UNITED STATES MARINE CORPS
THE BASIC SCHOOL
MARINE CORPS TRAINING COMMAND
CAMP BARRETT, VIRGINIA 22134-5019

DIRECTION W140003XQ STUDENT HANDOUT

Direction

Introduction

Military personnel need a way of expressing direction that is accurate, adaptable to any part of the world, and has a common unit of measure.

Importance

Being in the right place at the prescribed time is necessary for successfully accomplishing military missions. Direction plays an import role in a Marine's everyday life.

In This Lesson

This lesson will define the word azimuth and the three different norths. It explains in detail how to determine the grid and the magnetic azimuths with the use of the protractor and the compass. It explains the use of the declination diagram, and the conversions of azimuths from grid to magnetic, and vice versa.

This lesson covers the following topics:

Learning Objectives

Terminal Learning Objective

TBS-PAT-1002 Given a military topographic map, protractor, lensatic compass, and objective, navigate with a map and compass, to arrive within 100 meters of the objective.

Enabling Learning Objectives

TBS-PAT-1002a Given a military topographic map, identify marginal information, without error.

TBS-PAT-1002g Given a military topographic map, protractor, and two points on a map, determine grid azimuth, to within 3 degrees.

Learning Objectives Continued

TBS-PAT-1002h Given a military topographic map, protractor, a grid azimuth, and compass error, convert an azimuth, without error.

TBS-PAT-1002i Given a military topographic map, protractor, and two points on a map, determine a back azimuth to within 3 degrees.

Direction Defined

Direction

Definition: The line or course on which something is moving or is aimed to move or along which something is pointing or facing.

Required Elements for Land Navigation:

- A unit of angular measure.
- An understood base line.
- An angle measured from that base line.

Methods for Expressing Direction: The Units of Angular Measure

Introduction

Directions are expressed as units of angular measure, such as:

Degree

The most common unit of measure is the degree (°) with its subdivisions of minutes (′) and seconds (″). The degree expresses the size of an angle formed when a circle is divided into 360 angles with the vertex of the angles at the center of the circle.

Mils

The mil is used mainly in artillery, tank, and mortar gunnery. The mil expresses the size of an angle formed when a circle is divided into 6400 angles with the vertex of the angles at the center of the circle.

Grad

The grad is a metric unit of measure found on some foreign maps. There are 400 grads in a circle (a 90-degree right angle equals 100 grads). The grad is divided into 100 centesimal minutes (centigrads) and the minute into 100 centesimal seconds (milligrads). Note: You will not be evaluated here at TBS for the unit of measure.

Base Lines: The Understood Base Line

True North

- A line from a point on the earth's surface to the North Pole.
- All lines of longitude are true north lines.
- True north is usually represented by a star.

Base Lines: The Understood Base Line (Continued)

Magnetic North

- Is the direction to the north magnetic pole.
- This is indicated by the north-seeking needle of a magnetic instrument.
- The magnetic north is usually symbolized by a line ending with half of an arrowhead.

Grid North

- Established by using vertical grid lines on the map.
- Do not converge at North Pole.
- May be symbolized by the letters GN or the letter “y.”

Azimuths: The Angle Measured from the Base Line

Definition

A horizontal angle measured clockwise from a north base line. This north base line could be true north, magnetic north, or grid north.

- When using an azimuth, the point where the azimuth originates is the center of an imaginary circle.

Grid Azimuth

When an azimuth is plotted on a map between point A (starting point) and point B (ending point), the points are joined by a straight line.

- A protractor is used to measure the angle between grid north and the drawn line, and this measured azimuth is the grid azimuth.

Magnetic Azimuth

This is determined by using magnetic instruments such as a lensatic and M2 compasses.

Azimuths: The Angle Measured from the Base Line (Cont)

Determining A Grid Azimuth

Step	Action
1	Determine the start point and objective.
2	Draw a line between these points. Ensure this line is at least two inches long to facilitate use of the protractor.
3	Place protractor on the map, ensuring that it is correctly oriented (i.e., north on protractor corresponds to grid north on map).
4	Read the grid azimuth from the degree scale.

Determining a Back Azimuth

This is the opposite direction of an azimuth. It is comparable to doing an "about face." To obtain a back azimuth from an azimuth, add 180° if the azimuth is 180° or less; subtract 180° if the azimuth is 180° or more. The back azimuth of 180° may be stated as 0° or 360°.

Examples:

14°	310°
+180°	-180°
194°	130°

Declination and Declination Diagram

Declination

The angular difference between two norths. Having a map and a compass, the most interest is between magnetic and grid north.

Grid Declination

- Is the angular difference between true north to grid north.
- Expressed in degrees east or degrees west.
- Example: 6°E

Magnetic Declination

- Is the angular difference between true north to magnetic north.
- Expressed in degrees east or degrees west.
- Example: 5°W.
- It has been proven that the geomagnetic poles migrate over time. This means that the effect on the declination diagram varies depending on location.
- The National Oceanic and Atmospheric Administration provides a magnetic field calculator to calculate declination. This will prove useful when operating with old maps.
- Go to http://www.ngdc.noaa.gov to find this calculator.

Declination and Declination Diagram (Cont)

Declination Diagram

A declination diagram is part of the information in the lower margin on most larger maps. On medium-scale maps, the declination information is shown by a note in the map margin (see Figure 1). Other map information includes:

Grid convergence

An arc indicated by a dashed line connects the prongs for true north and grid north.

- The value is given to the nearest full minute, with its equivalent to the nearest mil.
- These data are shown in the form of a grid-convergence note.

Conversion

This is the angular difference between the grid north and the magnetic north. Since the location of the magnetic north does not correspond exactly with the grid-north lines on the maps, a conversion from magnetic to grid or vice versa is needed.

Grid-magnetic (G-M) angle

The G-M angle is the angular difference between grid north and magnetic north. It is an arc, indicated by a dashed line that connects grid-north and magnetic-north prongs.

- The value is expressed to the nearest ½ degree.

The G-M angle is important to the map reader/land navigator because azimuths translated between map and ground are in error by the size of the declination angle, if not adjusted for it.

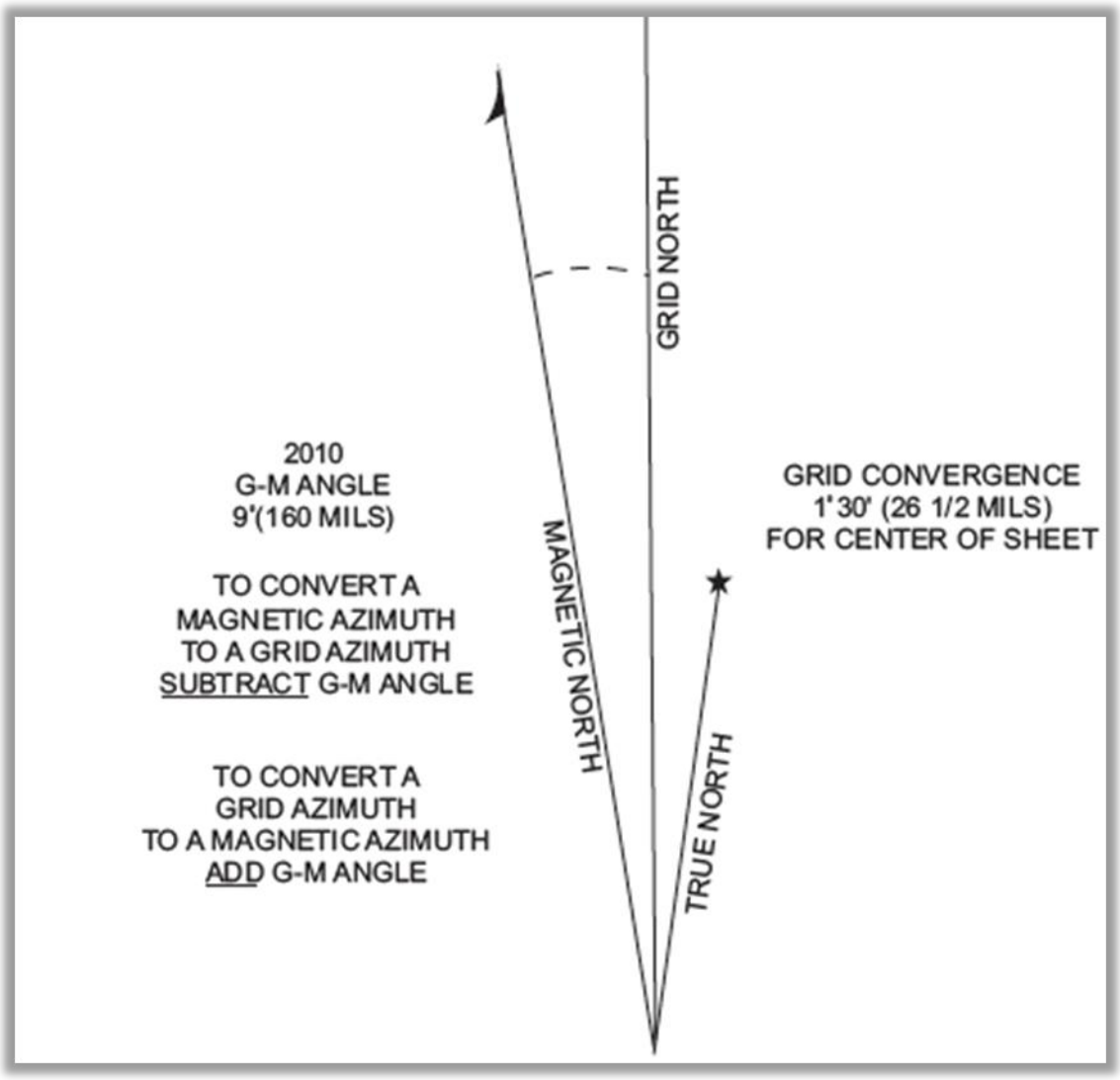


Figure 1 (Declination Diagram)

Declination Conversion of Grid and Magnetic Azimuths

Utilizing the Declination Diagram

A magnetic compass gives a magnetic azimuth, but in order to plot this line on a gridded map, the magnetic azimuth value is changed to grid azimuth. The opposite process is done for converting a grid azimuth to a magnetic azimuth. The declination diagram is used for these conversions.

Declination Conversion of Grid and Magnetic Azimuths (Cont)

Principles of Conversion

Conversions depend on whether one is converting easterly or westerly G-M angles, the degree of declination change, and whether one is going from magnetic to grid azimuth, or the opposite.

- From an easterly magnetic azimuth to grid azimuth, one would add. To go from a easterly grid azimuth to magnetic azimuth, one would subtract.
- From a westerly magnetic azimuth to a grid azimuth, one would subtract. To go from a westerly grid azimuth to a magnetic azimuth, one would add.

	Westerly G-M Angle	Easterly G-M Angle
Grid Azimuth to Magnetic Azimuth	ADD	SUBTRACT
Magnetic Azimuth to Grid Azimuth	SUBTRACT	ADD

Example for Grid to Magnetic Azimuth (Westerly G-M angle)

G-M Angle= 14 Degrees West
Grid Azimuth = 93 Degrees
Add G-M Angle = +14 Degrees
Magnetic Azimuth = 107 Degrees

Example for Grid to Magnetic Azimuth (Easterly G-M Angle)

G-M Angle= 17 Degrees East
Grid Azimuth = 303 Degrees
Subtract G-M Angle = -17 Degrees
Magnetic Azimuth = 286 Degrees

Example for Magnetic to Grid Azimuth (Westerly G-M Angle)

G-M Angle= 5 Degrees West
Magnetic Azimuth = 65 Degrees
Subtract G-M Angle = -5 Degrees
Grid Azimuth = 60 Degrees

Example for Magnetic to Grid Azimuth (Easterly G-M Angle)

G-M Angle= 12 Degrees East
Magnetic Azimuth = 210 Degrees
Subtract G-M Angle = +12 Degrees
Grid Azimuth = 222 Degrees

Declination Conversion of Grid and Magnetic Azimuths (Cont)

Converting Angles Greater than 360 Degrees and Angles Less than 0 Degrees.

1. When the converted angle is greater than 360 degrees (e.g. Grid Azimuth 357 degrees + 18 (G-M Angle) = 375 degrees magnetic) one must subtract 360 degrees. 375-360= 15 Degrees Magnetic.

2. If angle is less than 0 degrees (e.g. Grid Azimuth 5 degrees - 12 (G-M Angle) = -7 Degrees magnetic) one must add 360 degrees. -7 +360= 353 degrees magnetic.

Other Common Methods for Grid to Magnetic Conversions and Vice Versa.

There are three common methods for converting between grid and magnetic azimuths; it is *vital* to understand that these three methods are different ways of determining the *same information.* It is equally important to find the method that works best for you and to ignore the others. While it is easy to interpose the rules from LARS and MAGMGA, such a mix up will invariably lead to incorrect map work.

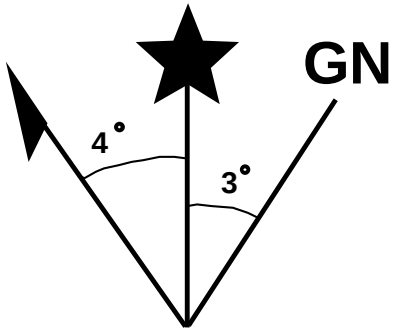
All azimuth questions can be solved in three general steps:

1. Determine the GM angle.
2. Determine the known azimuth.
3. Solve for the unknown azimuth.

LARS

LARS stands for **Left Add, Right Subtract**, and is used when going from *the known azimuth* to the *unknown azimuth,* irrespective of grid or magnetic azimuth*.* Once one has created a declination diagram and found the GM angle, LARS users are concerned only with the direction (right or left) from the known angle (azimuth) to the unknown angle, for the cardinal direction (east or west) is no longer relevant. Once the appropriate direction is determined, the GM angle is then added or subtracted to the known azimuth.

In this example, the known azimuth is 270 magnetic. Using LARS, convert to a grid azimuth.



1. GM Angle= 7W
2. Known= 270 **mag**
3. Going from the known (line representing mag az), to the unknown (line representing grid az) we went RIGHT. Now subtract the GM angle of 7 to find a grid azimuth of 263 deg.

Utilizing Azimuths (Continued)

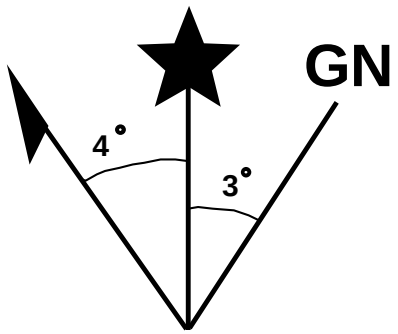
MAGMGA

MAGMGA is nothing more than an equation into which one fills known information and then solves for the unknown. The equation is expressed as follows:

Mag Az (MA) +/- GM angle (GM) = Grid Azimuth (GA)

The rule one must remember is EAST ADD, WEST SUBTRACT with regard to the GM angle.

As in the previous example of a 270 mag az, we must solve for GM angle first:



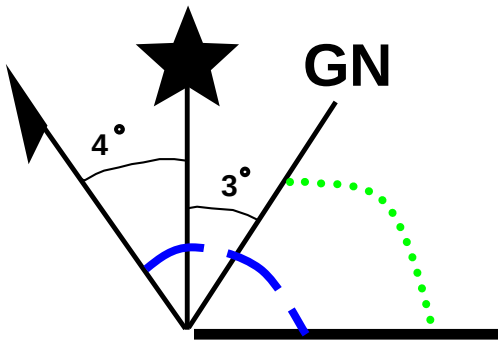
1. GM Angle = 7W
2. Known = 270 mag az
3. Plug in known, solve for unknown.

270 (MA) **–** (because it's W) 7 (value of the GM angle) = 263 deg (GA)

Utilizing Azimuths (Continued)

Picture Method

A third way to utilize the GM angle to convert azimuths is called the Picture Method. Begin by drawing a declination diagram and determining the GM angle; next, draw an arbitrary line at a 90 degree angle to true north. This arbitrary line represents the known angle. By drawing arrows from both the known line and the unknown, one can determine which angle is larger and whether or not to add or subtract the GM angle.



Here, the dashed line represents the known mag azimuth. The dotted line from GN represents the unknown grid azimuth. As one can see, the GN line is smaller; the GM angle, therefore, will be subtracted from the mag az to yield a grid az of 263 degrees.

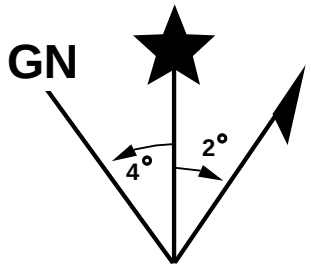
Review Questions

Requirement 1

Map: Margarita Peak, California, 1:50,000, Sheet 2550 IV Series V795, Edition NGA

Section 1: Question 1

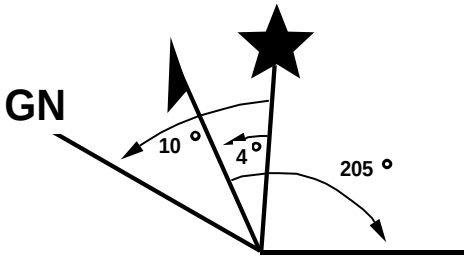
What is the GM angle in the following diagram?



Answer: _____

Question 2

What is the grid azimuth in the following diagram?



Answer: _____

Question 3

Draw the diagram and solve the following problems.

a. Magnetic declination = 3° E
Grid declination = 7° E
Magnetic azimuth = 209°
Grid azimuth = _____

b. Grid declination = 7° E
Magnetic declination = 5° W
Magnetic azimuth = 92°
Grid back azimuth = _____

Review Questions, Requirement 1 (Continued)

Requirement 1
Section 1 (Continued)
Question 4

From the earthen dam in MS7082 on a magnetic azimuth of 29 degrees to the first four lane road, how many streams do you cross?

Question 5

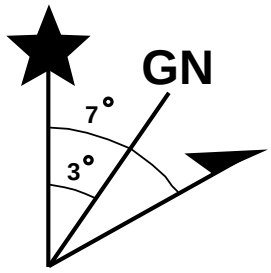
What is the magnetic azimuth from…

a. the tower in MS6185 to the south eastern corner of the culvert in MS 6489?

b. the northern most structure hill 259 (spot elevation 259) in MS5993 to the center of the northern bridge in MS6191?

Section 2:
Question 1

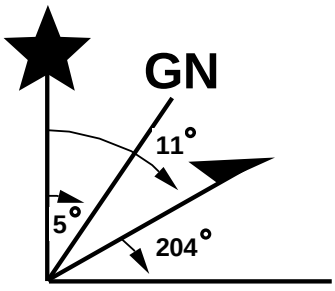
What is the GM angle in the following diagram?



Answer: _____

Question 2

What is the grid back azimuth in the following diagram?



Answer: _____

Review Questions, Requirement 1 (Continued)

Requirement 1
Section 2 (Continued)
Question 3

Draw the diagrams and solve the following problems.

a. GM angle = 6° W
Grid azimuth = 149°
Magnetic azimuth = _____

b. Grid declination = 4° W
Magnetic declination = 1° W
Magnetic azimuth = 200°
Grid back azimuth = _____

Question 4

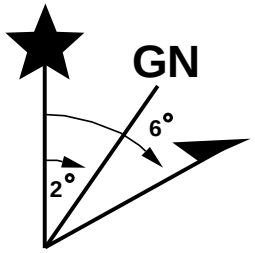
From the Del Rio Elementary School in MS7380 on a magnetic azimuth of 33 degrees for 1200 meters, how many all weather hard surface roads will you cross?

Question 5

You are standing inside the Marine Corps Air Station Camp Pendleton Control Tower in MS6784 and observe a structure on a magnetic azimuth of 241 degrees. The structure appears to be between two and three kilometers from your position. You reference your map; what structure is this?

Section 3:
Question 1

What is the GM angle in the following diagram?

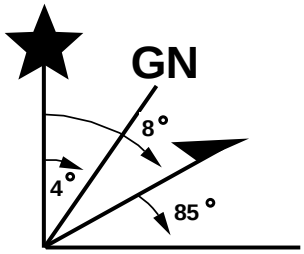


Answer: _____

Review Questions, Requirement 1 (Continued)

Requirement 1
Section 3 (Continued)
Question 2

What is the grid back azimuth in the following diagram?



Answer: _____

Question 3

Draw the diagrams and solve the following problems.

a. GM angle = 5° E
Grid azimuth = 199°
Magnetic back azimuth = _____

b. Grid declination = 5° W
Magnetic declination = 3° W
Magnetic azimuth = 163°
Grid back azimuth = _____

Question 4

From hill 786 in MT6204 you observe another hill to your northwest and determine it must be the hill labeled 751 on your map. What magnetic azimuth should you see on your compass when you orient yourself towards that hill?

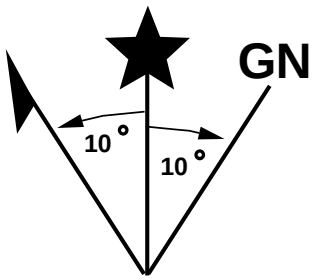
Question 5

You are flying lead in a section of AH-1W Cobras out of Marine Corps Air Station Camp Pendelton. Your flight plan has you traveling south towards hill 216 in MS5988 and then over Las Flores before heading back to the Air Station. Just as you pass hill 216 you receive radio traffic to divert to the heliport in MS5783. You pick out hill 238 in MS 5986 ahead of you; what magnetic azimuth should you follow from this hill to the heliport?

Review Questions, Requirement 1 (Continued)

Section 4:
Question 1

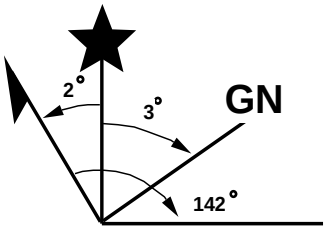
What is the GM angle in the following diagram?



Answer: _____

Question 2

What is the grid azimuth in the following diagram?



Answer: _____

Question 3

Draw the diagram and solve the following problems.

a. Magnetic declination = 4° W
Grid declination = 3° E
Magnetic azimuth = 113°
Grid azimuth = _____

b. Grid declination = 2° E
Magnetic declination = 7° E
Magnetic azimuth = 279°
Grid back azimuth = _____

Question 4

Your platoon must traverse from hill 953 on Margarita Peak along a magnetic azimuth of 60 degrees for 1700 meters to your next objective. How many times should you expect to cross a stream along your route?

Question 5

What is the magnetic azimuth from the…

a. Fallbrook Elementary School in MS7693 to hill 250 in MS7393?

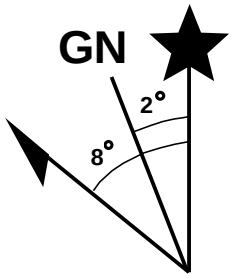
b. the center building at Camp De Luz in MS6992 to the northern most bridge in MS6691?

Review Questions, Requirement 1 (Continued)

Requirement 1

Section 5: Question 1

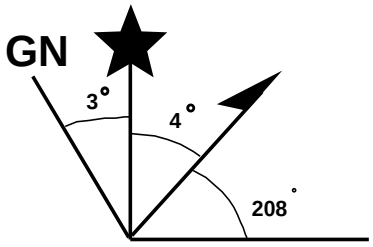
What is the GM angle in the following diagram?



Answer: _____

Question 2

What is the grid back azimuth in the following diagram?



Answer: _____

Question 3

Draw the diagrams and solve the following problems.

a. GM angle = 6° W
Grid azimuth = 136°
Magnetic azimuth = _____

b. Grid declination = 4° W
Magnetic declination = 1° W
Magnetic azimuth = 358°
Grid back azimuth = _____

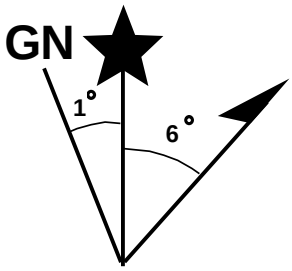
Question 4

Your scout sniper team is atop hill 281 in MS5499 conducting surveillance training. They spot a red cell Marine emplacing what appears to be an Improvised Explosive Device (IED) inside a culvert closest to their position in MS5599. What should they read on their compass when confirming the culvert's azimuth from their current location?

Review Questions, Requirement 1 (Continued)

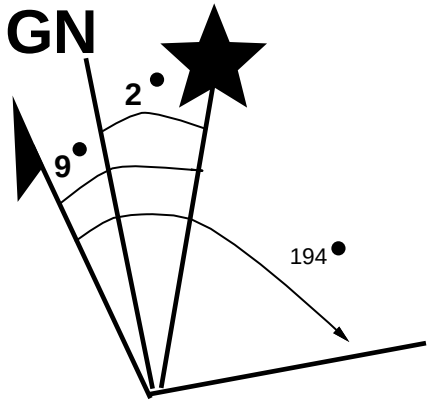
Requirement 1
Section 6:
Question 1

What is the GM angle in the following diagram?



Answer: _____

Question 2 What is the grid back azimuth in the following diagram?



Answer: _____

Question 3 Draw the diagrams and solve the following problems.

a. GM angle = 5° E
Grid azimuth = 27°
Magnetic back azimuth = _____

b. Grid declination = 5° E
Magnetic declination = 3° W
Magnetic azimuth = 163°
Grid back azimuth = _____

Review Questions, Requirement 1 (Continued)

Requirement 1
Section 6 (Continued)
Question 4

You have to relocate one of your squad's Vehicle Check Points (VCP) from the intersection of the trail and the all-weather loose surface road in MS5984 to a new location. You direct your squad leader to move his Marines to a nearby man-made feature in order to beter control an avenue of approach. You help orient him by telling him this manmade feture is on a magnetic azimuth of 268 degrees for 1950 meters from his current position. What manmade feature are you directing him to towards?

Question 5

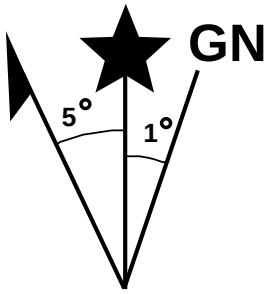
Solve the following problems.

a. What is the magnetic azimuth from the Pacific Elementary School in MS 7179 to the earthen dam in MS7082?

b. What is the grid back azimuth for the above problem?

Question 6

Given the below diagram and information, determine the GM angle for the current year.



Annual magnetic change = 15′ Easterly
Original map date = 1963
Current year = 2011

Answer: _____

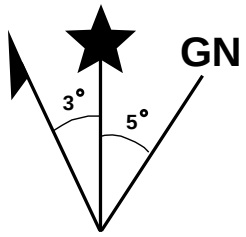
Review Questions, Requirement 2

Requirement 2

Map: New River, 1:50,000, Sheet 5553 III, Seriew V742, Edition 9-NGA

Section 1: Question 1

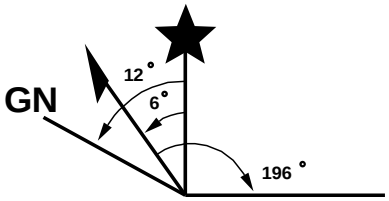
What is the GM angle in the following diagram?



Answer: _____

Question 2

What is the grid azimuth in the following diagram?



Answer: _____

Question 3

Draw the diagram and solve the following problems.

a. Magnetic declination = 4° E
Grid declination = 9° E
Magnetic azimuth = 254°
Grid azimuth = _____

b. Grid declination = 5° E
Magnetic declination = 3° W
Magnetic azimuth = 122°
Grid back azimuth = _____

Review Questions, Requirement 2 (Continued)

Requirement 2

Section 1 (Continued)
Question 4

One of your squads is at the intersection of the fair weather loose surface road and the all-weather loose surface road in TD8038. You direct him on a magnetic azimuth of 230 degrees for 2900 meters in order to conduct a resupply. How many roads (of any type) can you tell him to expect enroute to the resupply point?

Question 5

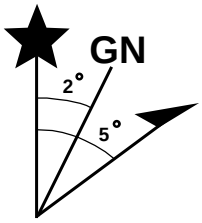
What is the magnetic azimuth from

a. Union Chapel in TD8942 to the Kellumtown School in TD9143?

b. the southern most tower in TD8539 to the water tower in TD8636?

Section 2:
Question 1

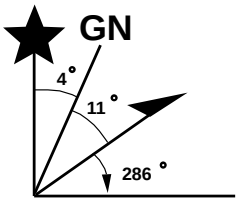
What is the GM angle in the following diagram?



Answer: _____

Question 2

What is the grid back azimuth in the following diagram?



Answer: _____

Review Questions, Requirement 2 (Continued)

Requirement 2
Section 2 (Continued)
Question 3

Draw the diagrams and solve the following problems.

a. GM angle = 9° E
Grid azimuth = 112°
Magnetic azimuth = _____

b. Grid declination = 5° W
Magnetic declination = 2° W
Magnetic azimuth = 198°
Grid back azimuth = _____

Question 4

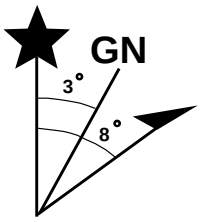
What is the magnetic azimuth from the church in TD7238 to the tower in TD7236?

Question 5

You are a member of an engineer support battalion conducting rafting operations in support of a company of tanks. The M1A1s must be ferried across the New River to the live fire ranges. You shoot an azimuth from the end of the fair weather loose surface road at Well's Point (TD8535) west towards the all-weather loose surface road at Rhode's Point (TD8235) in order to confirm the route. What should your compass read?

Section 3:
Question 1

What is the GM angle in the following diagram?

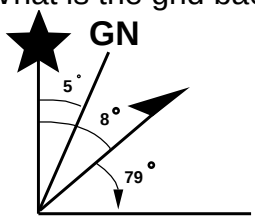


Answer: _____

Review Questions, Requirement 2 (Continued)

Requirement 2
Section 3 (Continued)
Question 2

What is the grid back azimuth in the following diagram?



Answer: _____

Question 3

Draw the diagrams and solve the following problems.

a. GM angle = 7° W
Grid azimuth = 161°
Magnetic back azimuth = _____

b. Grid declination = 5° E
Magnetic declination = 2° E
Magnetic azimuth = 147°
Grid back azimuth = _____

Question 4

You are flying a CH-53E north at 1000 feet Above Ground Level (AGL) and are about to pass over the fire tower in TD9032. You need to vector towards the all weather loose surface road at Well's Point (TD8535) that points towards the New River Air Station. What magnetic azimuth should you fly from the firetower in order to reach that road?

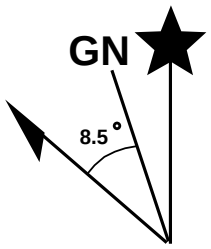
Question 5

Once you pass the road at Well's Point your copilot tells you to fly from the western most tip of Hadnot Point (TD8239) on a magnetic azimuth of 309 degrees for 5.1 kilometers. What manmade feature is he directing the helicopter towards?

Review Questions, Requirement 3

Requirement 3

You are a communications officer assigned to a Marine Expeditionary Unit (MEU) afloat. You have been tasked with setting up a radio relay site in support of an operation ashore. Your relay site will provide communications between the MEU (which has already landed on a hostile shore) and friendly ground forces. The current distance between these two forces is approximately 300 miles, and your relay site will be positioned approximately midway between them. The S-2 issues you the only maps he has of the area you are going into. After your initial map study, you determine that from your insertion point you must travel on a grid azimuth of 120° for 1200m over relatively featureless terrain to get to the best position for your relay site. The maps issued to you were printed in 1962. The declination diagram from the map is provided below. You must board the insertion aircraft 3 hours from *now*. Assume the current year is 1991.



APPROXIMATE MEAN DECLINATION 1960 FOR THE CENTER OF SHEET. ANNUAL MAGNETIC CHANGE 7′ WESTERLY.

Question 1

What is the GM angle you will use relating to this map?

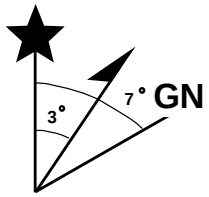
Question 2

What is the magnetic azimuth you would follow from your insertion point to the relay site?

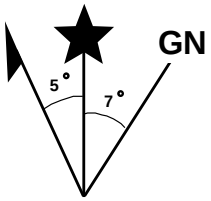
Review Answers, Requirement 1

Requirement 1
Section 1

1. 6° E
2. 211°
3. a. 205°



b. 260°

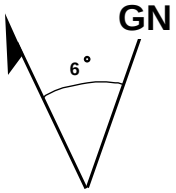


4. Three streams
5. a. 26°

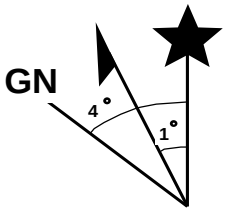
   b. 110°

Section 2

1. 4° E
2. 30°
3. a. 155°



b. 23°

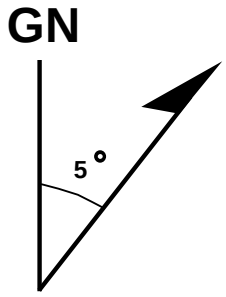


4. Two roads
5. 14°. Water intake tower in MS6584

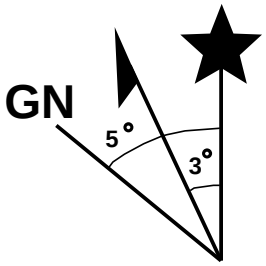
Review Answers, Requirement 1 (Continued)

Requirement 1 (Continued)
Section 3

1. 4° E
2. 269°



3. a. 14°

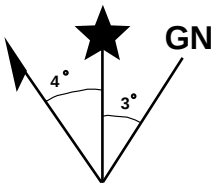


b. 345°

4. 313°
5. 204°

Section 4

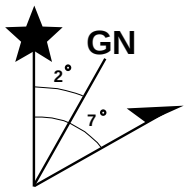
1. 20° W
2. 137°



3. a. 106°

Review Answers, Requirement 1 (Continued)

Requirement 1
Section 4 (Continued)

3 b. 

104°

4. Twice

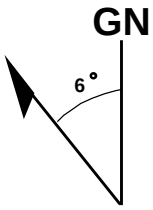
5. a. 264°

b. 243°

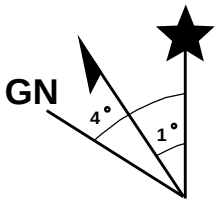
Section 5

1. 6° W

2. 35°

3. a. 

142°



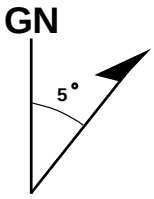
b. 181°

4. 52°

Section 6

1. 7° E

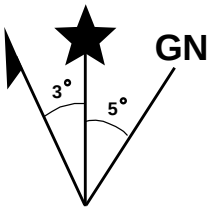
2. 7°

3. a. 

202°

Review Answers, Requirement 1(Continued)

Requirement 1
Section 1 (Continued)

3. b. 

335°

4. A bridge

5. a. 319°

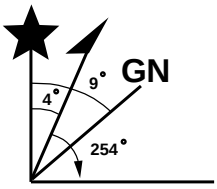
   b. 152°

6. 6° E

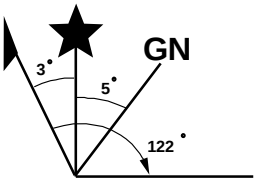
Requirement 2:
Section 1

1. 8° W

2. 202°

3. a. 

249°

   b. 

294°

4. Three roads

5. a. 102°

   b. 181°

Review Answers, Requirement 2 (Continued)

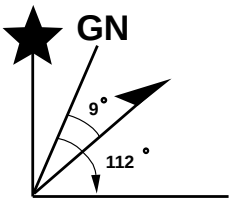
Requirement 2 (continued)

1. 3° E

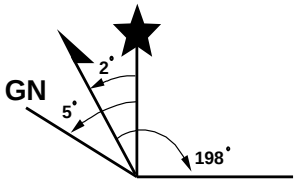
2. 113°

Section 2

3. a. 103°



b. 21°



4. 185°

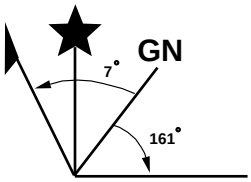
5. 283°

Section 3

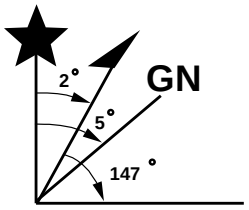
1. 5° E

2. 262°

3. a. 348°



b. 324°



4. 310°

5. The southern most tip of the north/south runway at the New River Air Station in TD7642

Review Answers, Requirement 3 (Continued)

Requirement 3

1. 12° W

To determine the current GM angle of the map:

a. Declination data as of 1960 with an annual change of 7′ Westerly.

b. Determine number of years:
1991
-1960
31 years

c. Multiply number of years by annual change:
31 years x 7′/year = 217′

d. Determine number of degrees change:
217′ ÷ 60′/degree = 3.6 = 3.5° (round to nearest .5°)

e. Apply change to update GM angle:

Old GM>		Change		Current GM>
8.5° W	+	3.5° W	=	12° W

2. 132°

To determine the azimuth, use one of the following methods:

a. MA ± GM = GA
E +
W –

Grid azimuth = 120°
MA -12° = 120°
MA - 12° + 12° = 120° + 12°
MA = 132°

b. LARS
You started with a GA, so go to the grid declination line and move to the mag declination line. You moved *L*eft, so you *A*dd the GM angle to the GA to determine the MA.

120° + 12° = 132°

Summary

You should now understand how to navigate between two plotted points on your map, identify the marginal information on a map that enables you to utilize a grid azimuth and converting it to magnetic azimuth and vice versa.

References

Reference Number or Author	Reference Title
TC 3-25.26	Map Reading and Land Navigation

Glossary of Terms and Acronyms

Term or Acronym	Definition or Identification
Az	Azimuth
CASEVAC	Casualty evacuation
DMA	Defense Mapping Agency
GA	Grid Azimuth
GM Angle	Grid-Magnetic angle
LARS	Left Add, Right Subtract
MA	Magnetic Azimuth
MAGMGA	Mag Az (MA) +/- GM angle (GM) = Grid Azimuth (GA)
MGRS	Military Grid Reference System
USGS	United States Geological Survey

Notes