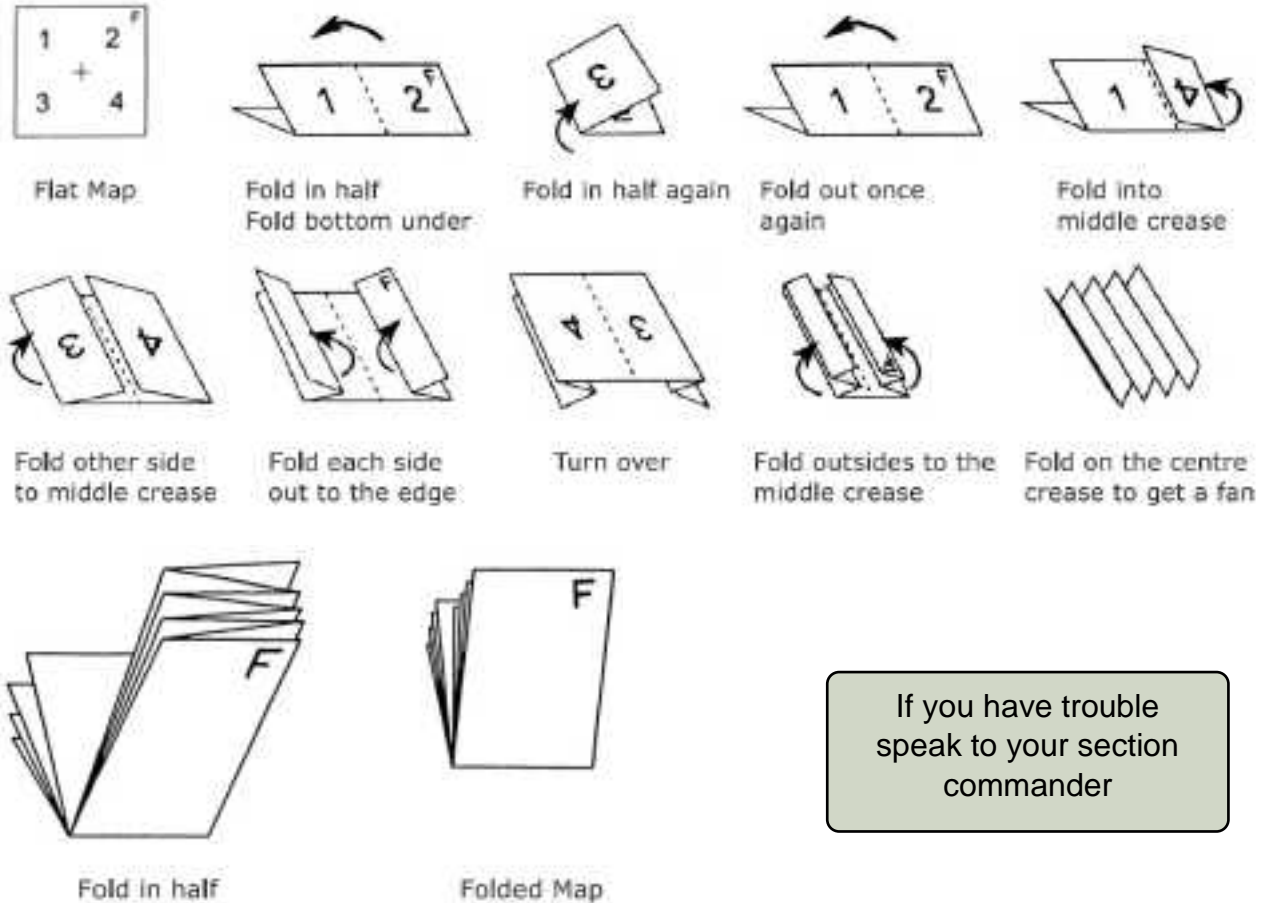


- A. Map title
- B. Series, Sheet and Edition Box
- C. Vertical (Contour) Interval
- D. Information on map age
- E. Grid magnetic angle (GMA) and annual change information
- F. Detailed Grid magnetic angle (GMA) and annual change information
- G. Scale Lines
- H. Map legend showing all conventional signs (symbols) used.
- I. Information on how to take a grid reference.

See how much of this you can memorise as it will come in handy later

CARE OF MAPS

Folding a map will help keep it clean and make it easier to use. If the map is correctly folded to fit into a pocket, then its life can be extended considerably. Use the following diagram and fold the map:



If you have trouble speak to your section commander

Once folded you can see that the map has been designed to fold easily into a convenient size with the cover out most. You need to keep your map as clean as possible and not obscure it by writing all over it. Follow these guidelines

- Prevent it from getting wet and dirty; this will extend its life
- Keep any markings or drawings on the face of the map to a minimum
- Fold the map correctly to help reduce wear and tear

NOTES

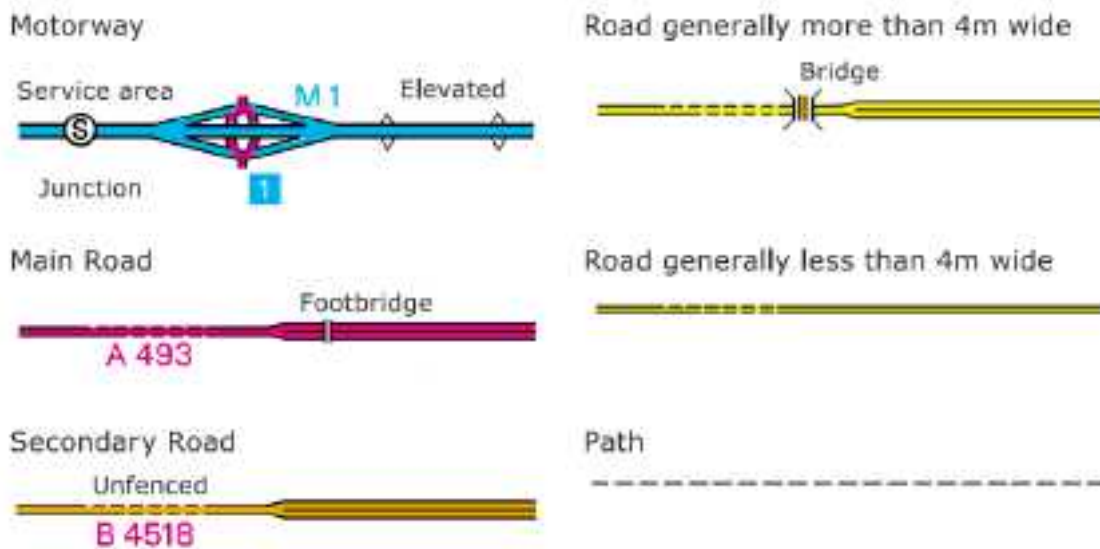
A series of horizontal dotted lines for writing notes, spanning the width of the page below the 'NOTES' header.

LESSON 2: MAP AWARENESS 2 CONVENTIONAL SIGNS

A map is a birds-eye view of the ground, drawn on paper. It is not possible to draw all ground features exactly to scale on the map. That is why conventional signs are used. Map symbols (Conventional Signs) are icons like you see on some computer games placed onto the map so you can find them. Look at the right-hand edge of your map and find this 'legend'. It is important to remember most conventional signs. These are divided into five main groups

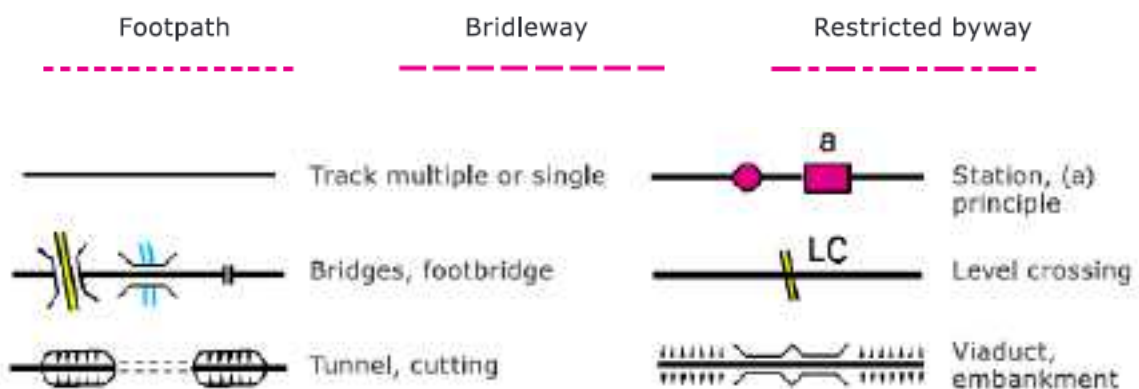
LINE SYMBOLS:

Roads and Paths (not necessarily rights of way)



When you look at a map for the first time your eyes are drawn to the sine symbols. Roads are shown according to their classification; this is not always obvious on the ground.

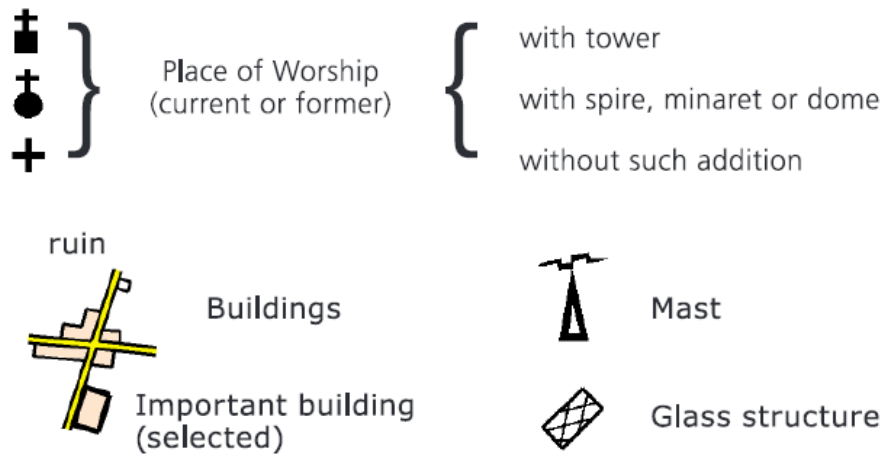
Public Rights of Way (PRoW)



Railways

Railways are indicated using a black line. Associated features such as bridges, cuttings and embankments will help identify specific points along the railway.

BUILDINGS:

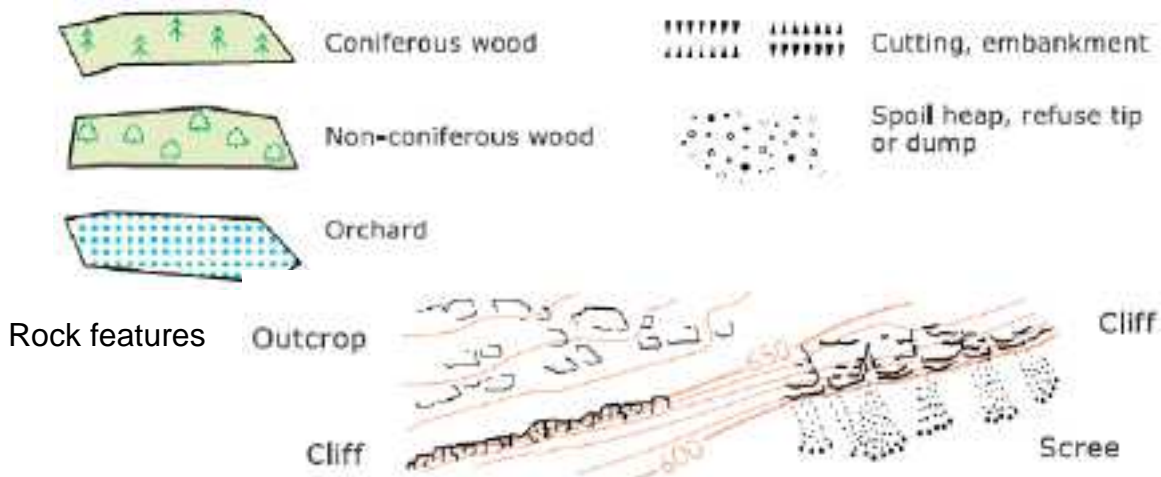


Most buildings are shown by a symbol or a plan of their position. Places of worship are important as they are easily identified and are often tall structures which can be seen from a long distance.

Built up areas are shaded because there is not enough room to show individual buildings

Notice there are 3 different types of places of worship. The grid reference is given from the centre of the square or circle

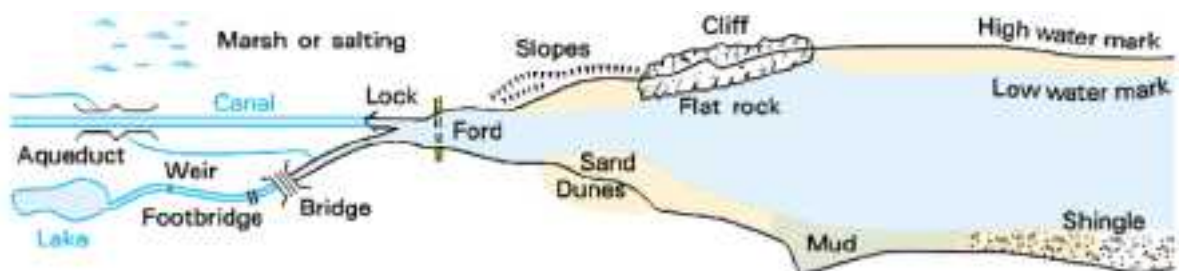
TREES & LANDSCAPE:



Apart from roads and towns, much of the colour on your map represents different kinds of woods. Single trees or thin rows of trees are not shown, even though they may be important on the ground because they may block your view or provide cover. Areas of trees less than 100 metres square are not normally shown, unless they are significant - a lone clump of trees for instance.

The shape of the ground is shown by contour lines which are the brown wavy lines all over the map. Other features such as rock outcrops, cliffs and scree, are shown in black.

WATER FEATURES:



Have a look at the symbols which represent water, such as streams, rivers and lakes as well as various coastal features. Notice the difference in the width between rivers and streams. Water is particularly important because it can be both an obstacle to military movement and a good navigational tool

ABBREVIATIONS & WORDS:

CH Clubhouse

P Post Office

PH Public house

MS Milestone

Danger Areas

Firing and test ranges in area

During your lesson it was said that conventional signs are a form of shorthand. This is true but where diagrams or symbols cannot be used, either words in full (Danger area) or abbreviations (PH) are used to provide additional information.

NOTES

Handwriting practice lines for notes, consisting of 28 horizontal dotted lines.

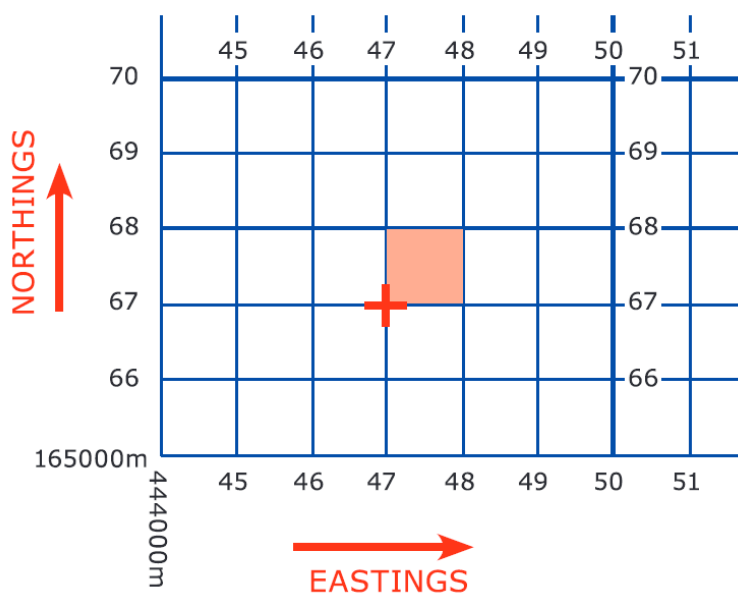
LESSON 3: GRID REFERENCES

THE GRID SYSTEM

Grid Lines A series of horizontal and vertical lines that criss-cross and form the Grid Squares.

Grid Squares These are a series of squares that form a matrix, which is overlaid on the map.

Four Figure Grid References. A four-figure grid reference is made up from the two-figure easting followed by the two-figure northing and is the point where the lines cross. A four-figure grid reference identifies the south-west corner of the one-kilometre square east and north of where the lines cross.



REMEMBER!
Along the corridor
and up the stairs

**4 Figure
Grid
Reference**

47 67

A four-figure grid reference can be given when giving a general feature or when a feature is the only one in that grid square.

In this example a four-figure grid can be given for the village of Patrington, at grid 3122.

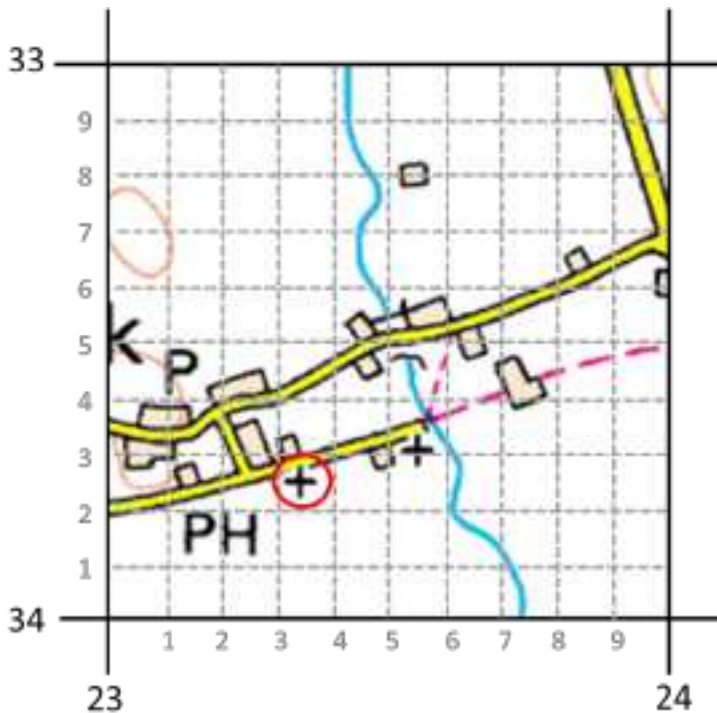
A four-figure grid could also be used to identify the windmill circled at grid 3021 as it is the only windmill in that grid square.

This method, however, would be no use trying to identify a place of worship without additions in grid 3122 as there are three of them.



Six Figure Grid References

In the case of identifying a specific feature we need to use a six-figure grid reference. This is done by splitting the grid square down into a further ten divisions east and north:



**6 Figure
Grid
Reference**

233 342

In this case we have split grid square 9084 further, helping us identify the place of worship without additions from the other.

BRITISH NATIONAL GRID (BNG) REFERENCE

The numbers of a grid reference are repeated every one hundred kilometres in each direction. On M726 maps the BLUE GRID LETTERS in each corner of the map refer to the 100-kilometre square for that area. Each 100-kilometre square has different grid letters.

This map (sheet 163) lies over the join of four of these 100 kilometre squares, so has four different 100km grid letters on the map.

To give a British National Grid (BNG) grid reference you must give the correct 100km grid letters before the figures.

ROMERS

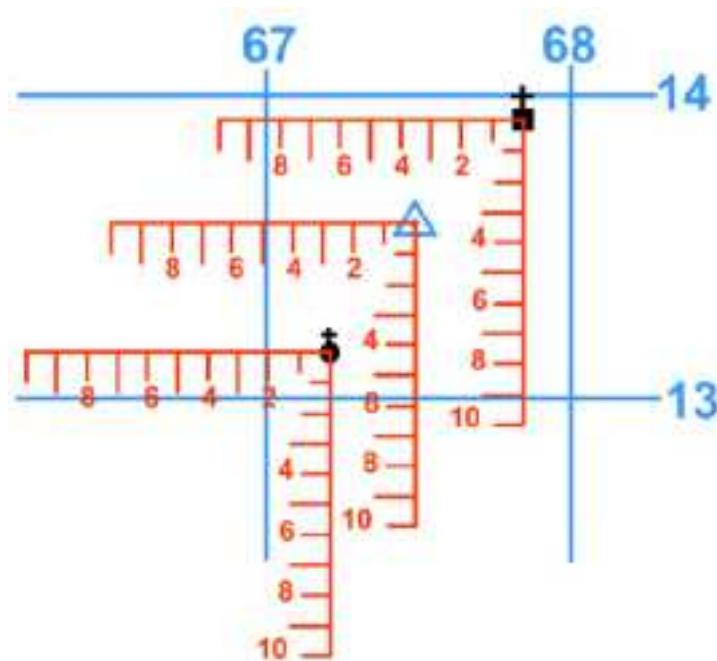
Targets and features can be identified very quickly using 4 and 6 figure grid references. Make sure to practice on your map.

To help give a grid reference we can use a romer. A romer is a tool that can be placed over the map giving the user graduations at the correct scale to give an accurate grid reference. You have Romers on a lightweight compass.





To use a romer, place the corner on the feature and read the final figures of eastings and northings against the scale. In all cases the figure is rounded DOWN to the lower value.



In the examples above we can see that the trig pillar is at grid 674135 and the church with tower is at grid 678139. If we look closely at the romer used on the trig pillar we can see that the blue grid line for the easting lies between the 4 and 5 of the romer and is in fact very nearly 5, but not quite therefore giving us a reading of 674. The grid line going north cuts between the 5 and 6 on the romer giving us a reading of 135.

BRITISH NATIONAL GRID (BNG)

At the bottom of every Ordnance Survey map legend is a guide on how to give a full British National Grid (BNG) grid reference.

HOW TO GIVE A NATIONAL GRID REFERENCE TO NEAREST 100 METRES

SAMPLE POINT: Upper Urquhart

1. Read letters identifying 100 000 metre square in which the point lies **TO**
2. **FIRST QUOTE EASTINGS**
 Locate first **VERTICAL** grid line to **LEFT** of point and read **LARGE** figures labelling the line either in the top or bottom margin or on the line itself **19**
 Estimate tenths from grid line to point **0**
3. **AND THEN QUOTE NORTHINGS**
 Locate first **HORIZONTAL** grid line **BELOW** point and read **LARGE** figures labelling the line either in the left or right margin or on the line itself..... **08**
 Estimate tenths from grid line to point **1**

SAMPLE REFERENCE **TO 190 081**

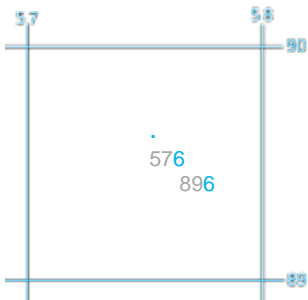
For local referencing grid letters may be omitted

MILITARY GRID REFERENCE SYSTEM (MGRS):

The Military Grid Reference System (MGRS) is a worldwide grid reference system used throughout Europe and on all operational mapping but NOT in Great Britain or Ireland.

The MGRS has three parts. The first is the Grid Zone Designation (GZD), this defines the part of the world being referenced and consists of a number between 1 and 60 and a letter. The second part is the 100 km letters. These are similar to and work in the same way as the 100 km letters in the British National Grid. The third part is the figures of the grid reference, which again work in the same way as in the British National Grid.

On the map you will find a guide in the legend, much like that on the Ordnance Survey map, that will give you a guide on how to give an MGRS grid reference as well as the GZD and 100km letters to be used.

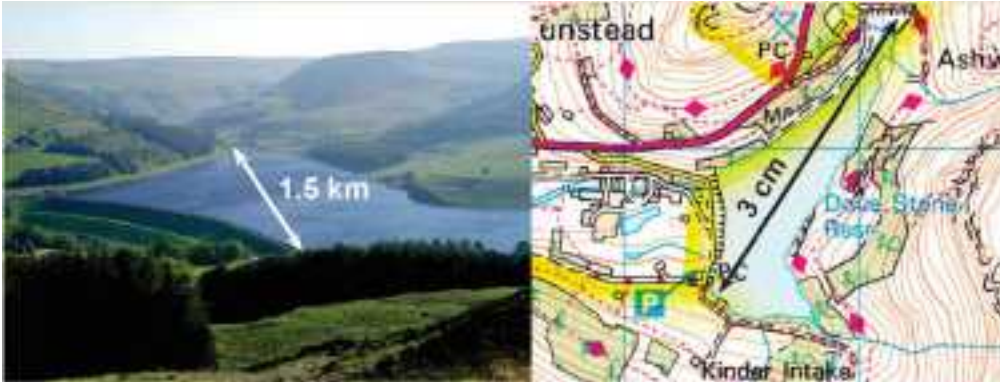
	<p style="text-align: center;">100 METRE REFERENCE</p> <ol style="list-style-type: none"> 1. Read large numbers labelling the VERTICAL grid line left of point and estimate tenths (100 metres) from grid line to point 57 6 2. Read large numbers looking the HORIZONTAL grid line below point and estimate tenths (100 metres) from grid line to point: 89 6 <p style="text-align: center;">Example: 576896</p>
<p>100,000M SQUARE IDENTIFICATION</p> <p><u>QR</u> QQ</p>	<p>WHEN REPORTING ACROSS A 100,000 METRE LINE. PREFIX TILE 100,000 METRE SQUARE IDENTIFICATION IN WHICH THE POINT LIES.</p> <p style="text-align: center;">Example: QQ576896</p>
<p>GRID ZONE DESIGNATION</p> <p>41R</p>	<p>WHEN REPORTING OUTSIDE THE GRID ZONE DESIGNATION AREA. PREFIX THE GRID ZONE DESIGNATION.</p> <p style="text-align: center;">Example: 41ROQ576896</p>

NOTES

A series of horizontal dotted lines intended for writing notes.

LESSON 4: SCALE & DISTANCE

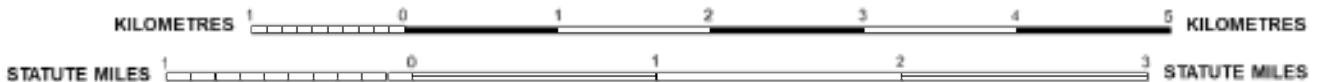
Scale is the relationship between the distance on the ground and the distance on the map. E.g. if the distance on this map is 1/50,000 of the distance on the ground.



- 3cm on the map represents 150,000cm on the ground
- Or 1500m
- Or 1.5km

Scale can be expressed in 4 ways:

- As a ratio e.g. 1:50,000 or 1 to 50,000
- By a scale line



- As a fraction e.g. $\frac{1}{50,000}$ or $\frac{1}{50,000}$
- In words e.g. 2cm to 1km or 2cm equals 1km

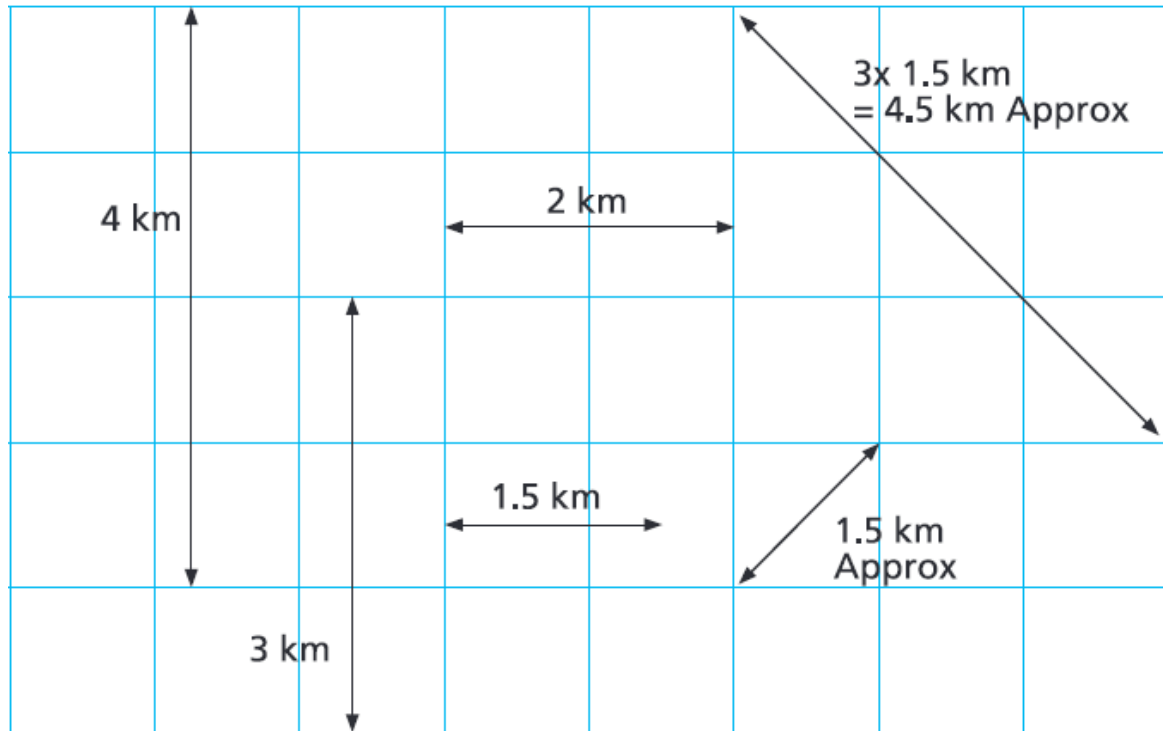
On different scales of map grid squares will represent differing distances:

- 1:50,000 map - Each grid square measures 2 cm and represents 1 km on the ground.
- 1:25,000 map - Each grid square measures 4 cm and represents 1 km on the ground.
- 1:100,000 map - Each grid square measures 1 cm and represents 1 km on the ground.

If we were to measure 8cm on a 1:50,000 map what would the equivalent ground distance be? 4km

ESTIMATING DISTANCES

Estimating the straight-line distance on a 1:50,000 map is easy if you use the grid as a reference.



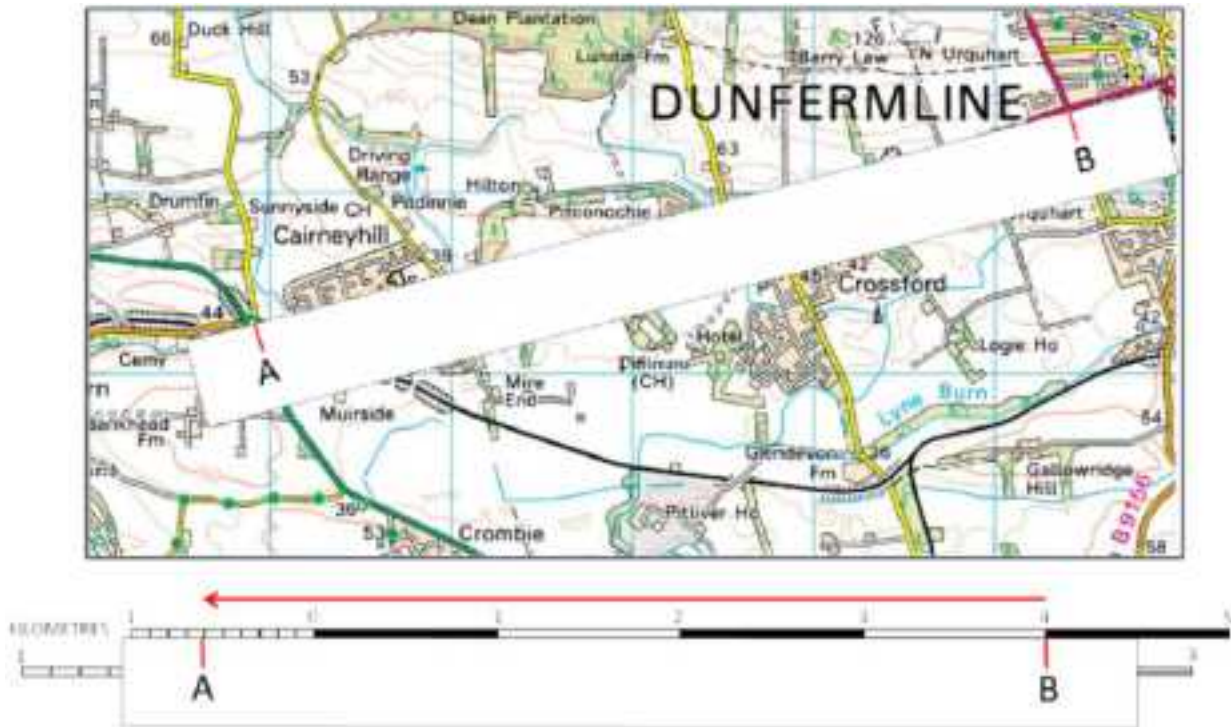
One grid square is 1 Km (no matter the scale of the map) therefore a line along 3 grid squares will be 3Km. The approximate distance across the corners of a grid square is 1.5Km. Knowing these distances can help you work out approximate distances on routes.



Looking at the route on the above map extract we can quickly work out an approximate distance. The first part of the route is about a diagonal of a grid square: 1.5 km. The second part is around 2 squares i.e. 2 km and the last part is 3 grid squares long: 3 km, therefore the route is approximately 6.5 km long.

MEASURING STRAIGHT LINE DISTANCES

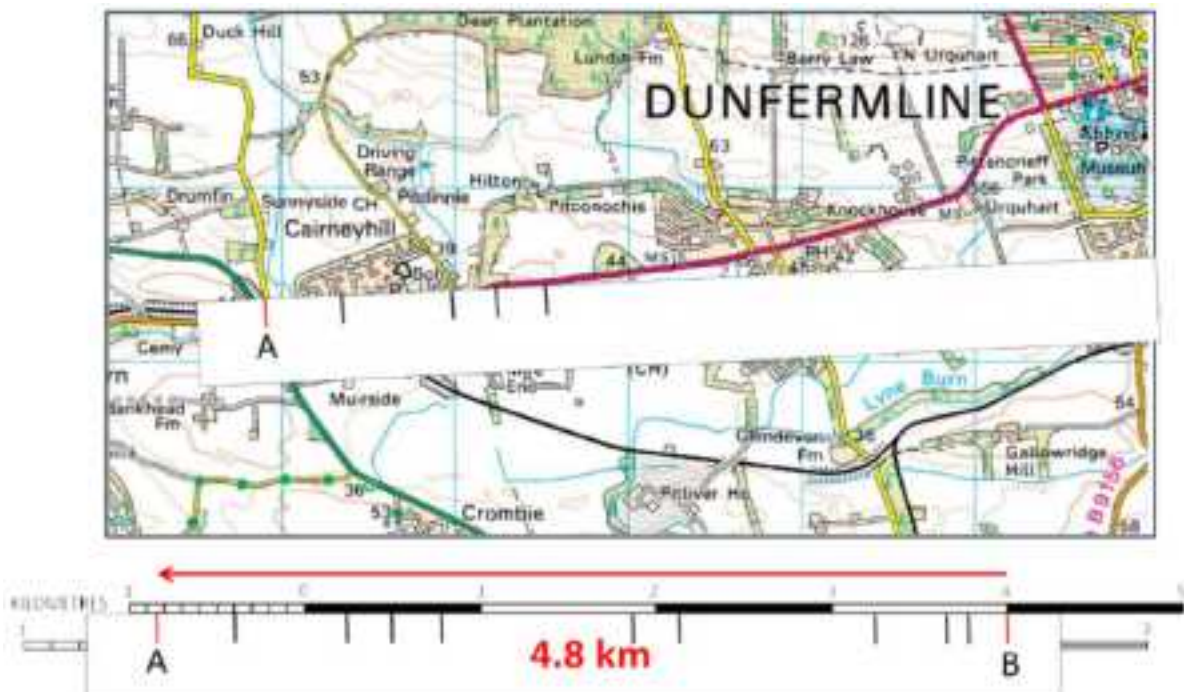
It is very easy to measure the straight-line distance (as the crow flies) on a map. All you need is a piece of paper and the use of the scale bar at the bottom of the map.



In this case the straight-line distance between A and B is 4.6Km.

MEASURING INDIRECT DISTANCES

When we measure an indirect distance, we are measuring the distance following a particular route or set of routes. Again, we make use of the scale bar and a piece of paper. We would carefully follow the route marking our piece of paper as we turned the curves of the route (as shown in the lesson). Then we would measure this against the scale bar.



In this case the indirect distance between point A and B is 4.8Km

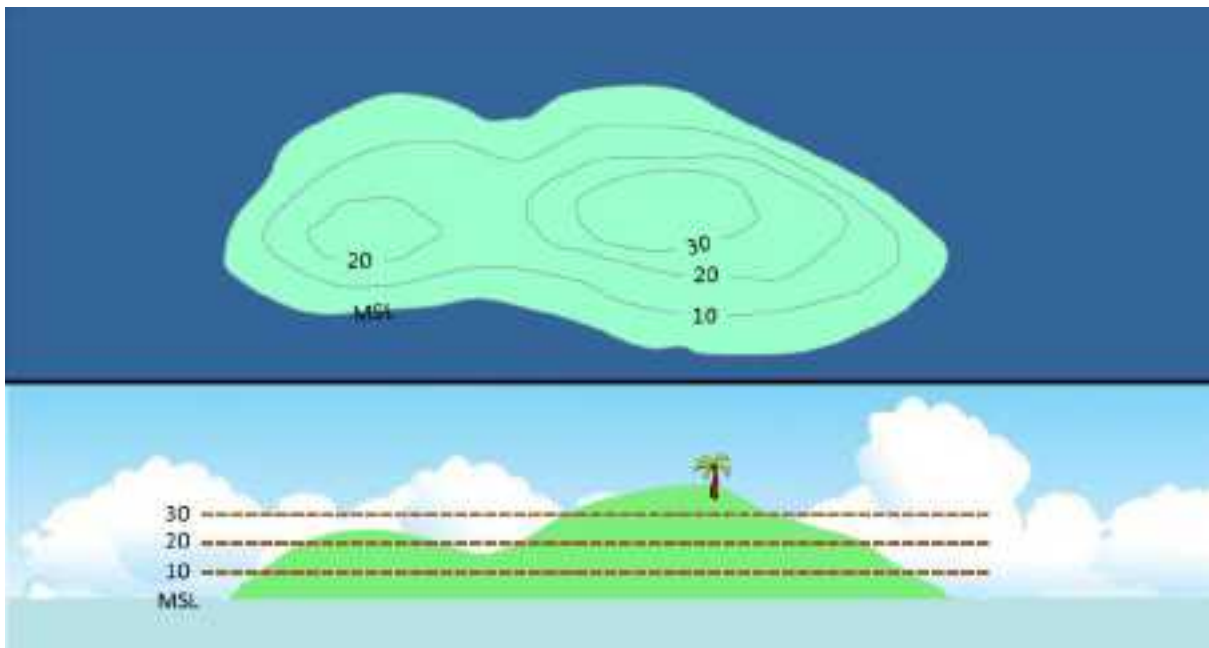
LESSON 5: CONTOURS & RELIEF

CONTOURS:

What is a contour?

The definition of a contour is - a line drawn on a map joining all points of equal height above mean sea level.

Careful examination of contour lines will reveal both the slope and the shape of the ground. If you walk along a contour line you neither gain nor lose height, remembering that contours do not exist on the ground - only on the map



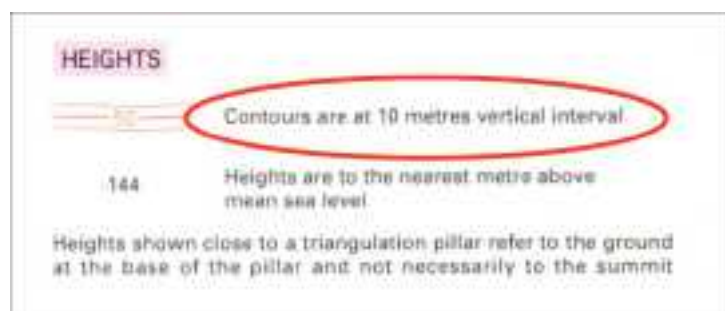
The difference between successive contours is called the Vertical Interval (VI) or Contour Interval (CI).

All maps have the Vertical Interval clearly shown in the margin.

The difference in height between each contour line on Series M726, 1:50,000 maps is 10 metres.

You will see that heights on this map are in metres and that the contour interval is 10m

This information can also be found in the legend.

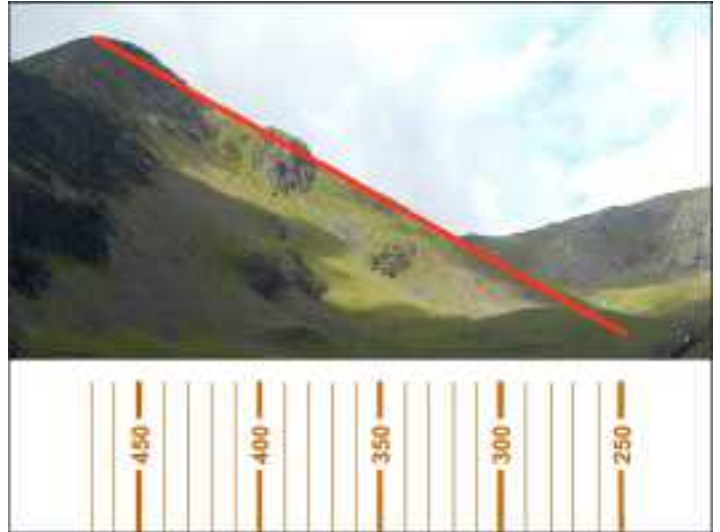


CONTOUR SPACING:

When examining contours on a map to identify the relief we can look at the contour spacing, this will show us the type of slope and how steep it is. We can also examine the values of the contours and look for the thick contour lines (index contours) to judge the steepness of the slope. The index contours will be the only contours with values shown. That will be every 50m on a UK 1:50,000 map. Each primary contour (thin brown contours) represents a further 10m.

Even Slope

A slope with a steady and even climb.
Contour spacing is equal up the slope.



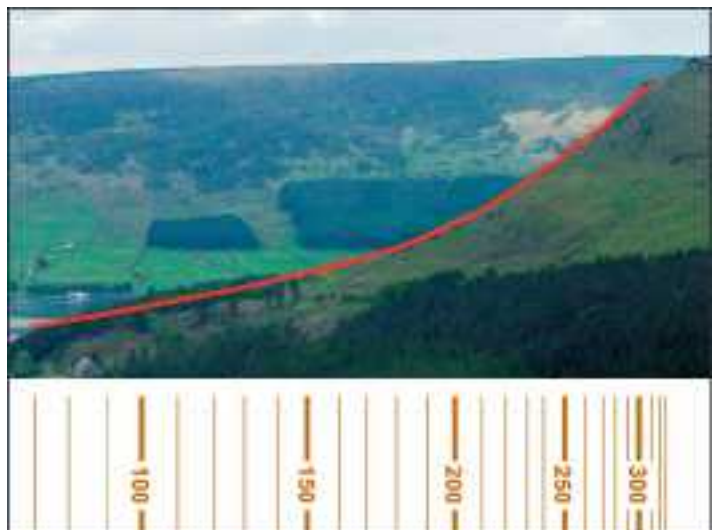
Convex Slope

A slope that begins steep and evens out towards the top.
Contour spacing is close together at the bottom and gets wider apart as you go up the slope.



Concave Slope

A slope that becomes steeper nearer the top.
Contour spacing is wide at the bottom and gets closer together as you go up the slope.



CONTOUR SHAPE

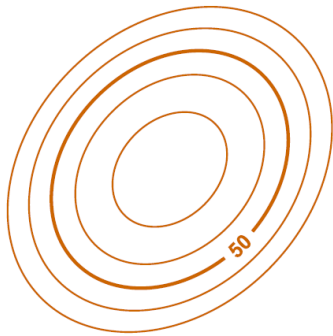
When examining contours on a map to identify the relief we can look at the contour shape, this will show us the physical features.

Physical features are defined by what we call KEY CONTOUR PATTERNS.

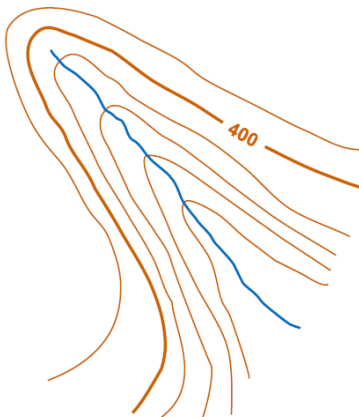
Each type of feature can be defined by a basic pattern.

Round, Conical, Flat & Irregular Top Hills

Hills with a distinctive shape to their top.

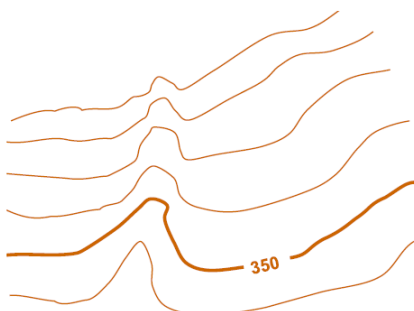


Valley



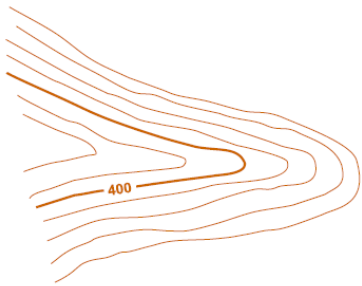
Re-Entrant

A small depression in a slope or a small valley



SPUR

A finger of higher land sticking out into lower ground.



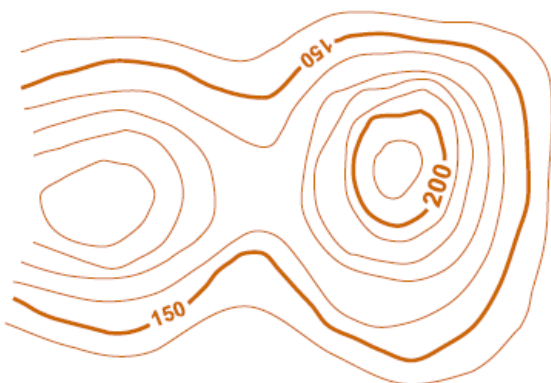
Ridge

Long narrow hill, or series of linked hills.



Saddle, Col or Pass

Low point between two hills



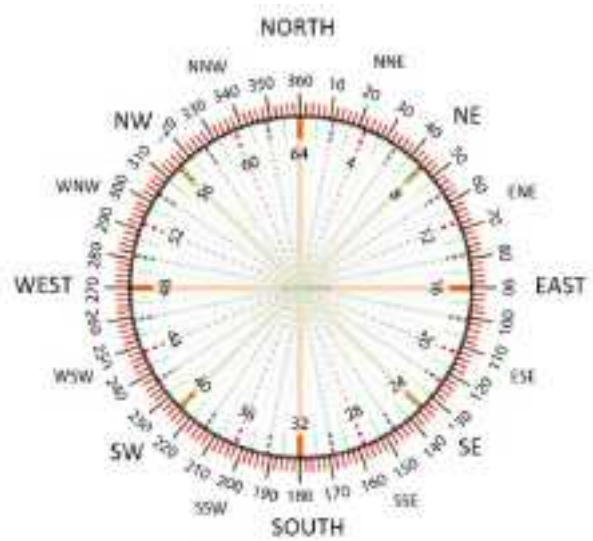
It is important to identify these features. Why go up a hill when you can go around it?

LESSON 6: DIRECTION & BEARING

DIRECTION

A bearing in its simplest form provides us with a direction. Whether using cardinal points (North, East, South, West), degrees (360° to a circle) or what we use within the Royal Marines Cadets Mils (6400m to a circle)

- We use Mils because they offer a way to be considerably more accurate to the alternative 1 ° is equivalent to 17.78mils
- The use of mils started around WW1 by Artillery units as a solution to being more accurate over great distances
- There are 6400mils in a circle



TYPES OF NORTH

There are three types of North that you should be aware of, know what they can tell us and in what situations they should be used

- True North,
- Magnetic North
- Grid North

TRUE NORTH: is the direction from where you are standing to the geographic North Pole.

GRID NORTH: This is a concept that we invented to make maps make sense, rather than a fixed location because the world ISNT flat, but we need a fixed point that doesn't change on a map to use as our starting point for taking bearings. Here you can see the north south grid lines of a map (Eastings), grid north is defined by the direction of the north pointing grid lines on a map. A grid bearing is any bearing measured clockwise from grid north

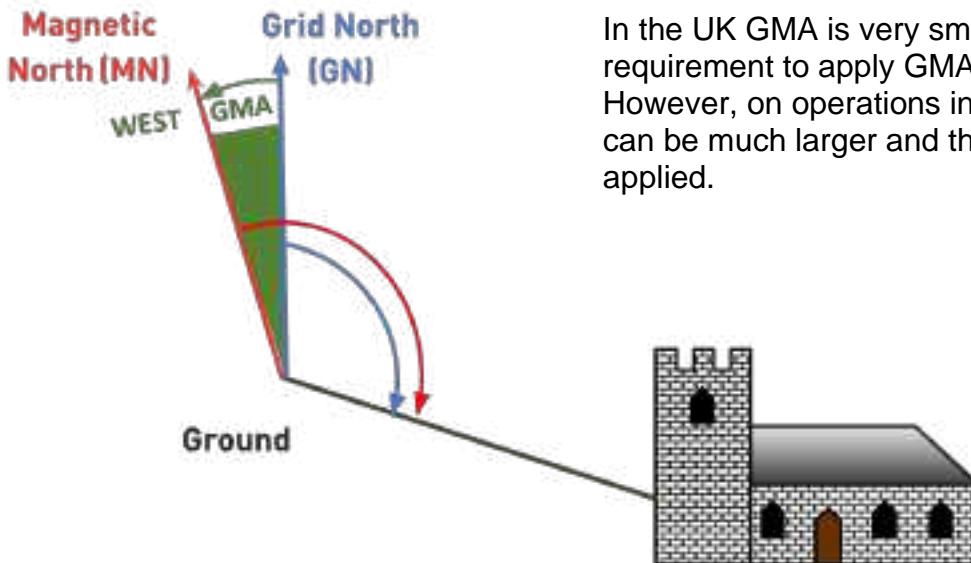


MAGNETIC NORTH: is defined as the north end of the world's magnet. The red end of the compass needle points to magnetic north. Therefore, it is measurable on the ground

GRID MAGNETIC ANGLE

The difference between Grid North and Magnetic North is termed the GRID MAGNETIC ANGLE or GMA for short. This is a number of Mils that we either need to add or subtract to change between Grid North and Magnetic North

Notice that GMA is measured from Grid North to Magnetic North. GMA is expressed in mils and can be either be West or East (of Grid North). Since grid bearings and the magnetic bearings are different, in order to plot a magnetic bearing on a map or use a grid bearing to locate a feature on the ground, GMA would need to be calculated and applied.



In the UK GMA is very small and therefore there is no requirement to apply GMA for navigational purposes. However, on operations in other parts of the world GMA can be much larger and therefore would need to be applied.

How to Figure Out GMA

This is the golden rule for applying GMA

GMA WEST

- 'Grid' to 'MAG' Add
- 'MAG' to 'GRID' Get Rid

GMA EAST

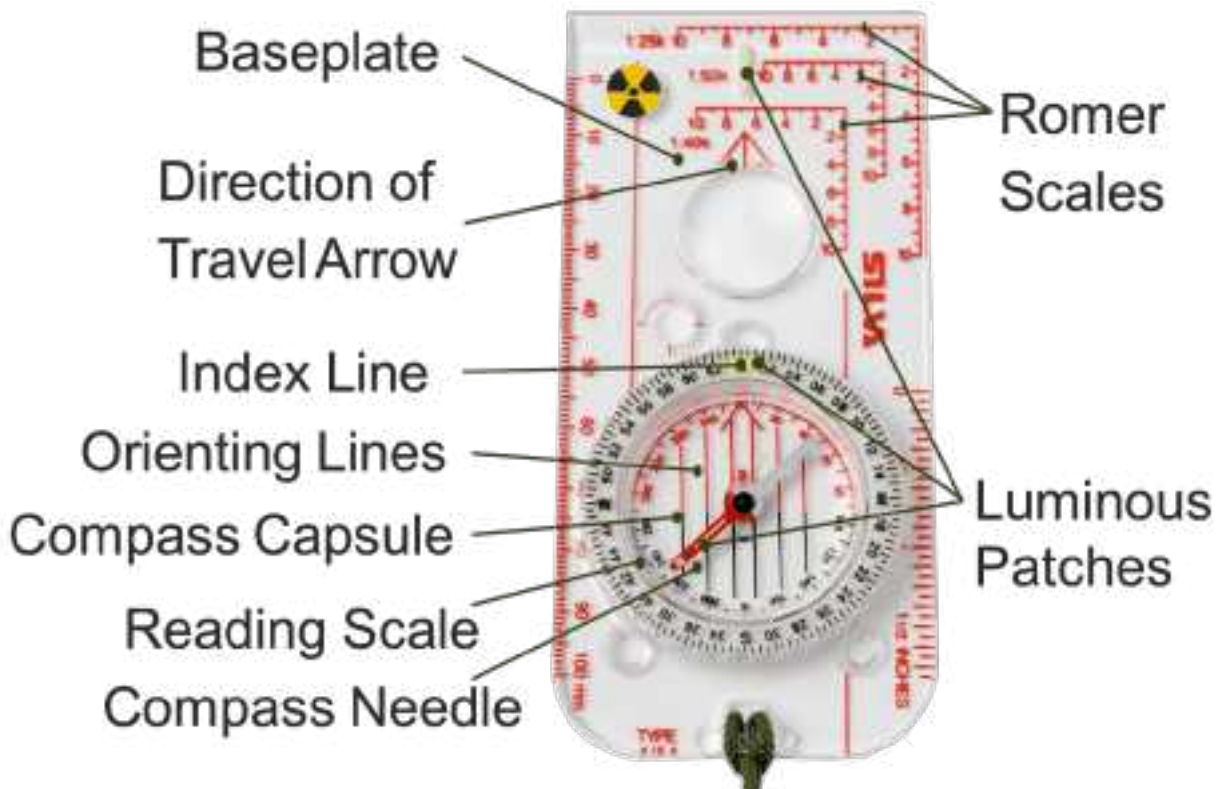
- 'GRID' to 'MAG' Get Rid
- 'MAG' to 'GRID' Add

- As of 2014, for the first time in 350 years in Great Britain, we'll see the direction of Magnetic North move from being West of Grid North to East of Grid North (this was in the far depths of Cornwall)
- On the map you can identify if Magnetic North is Grid North. It will take approximately 20 years for the rest of the country to see Magnetic North change from being West to East of Grid North.
- By 2034 GMA over the entire of Great Britain will be East.



LESSON 7 THE LIGHTWEIGHT COMPASS 1 MAGNETIC BEARINGS

EVERY Royal Marines Cadet should be able to take bearings and that starts with being aware of all the relevant parts of the lightweight compass



Try to remember all these parts. Each is as important as the others

When using the lightweight compass, we must try to negate the effects of ferrous metals, if we don't then our bearings taken from the compass could be wrong. Metal objects effect the compass needle by interfering with the magnetic pull of magnetic north.

Being soldiers we are surrounded by metal objects such as vehicles, fences, power plants, signals equipment and, of course our weapons. Even small objects such as watches, or glasses can have an effect. To try and negate these effects we must try and stay a set distance from these objects:

Heavy armour	50m
Soft skin vehicles	20m
Radios	5m
Wire fences	3m
Small metal objects	1m

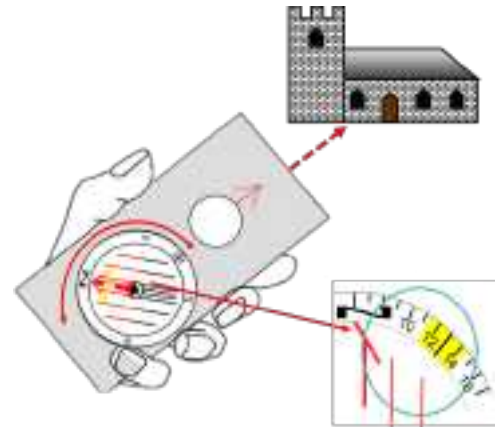
The Compass is an essential tool for the navigator

- 1. Treat is with respect**
- 2. Look after it like your life depends on it**
- 3. Trust it**

TAKING A MAGNETIC BEARING

This could be needed when on the ground to determine the direction from you to an object or to confirm you are indeed where you think you are relative to an object

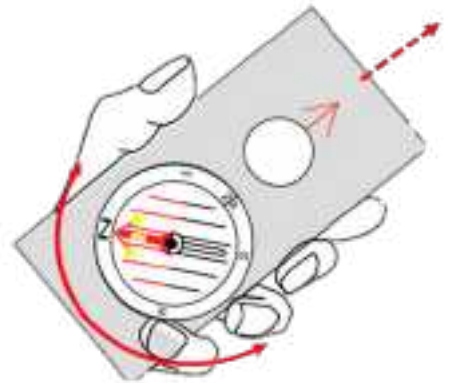
1. Hold compass flat
2. Point the direction of travel arrow at the location you want to take the bearing to
3. Rotate the compass capsule until the compass needle aligns with the red arrow/orientating arrow "Red on Red"
4. The number on the compass capsule that intersects the index line (lines up with the direction of travel arrow) is our Magnetic Bearing



MARCHING ON A MAGNETIC BEARING

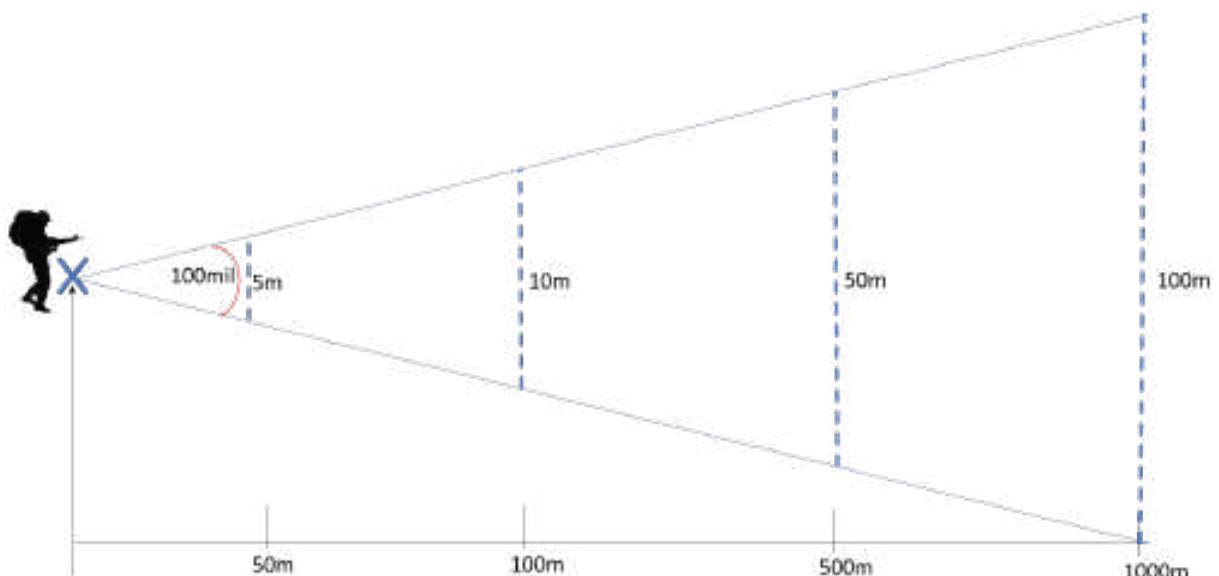
This is a vital skill to utilise the bearings you have planned and apply them to the ground. This will allow you to march in a pre-determined direction

1. Hold compass flat
2. Rotate the compass capsule so that the correct bearing is shown on the index line
3. Move the whole compass round to the needle lines with the red arrow/orientating line
4. The Direction of travel arrow now points in the correct direction of the bearing



BEARING ACCURACY

It's obvious to understand why its important to take precise bearings on when using a compass. However, what might be less obvious is the margin of error that is compounded over greater distances. For every 1 mil you are inaccurate over 100 metres you will be 0.1m out, over larger distances this means for every 100 mils over 100m you'll be 10m out, over a 1km your 100m out

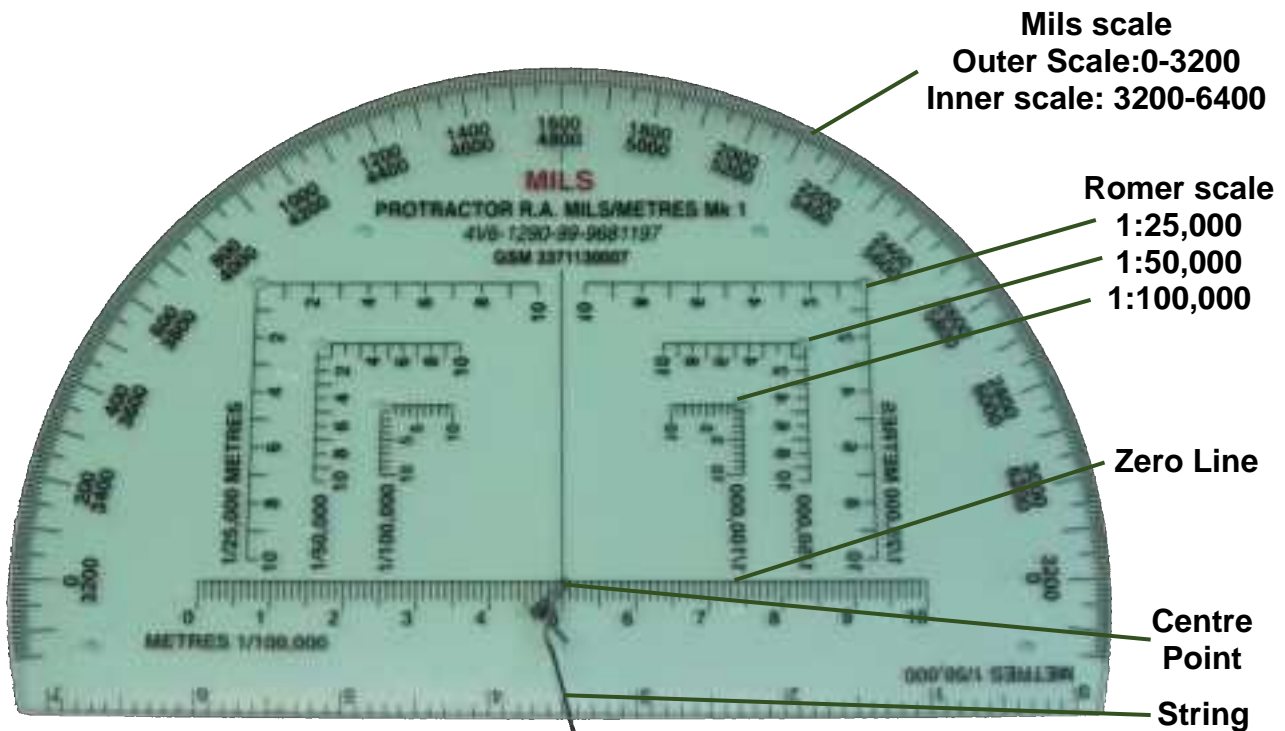


NOTES

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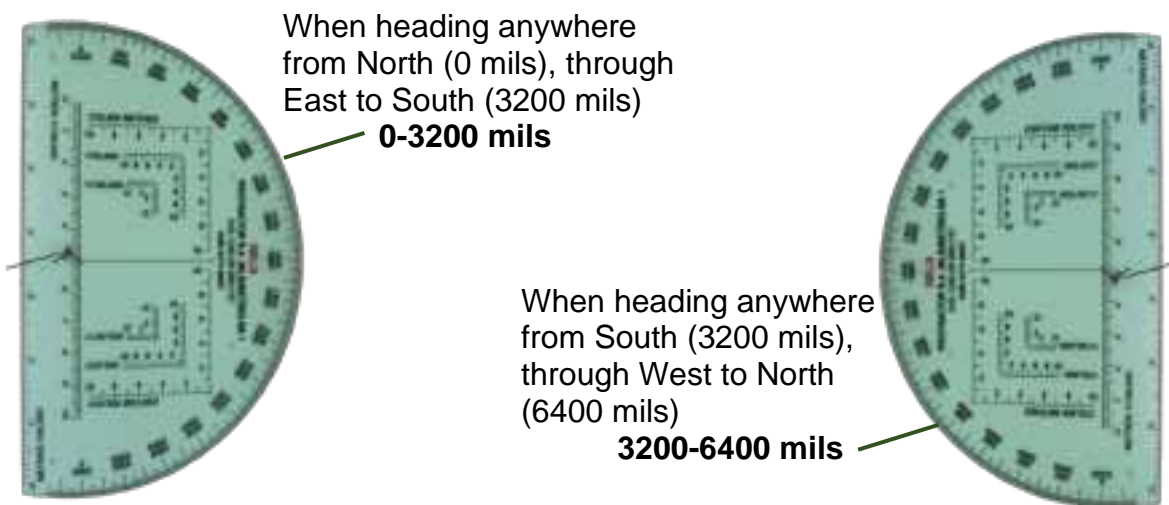
LESSON 8 THE LIGHTWEIGHT COMPASS 2 GRID BEARINGS

Taking a bearing from your map using the lightweight compass or a protractor is a vital tool on your navigational toolbox which will allow you to plan and prepare routes.



When taking or plotting grid bearings its preferable to use a protractor whenever possible as it is a more precise measuring instrument that will provide more accurate measurements.

When using a protractor its important to use the correct scale and orientation of the instrument. The protractor should be placed on the map in one of the two positions below using the Zero line to orientate it with the Easting lines on the map. The centre point is always your start position

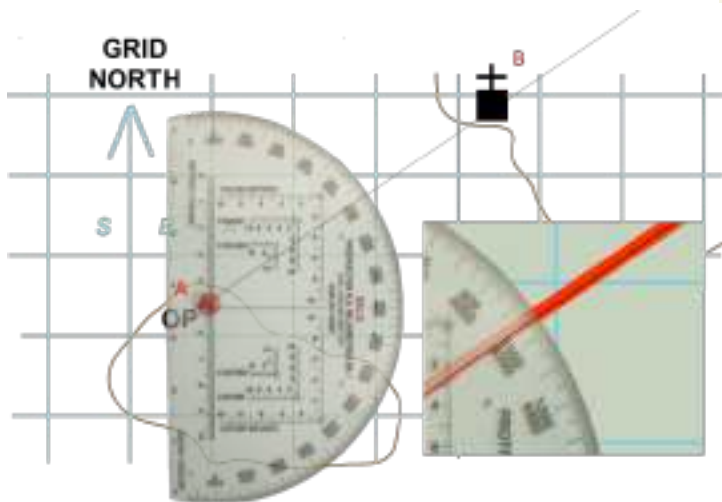


TAKING GRID BEARING

Taking a grid bearing is predominantly used in the route planning phase. This will help you appreciate the ground you are planning to march over and complete a route card to be used later when marching on a bearing.

Compass

1. Place the side of the compass along the line with the direction of travel arrow facing the way you want to travel
2. Rotate the compass capsule until the orienting lines point to grid north
3. Read off where the compass capsule intersects the index line
4. Practice with your map and lightweight compass



Protractor

1. Place the protractor on the map and orientate to align the Zero line with the eastings
2. Ensure the Centre point is at the starting position and the destination you are travelling to is on the semi-circle of the protractor
3. Move the string so its directly lined up from point A (start point) through point B (destination)
4. Use the correct scale to read off the bearing – e.g. 950 mils

PLOTTING A GRID BEARING

This could be used when reevaluating your direction of travel on the ground or to confirm your position relative to the ground.

1. You will need to be take a magnetic bearing or be given a grid bearing to plot
2. Place the protractor on the map and orientate to align the Zero line with the eastings
3. Ensure the Centre point is at the starting position and the destination you are travelling to is on the semi-circle of the protractor
4. Move the string so its directly lined up from point A (start point) through point B (destination)



NOTES

Handwriting practice lines for notes, consisting of multiple horizontal dotted lines.

LESSON 9 RELATING MAP TO GROUND

DDCRAPS

When using your map to navigate never make the mistake of making the ground fit the map. You must always relate the map to the ground. All soldiers should always study the ground, set their map (using your compass) then carry out DDCRAPS. DDCRAPS is an acronym for a process of checks to find out exactly where you are or to identify other positions.

Direction

Distance

Conventional Signs

Relief

Alignment

Proximity

Shape

Direction

Using a position on the ground, relate it to the map e.g. in our example a church can be seen set to the left of our view with a built-up area centrally and a monument to the right in the distance. This is what we should see on the map if we draw a line in the same direction. Remember features will be seen if they are not hidden by trees or landscape.

We now know that the buildings in the middle distance in the photo must be within the arc drawn on the map.

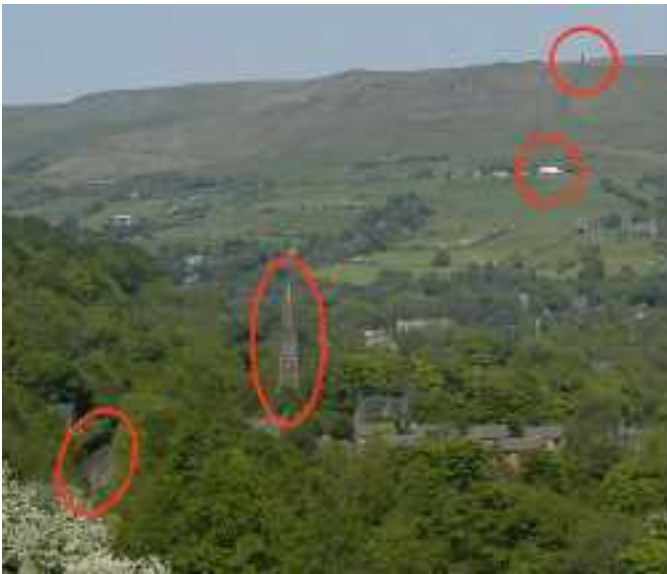


Distance

It requires a great deal of skill to accurately estimate the distance to an object, as you will use this constantly in the Army you will find that you will become proficient at it. Until then we will satisfy ourselves by dividing the ground into near and far. In this example we look at the map and see that we have buildings at set distances apart in the same direction. So, we should see the same thing on the ground.

Conventional Signs

It is important to learn as many of the conventional signs as possible as this will allow you to quickly identify the position without wasting time constantly referring to the legend. Once you get used to the symbology on the map you will know what to look for on the ground. In our example we can see a railway line to our left and in the same direction there is a place of worship with a spire. In the distance, in the same direction we can see a building on the side of a hill and at the furthest distance we can see a monument of some kind on the hill. The map confirms this by its use of conventional signs.



As said before, learn your conventional signs.

Relief

Landforms are easy to recognise and identify on the map. Look at the shape of the contours and the height information. Look at how close or far apart they are. Try to imagine what these contour patterns would look like on the ground. If we look at the next example, we can see that the photograph shows two re-entrants either side of the farm complex with the one on the left having a substantial amount of woodland associated with it. When we check the map, we can see exactly that depicted.



Alignment

Alignment is when objects are located along the same line. In this example we can see that the distant building aligns well with other buildings in the middle and near distance.



Proximity

How close an object that you can identify is to other features. In this example picture we can see that there are three buildings in close proximity to one another running close and parallel to the railway line and close to the road bend that travels away and up through the re-entrant.



Shape

The shape of an object or feature is one of the biggest giveaways. The curve of a road or rail track as well as the shape of a river can be easily identified. In our example below we can clearly see the shape of the lake in both the picture and the map, but we can also see that the shape of some of the woodland as well as the surrounding roads and relief also match the map.



LESSON 10 SELECTING ROUTES AND ROUTE CARDS

Selecting a route can be very complex as there are several variables that must be considered from the time you have to complete it to the hazards on the ground. These considerations are also mission dependent and their importance can change as the situation changes. Notwithstanding, considered planning is as important as adaptability

The first step in route planning is careful consideration of the ground, for this we use Trech

TRECH

Time & Distance

1 start point, 1 end point

Thinking about, distance, ease of movement, time and means of travel, how long have you got to travel, how far is the journey, how much time would it take? Are all considerations that must be accounted for. The map here shows 4 different routes for the same outcome all routes are correct in a specific situation



Time & Distance

Relief & Going

Ease of Navigation

Cover

Hazards



A bit of simple math tells us that $\text{time} = \text{distance}/\text{speed}$ or $\text{speed} = \text{distance}/\text{time}$. These rules can help us to plan how long it will take to get anywhere. The most common way to apply this is to measure the distance of a route, know you average speed to calculate the time needed to move. The table below is a useful tool for this

Have this table as a training aid to hand at all times to save potential errors working out timings

Distance/ Speed	100m	200m	400m	500m	700m	800m	1000m
5kmph	1 ¼ min	2 ½ min	5 min	6 min	8 min	10 min	12 min
4kmph	1 ½ min	3 min	6 min	7 ½ min	11 min	12 ½ min	15 min
3kmph	2 min	4 min	8 min	10 min	14 min	16 min	20 min
2kmph	3 min	6 min	12 min	15 min	21 min	24 min	30 min

Add 1 Minute for: Every 10m contour line crossed in ascent or descent.

Relief & Going

If you're in hill country it may be easier to go around rather than over steep terrain, or it may be better to make a gradual climb than go straight up. Situation depending, it's better to stay at the height climbed rather than keep going up and down. You must remember the morale, fatigue and speed of the section when making these route planning choices.

The going refers to the conditions of the ground underfoot. For instance, the ground may be relatively flat but due to marsh land you may not be as fast as through dry grassland or on a road.



Ease of Navigation

To minimise the chances of becoming lost try to select a route between obvious features on the map to aid navigation. This is particularly important in low visibility conditions. However, remember the enemy will target obvious features. Often the specifics of the situation will dictate the type/ease of the route that you can take, don't make your/your sections lives harder than they need to be.

Also think back to the bearing lesson, for every 100mils you are off over 1 km you will be 100m off, worse still if you get lost and are late or unable to complete your mission.

Cover

When you plan a route, another factor you may have to think about is cover, this will of course be mission specific

Cover gives safety and allows surprise. Consider using dead ground, stream beds, trees and hedges to make your movements

Cover can also be used to protect you from the worst of bad weather.



Hazards & Safety

These go hand in hand and will mean very different thing on operations than during training.

- If you cross ground over-looked by the enemy, because you did not plan the route carefully then you may have casualties
- Hazardous routes such as rugged ground, motorways, rivers or some coastal areas should only be used as a last resort when on foot
- When planning a route always consider what is the 'escape route' in case the weather closes or there is an accident or unforeseen circumstance forces you to abandon your route



There are many potential hazards that must be considered which will all become easier to spot with experience studying maps

ROUTE CARDS

Using TRECH is an ongoing process that will influence the next stage of route planning and may cause you to alter your planned route (Don't be afraid of doing this, it's a lot quicker to redo a leg on a route card than it is to retrace your steps on the ground)

Completing a route card is no dark art as many believe, it's a systematic approach to route planning bringing together the various skills learnt on this course including grid references, bearings (magnetic and grid), contours, measuring distances, time as well as bringing in your understanding of conventional signs, relief etc...

The example below shows one way in which to complete a leg, filling in all the necessary information within the boxes accurately to the best of your knowledge.

Leg	Loc. GR A	Loc. GR B	Grid Bear.	Mag Bear.	Height + & -	Distance (m)	Time (4kmph)	Ground/Escape Route
1	SH 353 440 Car Park	SH 361 453 Track jct	1050 mils	1090 mils	+30m - 60m	1100m	25 ½ mins	Head NNE initially downhill past mast. Then N uphill till reaching track jct. E-route: West to road
Complete Loc. A and B		Bearing from A to B		Count contours both up hill and down hill		@4kmph 1100m = 16.5min + 9min for contours		
			Grid to Mag ADD GMA +40mils		Measure the distance		Now describe the route in enough detail that anyone could pick up the route card and walk it	

Completing a full route card can appear daunting when faced with a blank template (like below). Like anything the more confident you are in your own skills the easier it is and the quicker you will be and doing it. Take each section at a time'

1. Complete the route card information section at the top of the route card (1), save ETA till the end when you have worked this out.
2. Complete the weather information (2), this may affect your route selection/when you set off
3. Complete the grid ref/Loc's (3). This is your initial route plan
- 4-11. Complete each leg in turn. It's important to do these row by row to fully grasp the intricacy of each leg
12. Complete the totals then go back to fill the ETA in section 1

ROUTE CARD			DATE:	SECTION:				
MAP:		1 GMA:						
START POINT GR:		ETA:						
FINISHING POINT GR:		ETA:						
Leg	Location - Grid Ref	Location - Grid Ref	Grid Bearing	Magnetic Bearing	Height +/ -	Distance	Time	Ground/Escape Route
						4		
						5		
						6		
						7		
						8		
						9		
						10		
						11		
TOTALS						12		
Weather			First Light		2			
			Last Light					
			Moon Phase					
			Notes					

NOTES

A series of horizontal dotted lines for writing notes, spanning the width of the page below the 'NOTES' header.

PRACTICAL NAVIGATION

We have covered a lot of theory with some practical skills now it is time to bring together everything YOU have learnt to navigate. Map reading isn't a mystical skill that only a few can master it's a collection of individual skills brought together to assist you getting from point A to point B. In the military context it also includes the tactical element of movement across ground.

GET OUTSIDE AND PRACTICE

BEFORE SETTING OFF

1. **Look at the GROUND**
2. **Set the map**
3. **Confirm the start point**
4. **Recap the first leg**
5. **Write down the start time**

One of the most common errors of navigation starts before you have even set off. Ensuring you are where you think you are is key. You can't get to where you want to go if you don't know where you are starting from.

Recap your plan before you go anywhere and write down the start time to ensure you use your timings to aid navigation.

Keep track of where you are throughout your leg, thumbing the map and identifying tick features on route are good means to doing this.

Navigation is a dynamic process where you may have to adapt to the situation, do this carefully and review any changes made.

ON THE ROUTE

1. **Thumb the map**
2. **Identify features (tick features)**
3. **Change direction carefully**
4. **Review last leg**

NOTES

Lined area for taking notes, consisting of numerous horizontal lines.

Task 1

1. Topographical maps are made up of three separate feature types. Give some examples of each:

Physical features	
Manmade features	
Relief information	

2. How are military map uniquely identified?
















3. What are the five key pieces of information you must be able to identify to effectively use a map?

**Remember
DVAGS**

4. What are the three ways to extend the life of a map?

Task 2

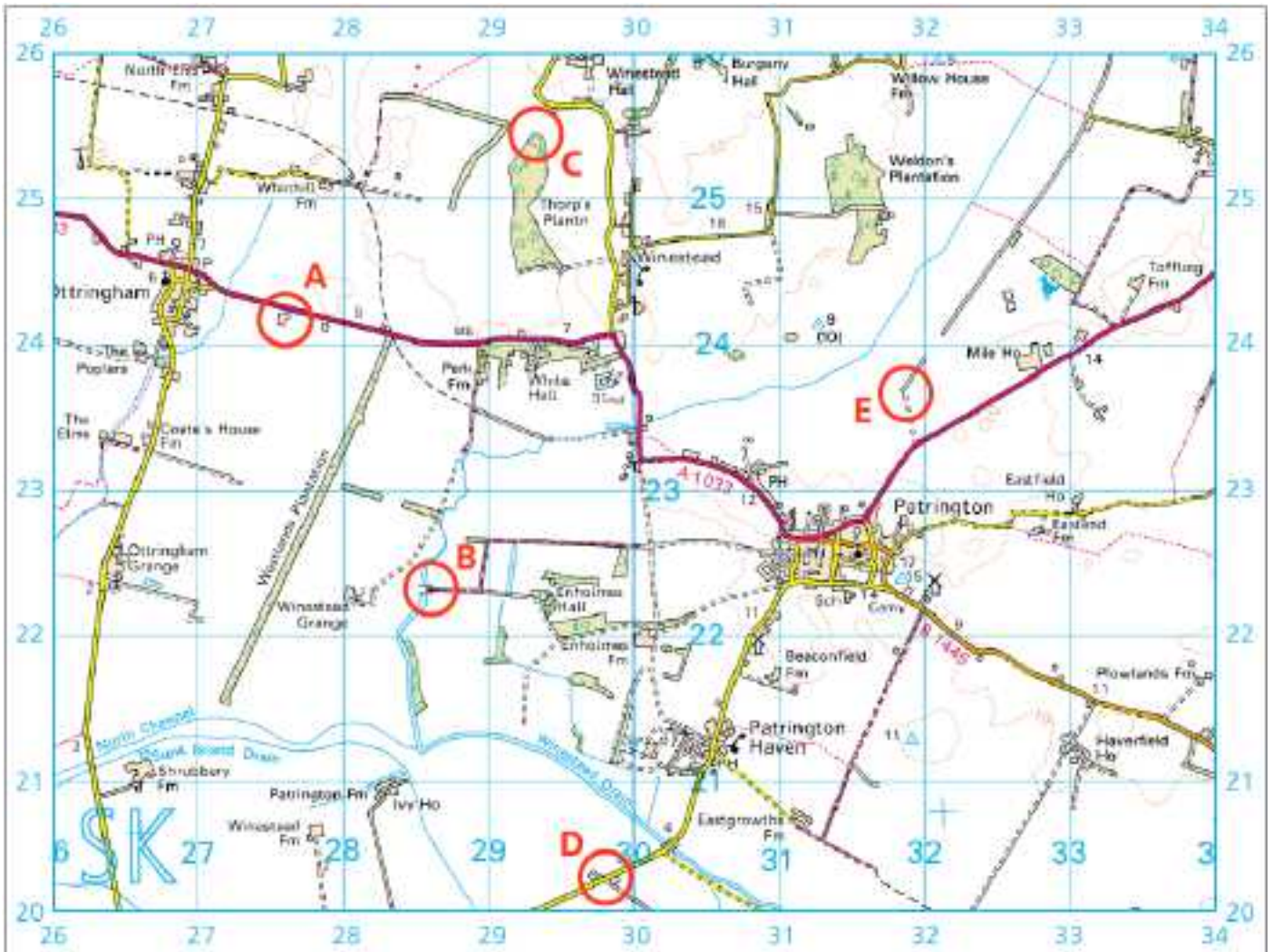
1. What are the following conventional signs? Write your answers next to the letters.

 a. _____	 b. _____	 c. _____	 d. _____
 e. _____	 f. _____	 g. _____	 h. _____
 i. _____	 j. _____	 k. _____	 l. _____
 m. _____	 n. _____	 o. _____	<p style="text-align: center;">PH</p> p. _____

2. What are the five main groups of conventional signs?

Task 3

Answer the following questions and practice grid references



1. Give the six figure British National Grid reference for the following:

A. Building	
B. Bridge	
C. North corner of wood	
D. Crossroads	
E. Corner of road/Track	

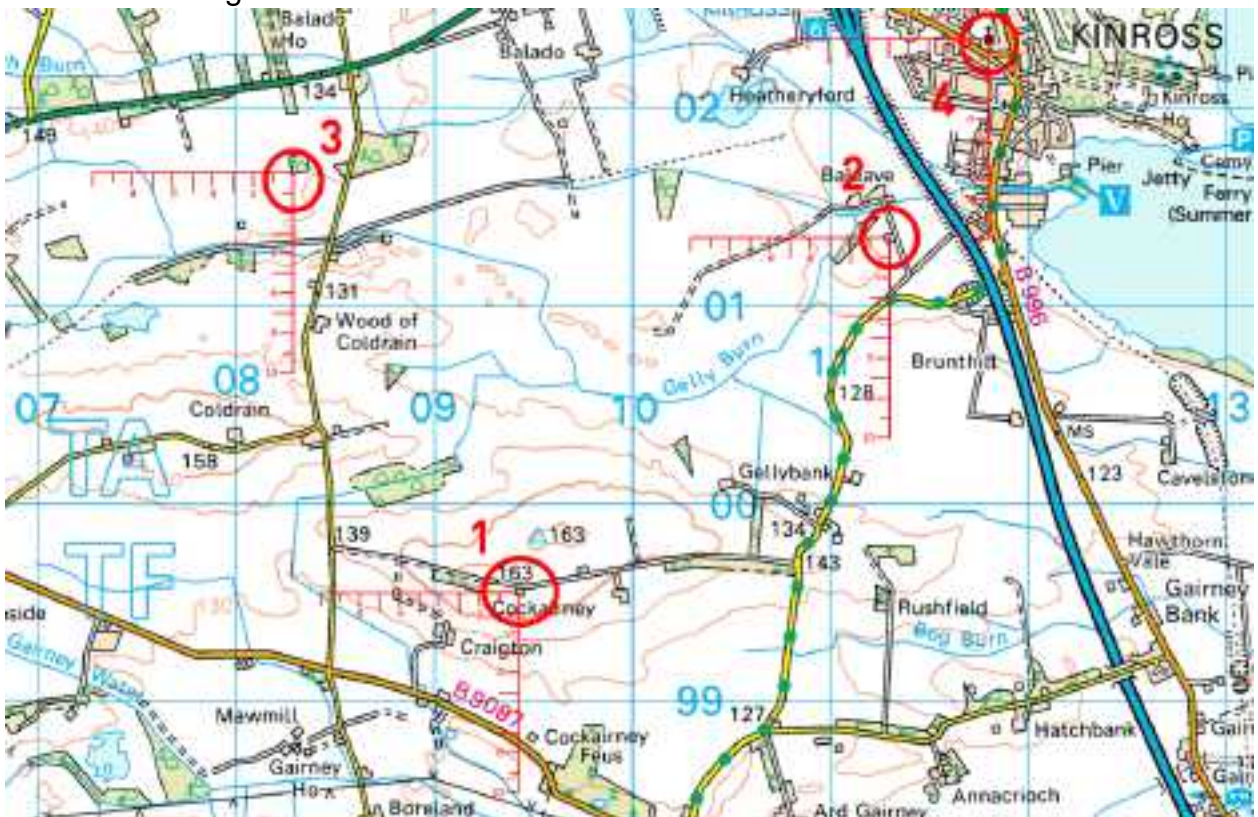
2. What feature is shown at the following locations?

A. SK 262 252	
B. SK 267 244	
C. SK 278 206	
D. SK 278 206	
E. SK 312 241	

3. Fill in the grid below and match the words to the meanings. The first one is done for you

Words	Meanings	Word no.
1. Northings	a. These are a series of squares that form a matrix which is overlaid on the map	6
2. Grid References	b. The numbers printed against each bold 10km grid lines	
3. Grid Letters	c. The horizontal grid lines	
4. Eastings	d. Used to remember to apply the eastings before the northings that indicate a position on the map	
5. Ladder Grids	e. The vertical grip lines	
6. Grid Squares	f. A series of horizontal and vertical lines that criss cross and form the grid squares	
7. Grid Lines	g. The combination of eastings and northings that indicate a position on the map	
8. "Along the corridor then up the stairs"	h. The blue letters, normally found at the corners of the map that refer to a 100km square e.g. TQ	

4. Give the 6 figure British National Grid References for the 4 features below



1.		2.	
3.		4.	

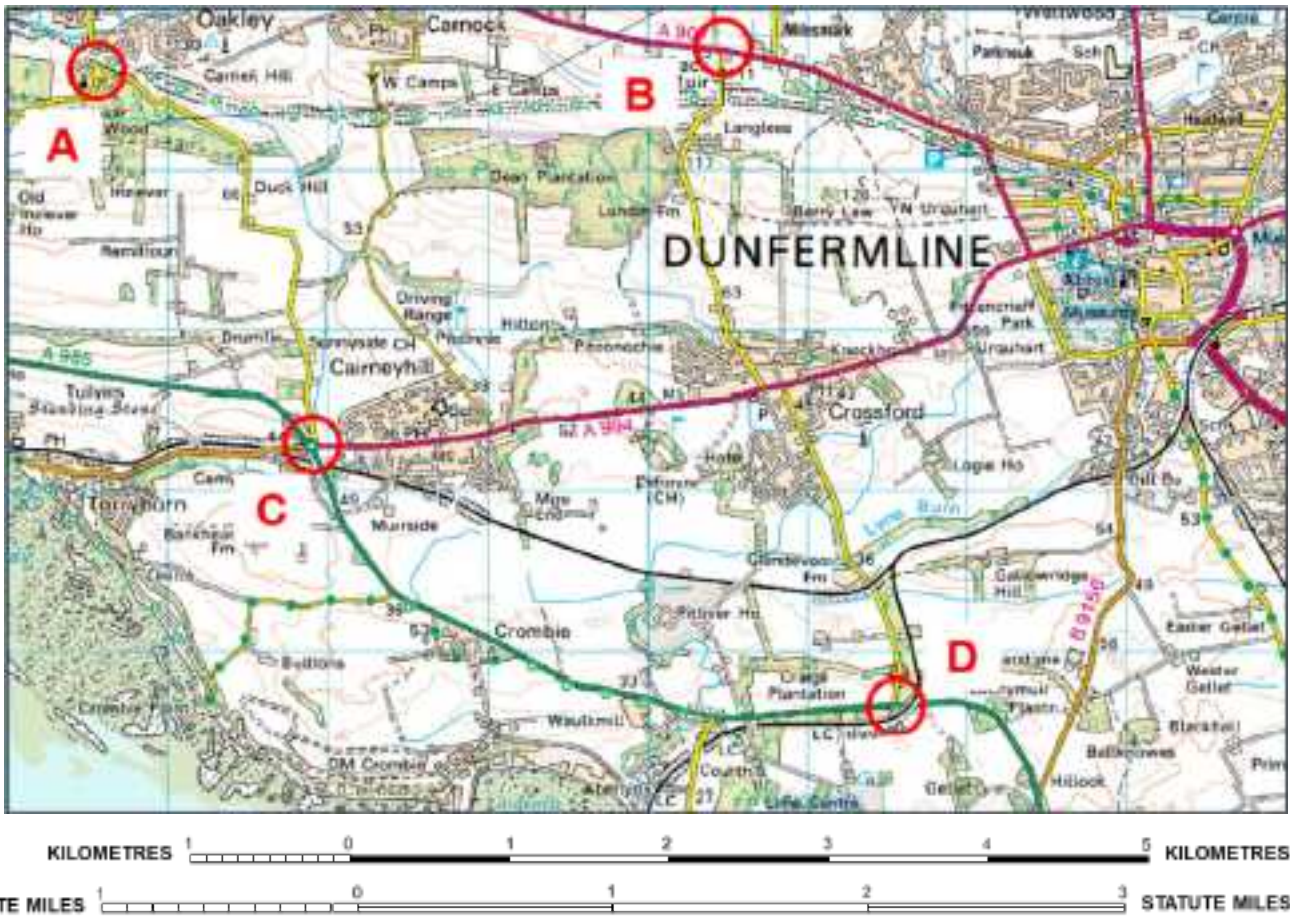
5. Use the Romer on your lightweight compass to give six figure grid references of the following 4 features



1.		2.	
3.		4.	

Task 4

Answer the following questions and practice measuring direct and indirect distances on the map below



1. If two points on the ground are 12Km apart what is the distance between the same two points on a 1 :50,000 map?

2. Using the map extract above what is the straight line distance between point A and B?

	Km
--	----

3. Using the map extract above what is the indirect distance between point A and B?

	Km
--	----

4. Using the map extract above what is the indirect distance between point C and D?

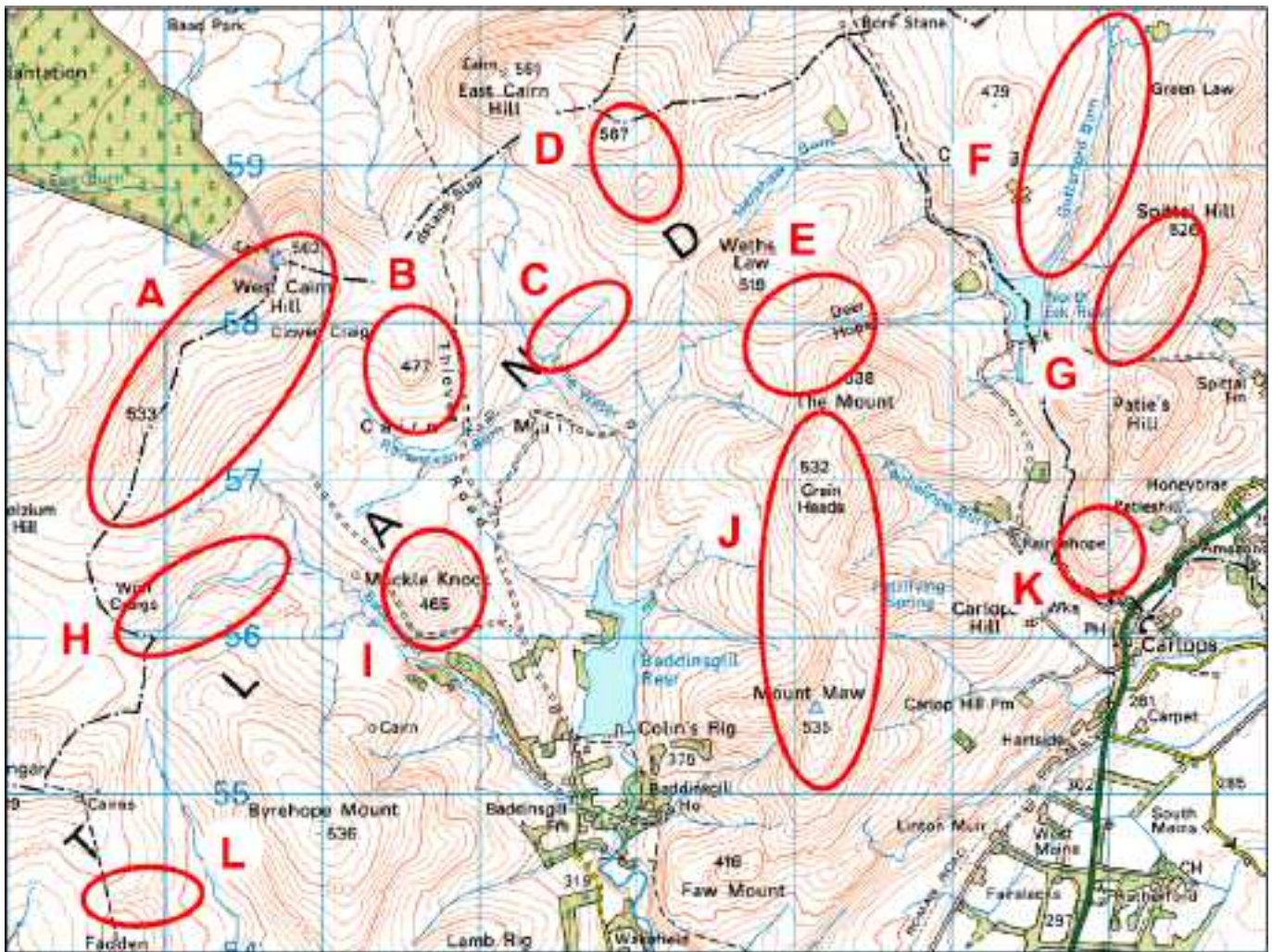
	Km
--	----

5. Using the map extract above what is the straight-line distance between point B and D?

	Km
--	----

Task 5

Answer the following questions and practice identifying features



1. Identify the key terrain features in the indicated areas on the above map.

A.		B.	
C.		D.	
E.		F.	
G.		H.	
I.		J.	
K.		L.	

Task 6

1. What are the three types of North?

2. Fill in the grid below and match the cardinal points to the correct mils. The first one is done for you

Cardinal points	Mils	Cardinal point no.
1. South	a. 1600	
2. North East	b. 5600	
3. South West	c. 0/6400	
4. East	d. 3200	1
5. North	e. 2400	
6. South East	f. 4800	
7. North West	g. 4000	
8. West	h. 0800	

3. What is the purpose of Grid Magnetic Angle (GMA)?

4. When GMA is West what is the rule for applying it?

Task 7

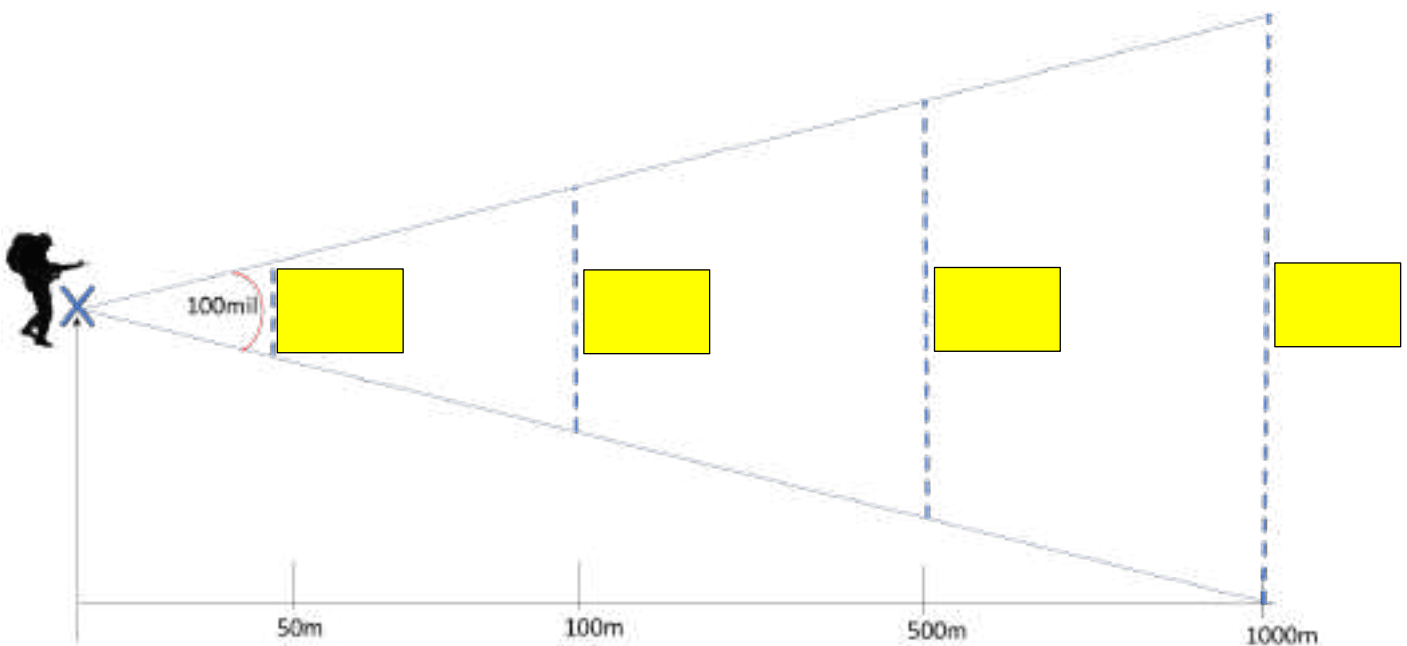
- Organise the following 4 steps into the correct order for taking a magnetic bearing

Step		Step	
	Rotate the compass capsule until the compass needle aligns with the red arrow/orientating arrow "Red on Red"		Hold compass flat
	The number on the compass capsule that intersects the index line (lines up with the direction of travel arrow) is our Magnetic Bearing		Point the direction of travel arrow at the location you want to take the bearing to

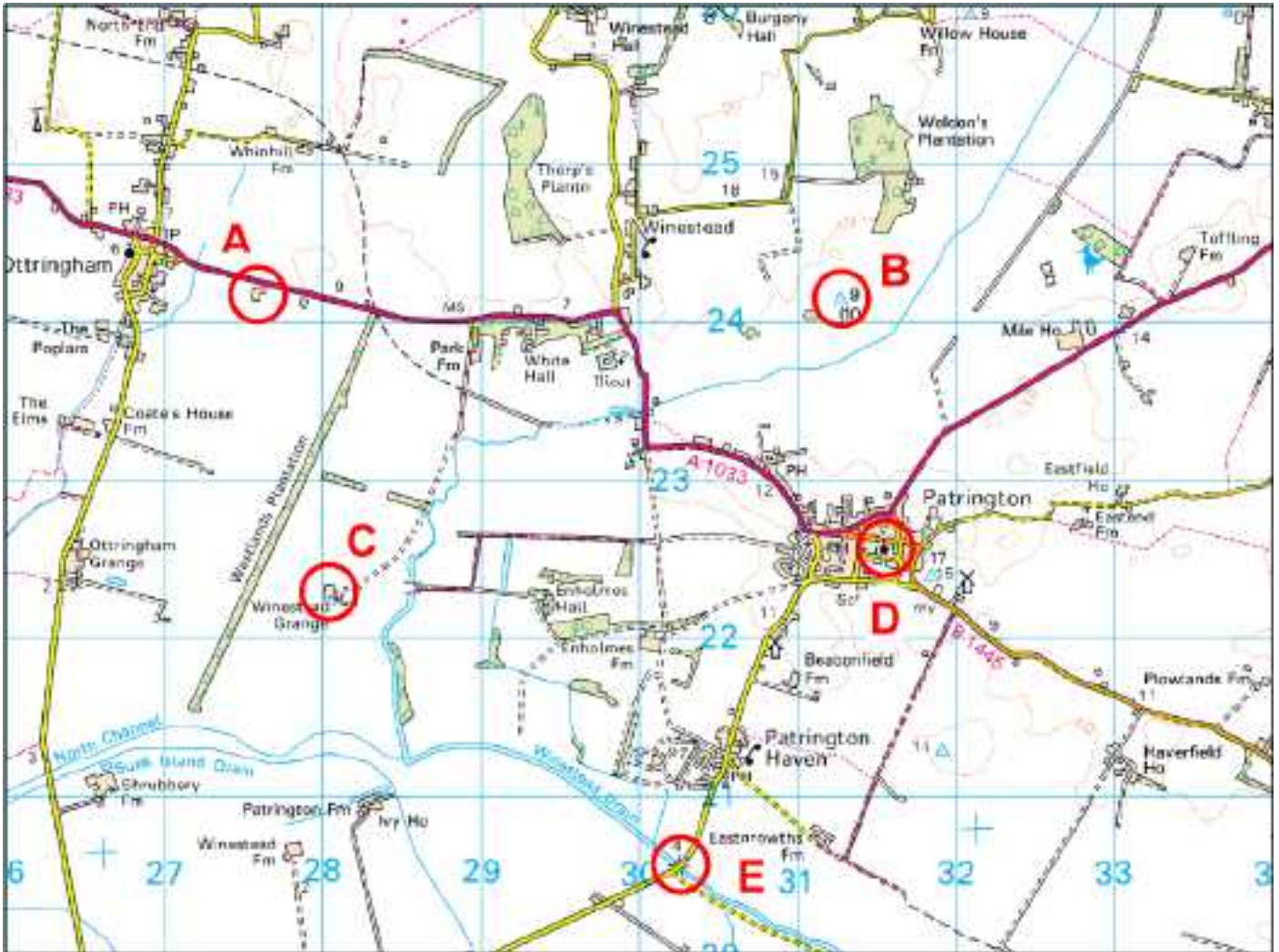
- Organise the following 4 steps into the correct order for marching on a magnetic bearing

Step		Step	
	Move the whole compass round to the needle lines with the red arrow/orientating line		Rotate the compass capsule so that the correct bearing is shown on the index line
	Hold compass flat		The Direction of travel arrow now points in the correct direction of the bearing

- Bearing accuracy is very important for good navigation, for every 100mils you are out how many metres off your target are you going to be for the following distance? (fill in the yellow boxes below)



Task 8



1. What is the bearing from the building at A to the building at C?
2. What is the bearing from the bridge at E to the building at C?
3. What is the bearing from the place of worship at D to the Trig point at B?
4. Plot a bearing of 2500 mils from the place of worship at D, and a bearing of 1150 mils from the bridge at E. What is the six-figure grid reference of the location the bearings cross?
5. Plot a bearing of 2200 mils from the Trig point at B. What building is on this bearing?
6. Plot a bearing of 2750 mils from the building at C, and a bearing of 5000 mils from the bridge at E. What is the six-figure grid reference of the location the bearings cross?

Task 9

1. Complete the following acronym that helps you identify your position:

D

D

C

R

A

P

S

Task 10

1. Complete the following acronym that helps you plan a route:

T

R

E

C

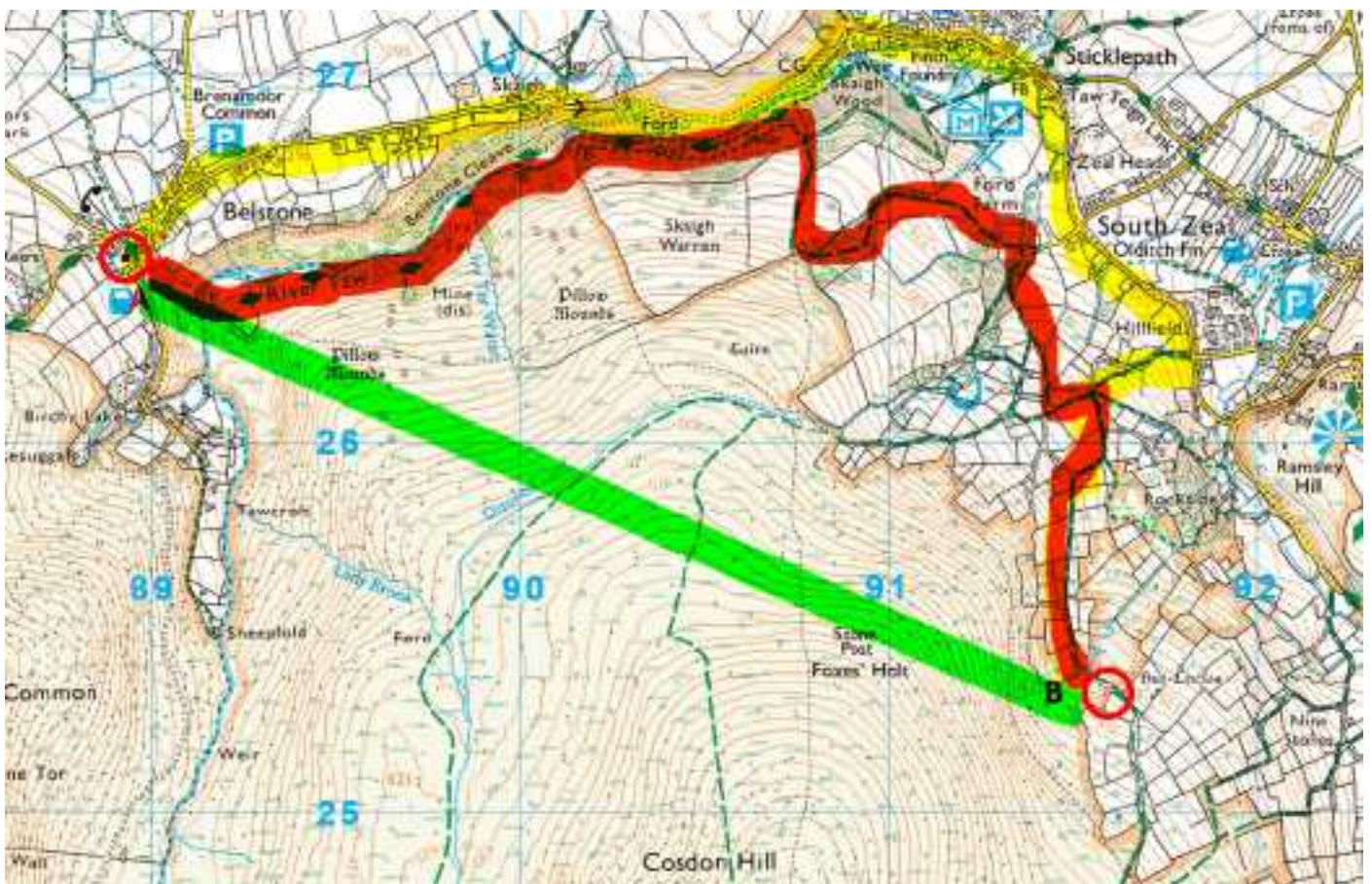
H

2. Select one of the following routes (Green/Red/Yellow) and complete the route card from A to B? (circle the route option below and complete the route card on the following page)

Green

Red

Yellow



**ROYAL
MARINES
CADETS**
PART OF THE SEA CADETS