MAP READING

I. GENERAL:

A. Map - is a graphic representation of the earth surface drawn to a scale in a plain surface.

1. Importance of Map:

a) Used for strategic, tactical planning in all command.
b) Used to show the relative position on a certain given area.
c) Used to show accurate distance, location, best routes and key terrain features.
d) To avoid lost and keep alive.

2. Care of Map:

a) Proper folding by:
   1. Accordion Fold
   2. Slit Fold
b) Carry Maps in a waterproof pocket and use acetate to cover the Map.
c) Avoid drawing or improper marking to avoid confusion.

3. Security of Maps:

a) Maps must not fail into unauthorized hand.
b) When in danger, destroy the map.
c) Avoid indication of plans or area of interest in the map.

4. Categories and Uses of Military Maps:

The term Military Map includes all maps designed for use of Military authorities except aeronautics and hydrographic charts.

a) **Scale** - is expressed as a fraction and gives the ratio of map distance to ground distance.

1) **Small scale** - Maps at the scale of 1:600,000 and smaller are used for general panning for strategic studies at the high echelon.
2) **Medium Scale** - Maps at the larger than 1:600,000 but smaller than 1:75,000 are used for planning operations, including the movement and concentration of troops and supplies.
3) **Large Scale** - Maps at the scale of 1:75,000 and larger are used for tactical technical and administrative needs of field units.

b) Types:

1) **Planimetric Map** - showing only the horizontal (flat) position of features.
2) **Topographic Maps** - a two dimensional Map which represents the horizontal (flat and vertical relief) positions of features represented.
3) **Plastic Relief Map** – a topographic map reprinted on plastic material and formed by heat and vacuum over a reproductive positive mold thus giving the same information as contained on topographic map.
4) **Photo Map** - a reproduction of photograph upon grid lines, marginal data, place, names and boundaries may be added.

5) **Joint Operation Map** – used for ground and air operations. The maps are published in a ground and air edition.
6) **Pictomap** – it is a map on which the photographic imaginary of a standard photomap has been converted into interpretable colors and symbols.
7) **Photomosaic** - an assembly of aerial photograph to form a complete picture.
8) **Military City Map** - a large scale of topographic Map of a city or town and the standard scale is 1:12,000.
9) **Special Map** - maps for special purposes such as traficability Maps, transformation maps and boundary maps.
10) **Terrain Model** - a three dimensional representation of an area Molded on plastic, rubber or another material symbolically.
11) **Hydrographic Map** – a nautical map used as navigational aid either above or below surface.

II. MARGINAL INFORMATION:

Marginal Information – are those printed notes outside the printed diagram of maps used as an instructional guide in reading maps.

Sheet Name – found at the upper center margin. A map is named after its outstanding cultural or geographic features.

Sheet Number – found in the upper right margin and used as reference number assigned to each map.

Series Name and Scale – found on the upper left margin. A map series usually comprises a group of smaller maps at some scale designed to cover a particular geographic area.

Series Number – appears in the upper right margin and lower left margin.

Edition Number – is found in the upper margin and in the lower margin, representing the age of the map.

Bar Scale – located in the center of the lower margin and in the lower margin use for determination of map distance to the corresponding ground distance with three different units of measures.

Credit Note – in lower left margin, primary purpose is to list the procedures and reference, the method of compilation for used by technicians.

Index to Adjoining Sheet – in lower margin, it identifies the map sheet covering areas around the area covered by the map you are using.

Index to Boundaries Diagrams – in lower margin, this is a miniature map that shows the boundaries and special show line that occurs within the map area.

Projection Note – in lower margin, it indicate the method use to portray the map area.

Grid Note – in the center lower margin, it gives information pertaining to the grid system used, the initial guidelines and the number of digit omitted from grid values.

Grid Reference Box - usually located at the center of the lower margin. It contains information identifying the grid zone designation and 100,00 meters square identification.

Horizontal Datum Note - located at the center of the lower margin and defined as geodetic reference point.

Legend - at the lower left margin, illustrates identifies the topographic symbols used to depict some of the prominent features on the map.

Declination Diagram - located in he center lower margin and indicates the relationships of true north and magnetic north.

Protractor Scale – in upper margin, use for laying out a magnetic north line on the map.

User Note – located in the lower margin use for connections and errors on the map.

Unit Imprint - at the left side of the lower margin, it identifies the agency which printed the maps with its respective symbols.

Contour Interval Note - located in the center of the lower margin. It states the vertical distance between adjacent contour lines on the map. When supplementary contours are used the interval is indicated.

Coverage Diagram – normally in lower margin, it indicates the methods by which the map was made, dates of photography and other sources material.

Graphic Scale - a ruler used to convert map distance to ground distance without going through mathematical computations.

Contour Interval – the contour interval states the vertical distance between adjacent contour lines on the map. When supplementary contour are used the intervals is indicated.

Vertical Datum Note – it designates the basis for all vertical control stations, contours and elevation appearing in the map.

OFFICIAL ITEMS:

Glossary – may appear on maps of foreign agencies where the native language is other than English.

Classification – when required a security classification will appear in lower and upper margin.

Special Note – under special condition, special note maybe added to the marginal information to aid or resist the map used.

III. MAPS SIGNS AND SYMBOLS:

Map Symbol – it was a sign composed of a diagram number, letters, abbreviation, color or combination thereof, which is used to identify and distinguish a particular place of area.

A. Purpose:

1. To visualize an area of the earth surface with pertinent feature planning.
2. To represent the natural and manmade feature.

B. Classification:

1. **Topographic Symbols** – are standard drawing of map features and organized by their colors.

a. Topographic colors:

1) **Black** – all manmade features, such as buildings, roads not shown in red, etc.
2) **Blue** – all water features, such as lakes, rivers, swamps, streams, etc.
3) **Brown** – all land forms, such contours, cuts, fills, etc.
4) **Green** – all vegetation, such as forest, orchid, hide grass, jungles, etc.
5) **Red** – main roads, built-up areas, and special info.

b. **Topographic Symbols**: (see legend and other symbols)

2. **Military Symbols** – a symbol used by the map user when he wants to show the disposition of troops and overlaying of military installation.

a. Military Colors:

1) **Blue** – all friendly forces, installations, activities and firepower.

2) **Red** – all enemy forces, installation and activities (double lines means enemy).
3) **Yellow** – shows grassed or contaminated areas maybe the result of either friendly or enemy actions.
4) **Green** – indicates friendly or enemy demolition, minefield and manmade obstacles.
5) **Spare Colors** – use for classification and accompanied by legend.

b. Types of Military Symbols:

1) **Troops Unit Symbols** – are shown by rectangle. (Basic symbols for military unit and activities).
2) **Branch Arm of Service and Type** – Organization Symbol – used in conjunction either other symbols to signify a military unit activity or installation.
3) **Size of Unit** – used to identify the size of a unit or installation.

IV. GRIDS AND COORDINATES:

1. **Grids** - are parallel lines from east to west, north or south that forms a square used as a reference system to help the map reader locate areas quickly.
2. **Coordinates** - are the numbered grid lines on the map and are further subdivided to show specified location.
3. **Geographic Coordinates** – the location of any point of the earth surface maybe given by stating into its distance north or south of the equator (latitude) and east or west of prime meridian (longtitude).
4. **Polar Coordinates** – on the map maybe determined or plotted from a known point by giving a distance along that direction.
5. **Grid Coordinates** - the military grid system divides the earth surface into many 100,000 meter squares. Each of these squares are further subdivided into 1,000 meter squares. The 1,000 meter squares is the basis of the military grid system which is used in reading military map.
6. **Grid Square** - can be located or identified by combining the number of the vertical grid line and horizontal grid line which intersect at the lower left corner of the square.

Characteristics of Grids:

- does not requires knowledge of the area
- applied to large areas
- does not requires land marks
- applies to all map scales

Locating Points within a Grid Squares:

- 4 digits nearest to 1,000 meters
- 6 digits nearest to 100 meters
- 8 digits nearest to 10 meters
- 10 digits nearest to 1 meter

Rule in determining grid coordinate – "<u>read right up</u>"

<u>GRID COORDINATES (GC)</u> – Nearest to 10 meters (8digits)

GC – 17320170	GC – 19140252
GC – 02385578	GC – 89052564

GRID COORDINATES (GC) – Nearest to 1 meter (10 digits)

GC – 1732301702	GC – 1914102520
GC – 0238855780	GC – 8905725642

IV. SCALE AND MEASUREMENT:

A. **Map Scale** – maps are drawn into scale; this means that a certain distance on the map represents a certain larger distances on the earth surface. The ration of the horizontal distance on the map equal to the corresponding distance on the ground.

B. **Comparison of the Map Scales** – when comparing scales maps we say that one map is smaller or large than another. The scale 1:25,000 is larger than 1:50,000. In other words, the larger the denominator of the RF the smaller the scale of the map.

C. **Graphic Scale** – as a ruled representation of ground distance drawn to scale of the map.

1. Parts:

a. **Primary Parts** – rights of zero, mark off in full units of measure.
b. **Extension Scale** – left of zero, divided into tenth of unit.

2. **Measuring Straight Line Distance** – to measure straight line distance, two points on map, lay a straight strip of paper on the map, the edge touches both points. This gives map distance between two pints. Now, lay the papers on the graphic scale that correspond to the unit of measure you are using extension scale the reminder of the measurement.

3. Measure distance on Winding Curve:

To measure distance along a winding road, stream or any other curved line, the straight edge of a piece of paper is used again. Make a trick mark at or near one end of the paper and place it at the point from which the curved line is to be measured. Align the edge of the paper along a straight line portion, and make a tick mark on both map and paper at the end of the aligned portion. Keeping both tick marks together, place the point of the pencil on the papers tick mark to hold it kin place. Pivot the paper until another approximately straight portion is aligned and again make a tick mark on both map and paper. Continue in this manner until the measurement is complete. Then place the paper on the graphic scale and read the ground distance.

a. Often, marginal notes gives the road distance from the edge of the map to a town, highways or junction off the map. If the road distance is desired from a point on the map to such a point off the map, measure the distance to the edge of the map and add to that measurement the distance specified in the marginal note. Be sure the unit of measure is the same.

b. The amount of time required to travel a certain distance on the ground is an important factor in most military operations. This can be determined if a map of the area is available and graphic time distance scale is constructed for use with the map as follows:

R = Rate of Travel (Speed)
D = Distance (Ground Distance)
T = Time

$$T = \frac{D}{}$$

Example: if an infantry unit is marching at an average rate ® of 4 kilometers per hour, it will take approximately 3 hours (T) to travel 17 kilometers.

$$\frac{12\ (D)}{4\ (R)} = 3(T)$$

PROBLEM: You are the Platoon Leader of the 1st Platoon of the Alpha Company. Your Platoon CP is located at the school at GS 0376. You have just received a Radio Message directing you to report at the Company CP at Hill 39 at GS 0276. The ground distance between your CP and the Company CP is 16.5 kilometers.

QUESTION:

If your service jeep will be traveling at an average speed of 30 kms per hours.

a. What will be your travel time in minutes? _____/minutes
b. What tine will you arrive at the Company CP if you will leave now? (tiem is 0830). _____ hrs

Comparison with another map of the same area that has an RF.

a. Select two point on the map with the unknown RF. Measure the distance (MD) between them.
b. Locate the same two points on the map that has known RF. Measure the distance (MD) between them. Using the RF for this map, determine, GD which is the same for both maps.

Using the GD and the MD from the first map, determine the RF using the formula:

$$RF = \frac{1}{X} = \frac{MD\ .}{GD}$$

Occasionally it may be necessary to determine map distance from a known ground distance and the RF.

$$MD = \frac{\quad}{\text{Denominator of RF}}$$

GD = 2,200 meters
RF = 1:50,000
MD = 0.044 meter x 100 (centimeters in a meter)
MD = 4.4 centimeters on map

GRAPHIC (Bar) SCALE – is the most accurate means of measuring distance on a map. It is the ruler printed on the map on which distances on the map may be measured as actual ground distance.

GRAPHIC SCALE IS DIVIDED INTO TWO (2) PARTS:

Primary Scale – distance from zero mark to the right.
Scale Extension – from the zero mark to the left. This is divided into ten (10) equal parts to enable more accurate measurements.

DIRECTIONS:

METHODS OF EXPRESSING DIRECTIONS ARE:

Degrees = 360 Degrees (1) one Circle
Mils = 6,400 Mils (1) one Circle
Grad = 400 Grads (1) one Circle

360 degrees = 6,400 mils
1 degree = 17.8 mils
90 degrees = 100 grads
1 degree = 60 minutes
1 minute = 60 seconds
1 click in compass = 3 degrees

THREE (3) BASIC LINES

True North	=	always constant
Magnetic North	=	when working with a compass
Grid North	=	when working with a military map

D. Representative Fraction (RF)

1. The numerical scale on a map expresses the ratio of horizontal distance on the map to the corresponding horizontal distance on the ground. It is usually a written as a fraction and is called the Representative Fraction (RF). The representative fraction is always written with the map distance as one (1). It is independent of any unit of measure. An RF of 1/50,000 or 1:50,000 means that one (1) unit of measure on the map is equal to 50,000 of the same units of measure on the ground.

2. The ground distance between two points is determined by measuring between the points on the map and multiplying the map measurement by the denominator of the RF.

Example:

RF = 1:50,000 or $\frac{1}{50,000}$ MAP Distance = 5 units

5 x 50,000 = 250,000 units of ground distance

3. The situation may arise where a map or sketch has no RF. To be able to determine ground distance of on such a map, the RF must be determined. There are two ways to do this.

a. Comparison with ground distance

1) Measure the distance between two points on the map (MD).
2) Determine the horizontal distance between the corresponding points on the ground (GD).
3) Utilizing the RF formula and remembering that RF must be in the general form.

$$\frac{1}{X} \quad RF = \frac{1}{X} = \frac{MD}{GD}$$

b. Both the MD and the GD must be in the same unit of measure and the MD must reduced to 1.

MD = 4.32 centimeters
GD = 2.16 kilometers (216,000 centimeters)

$$RF = \frac{1}{X} = \frac{4.32}{216{,}000} \quad \text{or} \quad 4.32X = 216{,}000$$

$$X = 50{,}000$$

$$\text{Therefore RF} = \frac{1}{50{,}000} \quad \text{or } 1{:}50{,}000$$

V. ELEVATION AND RELIEF:

A. Definition:

1. **Elevation** – the height (vertical distance) of an object above or below a datum plane.
2. **Datum Plane** – a reference from which measurement maybe taken. This datum plane for most maps is average sea level.
3. **Relief** – the configuration (shape) of the ground.

B. Effects of the Elevation and Relief:

1. Employment and movement of troops.
2. Limit route and speed
3. Restrict a certain types of equipment
4. Affect attack and defense position
5. Affect observation, field of fire, cover, concealment and the selection of key terrain features.

C. Methods of Showing Elevation and Relief.

1. **Hackures** – are short lines used to indicate significant ground formations not normally revealed by contour lines.

Characteristics and uses:

a. usually printed in brown
b. don't represent exact location
c. show the relative slope in places where contour lines or other method fail to accurately show the relief.
d. the shorter and closer together the lines are drawn, the steeper the slope they represent.
e. hackures radiating out from the center indicate a peak

D. **Layer Tinting** – shows relief by means of color.
   a. **Blue** – water level
   b. **Green** – orange and red for successively higher level
   c. **Brown** – high mountain region

NOTE: A legend is printed in the margin of layer-tinted maps to indicate the elevation ranges represented by each color.

Shading:

Characteristics and uses:

a. Use like layer tinting except that only one color is used.
b. Light shades for low level lands and darker shades for successively higher levels of terrain.
c. Shading does not give determination of elevation but gives the effect of the relief.

Spot Elevation – are points on a map where they are indicated by numbers.

Contour Lines – is an imaginary line on the surface of the earth at the same elevation above or below sea level.

Uses:

a. to indicate elevation
b. to show the relative configuration of the ground
c. to analyze terrain

Characteristics:

a. indicate vertical distance
b. small curving lines
c. has the same elevation
d. distance between them are the same and never met
e. brown color

Types of Contour:

a. **Index Contour** – every fifth contour line is an inches line and is indicated by heavier brown line.
b. **Intermediate Contour** – are the four lighter contour lines drawn between the index contours.
c. **Supplementary Contour** – represents half intervals between intermediate contours and is shown by brown lines.
d. **Depression Contour** – an area that is lower in elevation that all the surroundings terrain is indicated tick marks pointing down slope.
e. **Approximate Contour** - are broken lines of the same thickness and type as the contour replayed.

Using Contour Lines to Identify Ground Forms:

a. **Hills** – represented by series of concentric contour lines which gradually grow smaller, ending with a small closed contour line in the center.
b. **Peaks of Hill Tops** – a small closed, relatively circular contour at the center of the series of concentric contour line identifies a peak or hill top.
c. **Ridges** – a ridge is a series of connecting peak or hills indicated by a series of elongated contour lines.
d. **Saddles** – is a low point between two peaks along the crest of a ridges.
e. **Spur** – contour lines that form a series of successive rounded U shapes.
f. **Cliff C** – lines that form a series of successive V-shape, a stream course that neither has nor developed a valley floor.
g. **Draw C** – lines that form a series of successive V-shape, a stream course that neither has nor developed a valley floor.

TWO TYPES OF AZIMUTH

Forward Azimuth
Back Azimuth

PROCEDURE ON HOW TO GET THE BACK AZIMUTH

When the Forward Azimuth is less than 180 degrees, add 180 degrees in order to get the Back Azimuth.

FORWARD AZIMUTYH = 75 degrees

75 degrees
\+ 180 degrees
255 degrees is the Back Azimuth

When the Forward Azimuth is more than 180 degrees, less 180 degrees in order to get the Back Azimuth.

FORWARD AZIMUTH = 245 degrees

245 degrees
\- 180 degrees
65 degrees is the Back Azimuth

When the Forward Azimuth is 180 degrees, either add 180 degrees or less 180 degrees to get the Back Azimuth.

FORWARD AZIMUTH = 180 degrees FORWARD AZIMUTH = 180 degrees

180 degrees
\+ 180 degrees
360 degrees Back Azimuth

PROBLEM:	FA = 280	BA = _____
	FA = 90	BA = _____
	FA = 355	BA = _____
	FA = 183	BA = _____
	FA = 35	BA = _____

UPDATING THE DECLINATION DIAGRAM - The difference between GRID NORTH and MAGNETIC NOTH is GRID MAGNETIC ANGLE. The diagram at the bottom of lower maps tells you how to change grid azimuth to magnetic azimuth.

PROCEDURES:

1. Determine the number of years
2. Substitute from the present year
3. Multiply with the Annual Magnetic Change (AMC)
4. Determine the direction of the Magnetic Angle (MA)
5. Re-draw the present Grid Magnetic Angle (GMA)

GIVEN:

GMA = Grid Magnetic Azimuth

MA = Magnetic Azimuth
MA = 1 degree to 30 minutes
Effective of Diagram – 1 minute E

SOLUTION:

1986
- 1944
42 years x 1 minute E

= 42 minutes
1 degree to 30 seconds
+ 42 seconds
1 degree to 72 seconds of 2 degrees 12 minutes E

G – M Angle = 2 degrees 12 EAST

BEARING – express a direction as an angle measured east or west from a north deference. Bearing cannot exceed 90 degrees or one quarter of a circle. One quarter of a circle is known as quadrant.

TO GIVE A BEARING THE FOLLOWING INFORMATION IS NECESSARY

1. The reference line from which measured (north or south)
2. The amount of angle
3. The direction in which the angle was measured (east or west). A bearing of N 30 degrees E means from a north line and angle of 30 degrees measured in an eastward direction.
4. The four cardinal directions are expressed simply as north, east, south and west.

FORMULA IN SOLVING FOR BEARING

QUADRANT I	= AZ	=	N (AZ) E
QUADRANT II	= AZ	=	S (180-Z) E
QUADRANT III	= AZ	=	S (AZ-180) W
QUADRANT IV	= AZ	=	N (360-AZ) W

EXAMPLE:

GIVE THE BEARING OF THE FOLLOWING:

354 degrees _____
45 degrees _____
105 degrees _____

GIVE THE AZIMUTH OF THE FF:

N43 degrees W _____
S43 degrees W _____
N43 degrees E _____

THE COMPASS AND ITS USES:

The Magnetic Compass is the most commonly used and simplest instrument for measuring direction and angles in the field. Two varieties of magnetic compass are standard for

military use today, the lensatic compass and the artillery compass (M2). Since the latter is a special purpose compass, it will not be discusses on it. This is referred to as the Lensatic Compass.

CARE AND USE OF COMPASS:

1. Handle the compass with care. The dial is set at a delicate balance and a shock could damage.
2. Close and return the compass to its special container when not in use. In this way, it is not only protected from possible damage, but is readily available for use when needed.
3. When the compass is used in the dark, an initial azimuth should be set, it possible, while light is still available. With this, initial azimuth set, any other azimuth can be established using this as a base.
4. Compass reading should never be taken near visible masses of iron or electrical circuits. The following is the table of approximate safe distances to insure proper functioning of the compass.

a.	High tension power lines	-	55 meters
b.	Field Gun, truck or tank	-	18 meters
c.	Telegraph and telephone wires or barbwire	-	10 meters
d.	Machine Gun	-	1 meter
e.	Helmet or Rifle	-	2 meters

PARTS OF LENSATIC COMPASS

1.	Luminous Dot	10.	Eye Piece
2.	Cover	11.	Holding Ring
3.	Front Sight (Hair Line)	12.	90 Degrees Dot
4.	Dial	13.	180 Degrees Dot
5.	Stationary Index	14.	270 Degrees Dot
6.	Movable Brass Rim	15.	Movable Crystal
7.	Scale		a. Long Luminous Line
8.	Rear Sight		b. 45 Degrees Luminous Line
9.	Lens	16.	Rim Holder

ORIENTATION OF A MAP

Before a map can be used it must be oriented. A map is oriented when it is in a horizontal position with its north and south corresponding to north and south on the ground.

HOW TO ORIENT THE MAP

By the use of the **Lensatic Compass** – the map is oriented with the aid of Lensatic Compass and the use of the declination diagram.

1. With the map in the horizontal position, the compass is placed parallel to a north-south grid lines with the cover side of the compass pointing toward the top of the map. This will place the black index line on the dial of the compass parallel to grid north. Since the needle on the compass point to magnetic north, we have a declination diagram on the face of the compass formed by the index line and compass needle.
2. Rotate map and compass until the directions of the declination diagram formed by the black index line and the compass needle match the direction shown on the declination diagram printed on the margin of the map. The map is then oriented.

BY INSPECTION:

When compass is not available, map orientation requires a careful examination of the map and the ground to find linear features common to both, such as roads, railroad, fence, lines, power lines etc. By aligning the feature on the map with the same feature on the ground. The map is now oriented.

INTERSECTION

The location of an unknown point by successively occupying at least two but preferably three known positions and sighting point is called intersection. It is used to locate features that are not defined on the map or which not readily identifiable. The two methods:

1. **MAP AND COMPASS METHOD**

   a. Orient the map using the compass
   b. Locate and mark your position on the map
   c. Measure the magnetic azimuth to the unknown position, convert to grid azimuth.
   d. Draw a line on the map from your position on this grid azimuth.
   e. Move to a second known position on the map and again orient the map using the compass.
   f. Repeat c and d

2. **STRAIGHT EDGE METHOD:**

   a. Orient the map on a flat surface by the inspection method.
   b. Locate and mark your position on the map.
   c. Lay straight edge on the map with one edge at users position (A). As a pivot.
   d. Point and rotate the straight edge until the unknown point is sighted along the edge.
   e. Draw a line along the straight edge.
   f. Repeat the above procedure at position (B) and for a check on accuracy at a third position.
   g. The intersection of the lines is the location of the unknown point (C).

RESECTION:

The location of the user's position by sighting on two or three known features is called Resection. Resection can be done with or without compass.

A. MAP AND COMPASS:

   1. Orient the map using compass.
   2. Locate two or three unknown positions on the ground and mark them on the map.
   3. Measure the magnetic azimuth to a known position; convert to grid azimuth.
   4. Change the grid azimuth to a back azimuth and draw a line on the map from the known position back toward your unknown position.
   5. Repeat (3) and (4) above for a second known position.

6. For a check on your accuracy, repeat (3) and (4) above for a third known position.
7. The intersection of the lines is your position.

B. STRAIGHT EDGE METHOD: (When no compass is available)

1. Orient the map on a flat surface by the inspection method.
2. Locate two or three known position on the ground and mark them on the map.
3. Lay straight edge on the map as a center of the straight edge at a known position pivot point and rotate the straight edge until the known position on the map is aligned with the known position on the ground.
4. Draw a line along the straight edge until the known position on the ground towards your position.
5. Repeat (3) above using a second known position and as a check on your accuracy repeat (3) above using a third known position.

DETERMINIGN DIRECTIONS USING FIELD EXPEDIENTS:

SHADOW TIP – method of determining direction and time.

1. This simple and accurate method of finding direction by the sun consist of only three (3) basic steps.

   a. **Step 1** – place a stick or branch into the ground at a fairly level spot where a distinct shadow will be cast. Mark shadow tip with a stone or other means.
   b. **Step 2** – wait until the shadow tip moves a few inches. If you are using a 4-foot (1.22 meters) stick, about 10 minutes should lapse.
   c. **Step 3** – Draw a straight line through two marks to obtain an approximate east-west line. If you are uncertain which direction is east and which is west, observe this rule.

"The sun rises in the east and sets in the west" (but rarely DUE west). The shadow tip moves in just the opposite direction. Therefore the first shadow tip mark is always in the west direction, and the second mark in the east direction, everywhere on earth.

2. A line drawn at right angle to the east west line at any point is the approximate north south line, which will help orient you to any desired direction of travel.
3. Inclining the stick to obtain a more convenient shadow, in size of direction, does not the accuracy of the shadow tip method. Thus, a traveler on sloping ground or in highly vegetated terrain need not waste time valuable looking for a sizable area. A flat dirt spot the size of your hand is all that is necessary for shadow-tip markings, and the base of the stick can either be above, below or to one side of it. Also, any stationary objects (on the end of a tree limb) serves just as sell as an implanted stick, because only the shadow tip is marked.

POLAR COORDINATES

STRAIGHT LINE AZIMUTH – a point on the map may be determined or plotted from a known point by giving a direction and a distance along that direction line. This method of pint location uses polar coordinates. The reference direction is normally expressed as an azimuth and the distance in any convenient unit of measurement such as meters or yards. Polar coordinates are

especially useful in the field because magnetic azimuth can be determined from the compass and the distance can be estimated.

ELEVATION AND RELIEF

A knowledge of map symbols, grids, scale and distance gives enough information to identify two point, locate them, measure between them and determine how long it would take to travel between them. But what happens if there should be a 300-foot cliff between the two points? The map user must also become proficient in recognizing the various landforms and irregularities of the earths surface and be able to determine the elevation and differences in height of all terrain features.

1. **Datum Place** – this is a reference from which vertical measurement are taken. The datum plane for most maps is mean or average sea level.
2. **Elevation** – this is defined as the height (vertical distance) of an object above or below a datum plane.
3. **Relief** – is the representation of the shape and height of landform and the characterization of the earth surface.

The elevation of points and the relief of an area affect the movement and deployment of units by limiting the route along which they may travel, their speed of movement and the ease of difficulty of attacking or defending an area. Also affected are observation, fields of fire, cover and concealment and the selection of key terrain features.

CONTOUR LINE

There are several ways of indicating elevation and relief on the maps. The most common way is by contour lines. A contour line is a line representing an imaginary line on the ground along which all points are at the same elevation. Contour lines indicate a vertical distance above or below a datum plane. Starting at sea level. The vertical distance between adjacent contour lines is known as the contour interval and the amount of the contour interval is given in the marginal information. On most maps the contour lines are printed in brown. Starting at zero elevation, every fifth contour line is drawn in heavier line. These are known as index contours and some place along each index contour the line broken and its elevation is given. The contour lines falling between the index contours are called intermediate contours. They are drawn in a finer line than the index contour and usually do not have their elevation given.

HOW TO DETERMINE THE ELEVATION USING THE CONTOUR LINES

1. Finding the contour interval from the marginal information and noting both the amount and the unit of measure.
2. Finding the numbered contour line or given elevation nearest the point which the elevation is being sought.
3. Determining the direction of the slope from the numbered contour line to the desired point.
4. Counting the number of contour lines that must be crossed to go from numbered line to the desired point and noting the direction up or down. The number of lines crossed multiplied by the contour interval is the distance above or below the starting value.

    a. If the desired point is contour line, its elevation is that of the contour.
    b. To estimate the elevation of the top of an unmarked hill, add half the contour interval to the elevation of the highest contour line around the hill.

THE SPACING OF THE CONTOUR LINES INDICATES THE NATURE OF THE SLOPE

1. Contour lines evenly spaced and wide apart indicates a uniform, gentle slope.
2. Contour lines evenly spaced and closed together indicate a uniform, steep slope. The closer the contour lines to each other, the steeper the slope.
3. Contour line closely spaced at the top and widely spaced at the bottom indicate a concave slope. Considering relief only an observer at the top of a concave slope can observe the entire slope and the terrain at the bottom. Conversely, a unit attacking up such slope would no cover and concealment from observers or weapons at or hear the top, also the farther top the slope the more difficult is to climb.
4. Contour lines widely spaced at the top and closely spaced at the bottom indicate a convex slope. An observer at the top of a convex slope has no observation of most of the slope or of the terrain at the bottom. Conversely, a unit attacking up such slope has a such greater degree of cover and concealment than on a concave slope, also the farther up the slope the easier is the climb.

MAJOR RELIEF FORMATION

1. **Hill** – a point or small area of high ground. When you are located on a hilltop, the ground slopes down in all direction.
2. **Valley** – a stream course which has at least a limited extent of reasonably level ground bordered on the sides by higher ground. Contours indicating a valley are U-shaped and tend to parallel a major stress before crossing.
3. **Ridge** – a line on high grounds, with normally minor variation along it. The ridge is not simply a line of hills, all point of the ridge crest are appreciably higher than the ground on both sides of the ridges.
4. **Spur** – a usually short, continuously sloping line of higher ground normally jutting out from the side of a ridge. A spur is often formed by two roughly parallel streams cutting draws down the side of ridge.
5. **Saddle** – a dip or low point along the crest of a ridge. A saddle is not necessarily the lower ground between two hilltops, it may be simply a dip or break along and otherwise level ridge crest.
6. **Depression** – a low point or sinkhole, surrounded on all sides by higher grounds.
7. **Cuts and Fills** – man made features by which the bed of a road or a railroad is graded or leveled off by cutting through high areas and filling in low areas along the right-of-way.
8. **Cliff** – a vertical of near vertical slope. When a slope is so steep that it cannot be shown at the contour interval without the contour coalescing, it is shown by a ticked “carrying” contour or contours. The ticks always point towards lower ground.