

Lesson 4

Grid Reference Systems



Key Terms

grid coordinate
grid lines
grid squares
meridians
military grid reference system
prime meridian
superimposed
Universal Transverse Mercator Grid System

WHAT YOU WILL LEARN TO DO

- Use the Grid Reference System to locate points anywhere in the world

LINKED CORE ABILITIES

- Apply critical thinking techniques

SKILLS AND KNOWLEDGE YOU WILL GAIN ALONG THE WAY

- Locate grid zones and grid segments using the Universal Transverse Mercator Grid System
- Determine the six-digit coordinate within 100 meters of given locations on a map
- Define key words contained in this lesson

Introduction

This lesson introduces you to the Universal Transverse Mercator Grid System and the military grid reference system. After you are familiar with these systems and how mapmakers divide the globe into north-south and east-west rings, you can better understand how to locate and identify points anywhere in the world.

Chapter 1

Key Note Term

grid coordinate – a set of letters and numbers specifying the location of a point to the desired position within a 100,000 meter square

Figure 1.4.1: Meridians and parallels.

Courtesy of CACI and the US Army.

Key Note Term

meridian – an imaginary circle on the earth's surface passing through the North and South poles; a line or parallel of longitude

prime meridian – the line of longitude that passes through Greenwich, England, designated as zero degrees longitude, and from which longitude east and west is measured

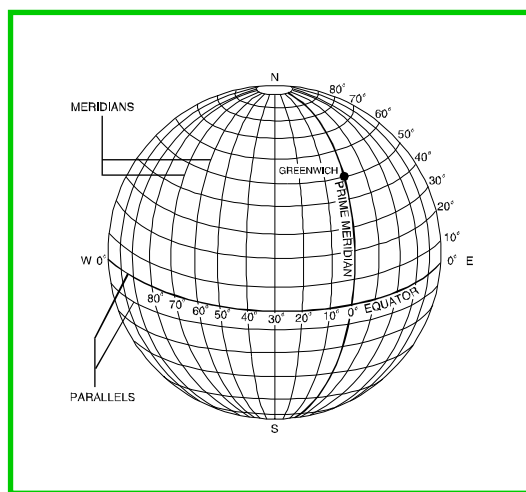
superimpose – to place over or on top of something else

Universal Transverse Mercator Grid System – a grid system that has been designed to cover the part of the world between latitude 84 degrees north and latitude 80 degrees south, and, as its name implies, is imposed on the transverse Mercator projection

From this very broad perspective, this lesson will then show you how to locate a point on a map to within 100 meters using a six-digit **grid coordinate**.

To keep from getting lost, you must know how to find your location. Street addresses may not always be available to you. Learning to use the grid referencing system in conjunction with maps will help you to quickly and accurately pinpoint your location.

Lines of Latitude and Longitude



By drawing a set of east-west rings around the globe (parallel to the equator), and a set of north-south rings crossing the equator at right angles and converging at the poles, mapmakers can form a network of reference lines from which you can locate any point on the earth's surface (see Figure 1.4.1).

The distance of a point north or south of the equator is its latitude and the rings around the earth parallel to the equator are parallels of latitude, or simply

parallels. Lines of latitude run east-west, but they are used to measure north-south distances. Starting with zero degrees at the equator, mapmakers number parallels to 90 degrees both north and south.

The second set of rings around the globe, that are at right angles to the lines of latitude and that pass through the poles are called **meridians** of longitude, or simply meridians. One meridian is the **prime meridian**, which runs through Greenwich, England. The distance east or west of the prime meridian to a point is known as its longitude. Lines of longitude run north-south, but they are used to measure east-west distances. Starting with zero degrees at the prime meridian, mapmakers number meridians to 180 degrees both east and west.

UTM Grid System

The U.S. military **superimposed** its grid reference system on the **Universal Transverse Mercator Grid System**, or UTM grid system. To better understand the military's grid reference system, you should have a basic knowledge of the UTM grid system.

The UTM grid system divides the surface of the earth into 60 north-south grid zones (each six degrees wide) like the one in Figure 1.4.2. Mapmakers number these zones from west to east, 1 through 60, starting at the 180 degree meridian. The grid zone in Figure 1.4.2 represents grid zone number 3.

Figure 1.4.3 is this same grid zone, but now further divided into 20 north-south segments. Each grid segment has a letter for identification. Mapmakers use the letters “C” through “X” (omitting the letters “I” and “O”) to identify these 20 grid segments. They do not use “I” and “O” because those letters can easily be mistaken for the numbers “1” and “0,” respectively. Nineteen of these grid segments are eight degrees high and the one row at the extreme north is 12 degrees high. This combination of zone number and row letter constitutes the grid zone designation.

With this designator, you are now able to identify specific grids. For example, if you wanted to locate the first segment north of the equator, its grid zone designation would be 3N.

However, if you were to cut out 60 shapes identical to those in Figures 1.4.2 or 1.4.3, your globe would not be complete at either end. Each of these 60 grid zones lay between the 84 degrees north and the 80 degrees south lines of latitude. The polar regions would be missing. Therefore, to complete your globe, extend these grid lines to 90 degrees in both directions: 90 degrees north latitude is the North Pole and 90 degrees south latitude is the South Pole. Mapmakers use the remaining four letters, “A,” “B,” “Y,” and “Z,” to identify the polar regions as shown in Figure 1.4.4.

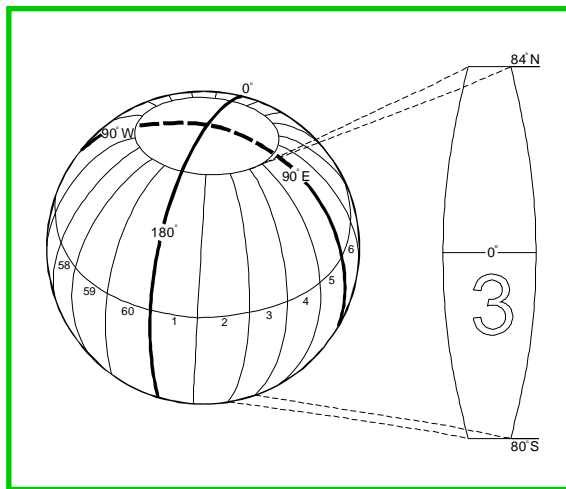


Figure 1.4.2: Grid Zones of the UTM Grid System.

Courtesy of CACI and the US Army.

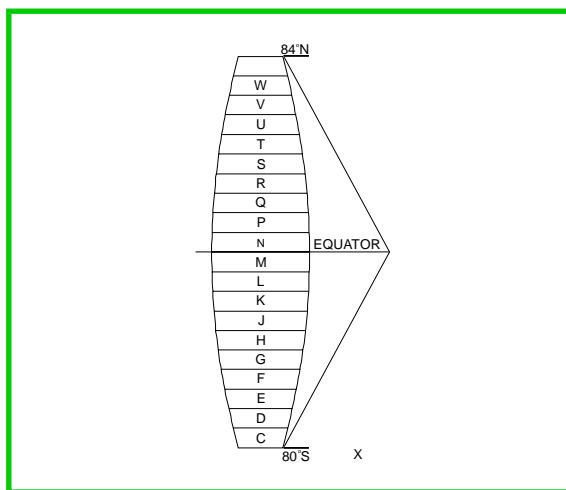


Figure 1.4.3: Grid Segments of the UTM Grid System.

Courtesy of CACI and the US Army.

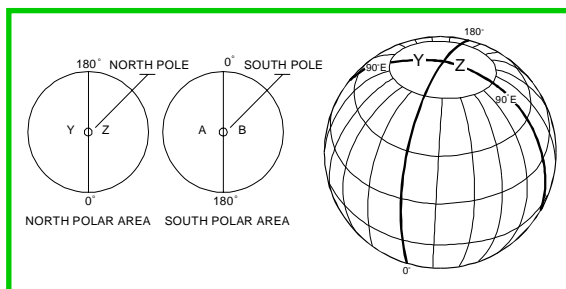


Figure 1.4.4: Polar Regions of the UTM Grid System.

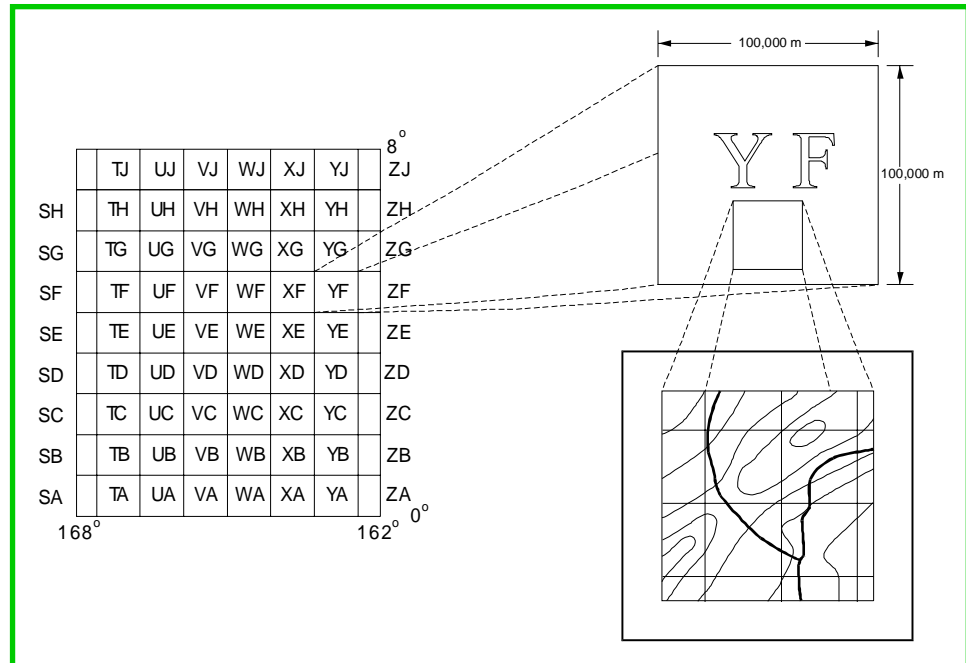
Courtesy of CACI and the US Army.

Military Grid Reference System

Superimposed on each grid zone segment are 100,000 meter squares. Each 100,000 meter square is assigned two identification letters (see Figure 1.4.5). The first letter is the column designation and the second letter is the row designation.

Figure 1.4.5: The Military Grid Reference System.

Courtesy of CACI and the US Army.

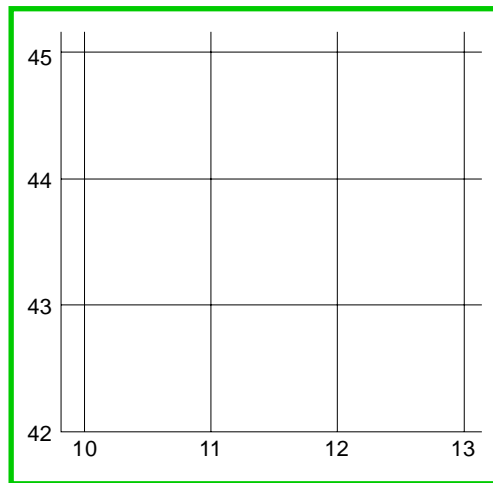


Key Note Term

grid lines – lines that are regularly spaced at 1,000 or 10,000 meter intervals that make up the grid on a map

grid square – the intersecting of north-south and east-west grid lines at 90-degree angles to form a square

Each 100,000 meter square is then divided by parallel lines (or **grid lines**) that are 1,000 meters or 10,000 meters apart (depending on the scale of the map). These parallel lines come together at right angles to form 1,000 meter or 10,000 meter squares (called **grid squares**)—see Figure 1.4.6. These grid lines and grid squares are the lines that you see on a standard military topographic map. Mapmakers number grid lines along the outside edge of each topographic map for easy reference. Using the two 100,000 meter square identification letters in conjunction with these numbers, you can identify each grid square accurately, without any two grid squares having the same grid number (or grid coordinate).



*Figure 1.4.6:
Grid squares.*

*Courtesy of CACI
and the US Army.*

Locating a Point Using the Military Grid Reference System

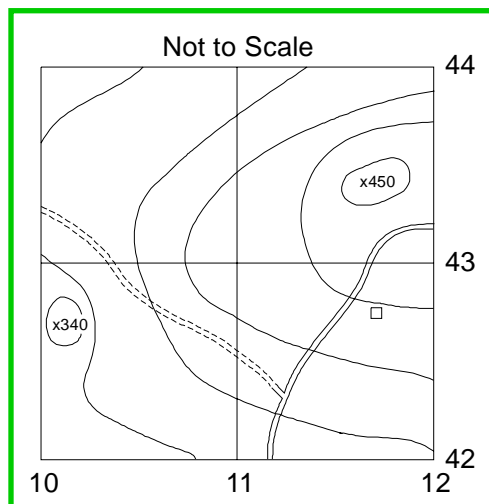
Whenever you read a grid coordinate, you always read right first, then up. This is one of the cardinal rules in map reading. Based on this rule, you can determine locations on a map using grid coordinates. The number of digits in a grid coordinate represents the degree of precision to which you can locate and measure a point on a map—the more digits, the more precise the measurement. For example, a four-digit grid coordinate locates a point to within 1,000 meters, a six-digit grid coordinate to within 100 meters, and an eight-digit grid coordinate to within ten meters.

You write grid coordinates as one continuous alphanumeric symbol without spaces, parentheses, dashes, or decimal points. Further, grid coordinates must always contain an even number of digits, both letters and numbers. To determine grid coordinates without using a protractor, the reader simply refers to the grid lines numbered along the margin of any map. The following example shows how to form a four-digit grid coordinate.

Suppose you want to locate Spot Elevation 450 in Figure 1.4.7 to the nearest 1,000 meters. Use the following steps to find this specific location:

Figure 1.4.7:
Determining a four-digit
grid coordinate.

Courtesy of CACI
and the US Army.



1. Identify the 100,000 meter square identification letters for the map you are using. You can find this identification in the Grid Reference Box located at the bottom center of the lower margin of a topographic map. For this example, continue to use the “YF” identifier from Figure 1.4.5.

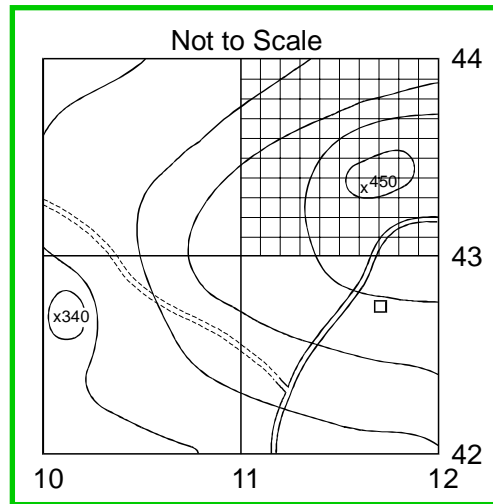
Note

The next two steps would normally be to break down the 100,000 meter square into 10 equal 10,000 meter grid squares, then to further break down one of those into 10 equal 1,000 meter grid squares. However, you can omit these steps because this example already has 1,000 meter grid squares.

2. Identify the 1,000 meter grid square in which the spot elevation is located. To do this, remember the first cardinal rule of map reading: read right, then up. When reading a map right and up, each north-south grid line increases in value from west to east, and each east-west grid line increases in value from south to north.
2. Read right. You will see that the last north-south grid line before reaching the grid square containing Spot Elevation 450 is 11.
3. Read up. Note that the last east-west grid line before reaching the grid square containing Spot Elevation 450 is 43.
4. Combine these steps by writing the 100,000 meter square identifier (YF) and the coordinates of the 1,000 meter grid square (11 and 43) as one continuous symbol. Thus, you would write this grid coordinate as YF1143. You have now correctly located a point on the map (Spot Elevation 450) to the nearest 1,000 meters and written a four-digit coordinate.

Locating a Point Using Six-Digit Grid Coordinates

To locate a point to within 100 meters, follow the procedures in the previous section, and add one more step. In this step, you must divide the 1,000 meter grid square into tenths, or 100 meter increments. Figure 1.4.8 shows what a 1,000 meter grid square would look like if you divided it into 100 meter segments.



*Figure 1.4.8:
Determining a six-digit
grid coordinate.*

Courtesy of CACI
and the US Army.

Suppose you now want to again locate Spot Elevation 450, but this time to within 100 meters. First, read right. Spot Elevation 450 is approximately six-tenths into the grid square. The right reading then is the value of the last north-south grid line before reaching this grid square, or 11, plus a 6 for the six-tenths. This value is read as 116.

By reading up, you can see that Spot Elevation 450 is approximately four-tenths of the way up into the grid square. Therefore, the up reading is the value of the last east-west grid line before reaching this grid square, or 43, and a 4 for the four-tenths. This value is read as 434.

Combining both of these numbers and the 100,000 meter square identifier labels the location as YF116434 for Spot Evaluation 450. You have now used one method to locate a point to the nearest 100 meters by using a six-digit grid coordinate.

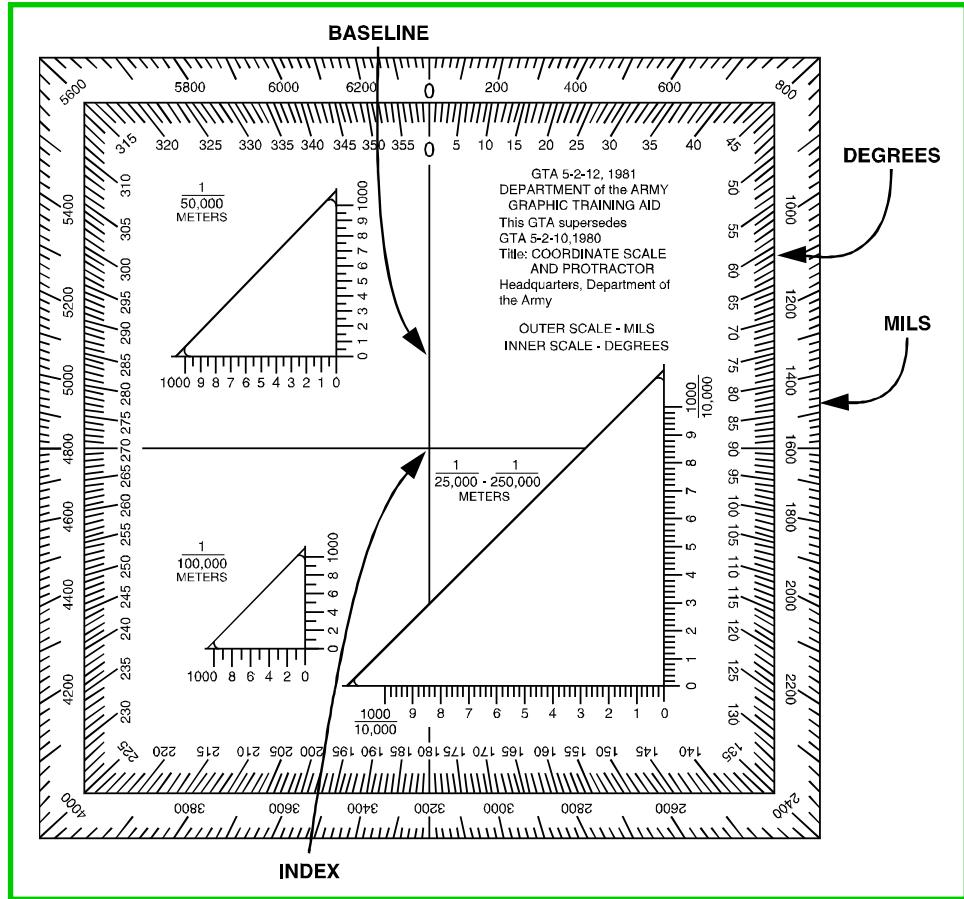
Using a Coordinate Scale

Another way to locate a point to within 100 meters is to make use of a coordinate scale. The following is the correct way to use a coordinate scale. To explain this procedure, once again find the six-digit grid coordinate for Spot Elevation 450.

The coordinate scale used by the Army is the one shown in Figure 1.4.9. Note that in the center, it has three different scales: 1:100,000 meters, 1:50,000 meters, and 1:25,000 meters (or 1:250,000 meters).

Figure 1.4.9: The Army coordinate scale.

Courtesy of CACI and the US Army.



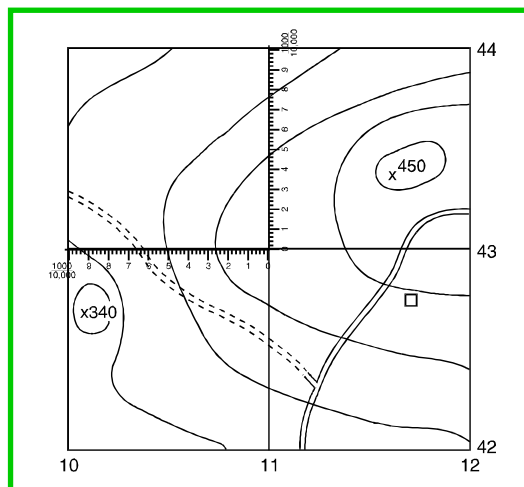
First, check to ensure that you are using the correct scale.

Note

If you obtained a coordinate scale from the JROTC instructor staff, use the 1:25,000 scale for Figures 1.4.9 and 1.4.10.

Figure 1.4.10: Using a coordinate scale.

Courtesy of CACI and the US Army.



Place the horizontal scale parallel to and directly on top of grid line 43 with the "0 mark" at the lower left corner of grid square YF1143 (see Figure 1.4.9).

Keeping the horizontal scale on top of the 43 grid line, slide the scale to the right into the grid square until the vertical scale intersects the center of mass of Spot Elevation 450 (see Figure 1.4.10).

Now, reading left from the “0 mark,” you can see that Spot Elevation 450 lies almost directly on the six-tenths indicator. Therefore, you would read this number as 116.

Note

When you have to round off numbers using a coordinate scale for a six-digit coordinate, apply the following rule: round down for numbers that are four or less; round up for numbers that are five and above.

Reading up, you can see that Spot Elevation 450 lies midway between the three and four mark on the coordinate scale. By applying the above rounding-off rule, round up to read this number as 434. Next, combine both sets of numbers and add the 100,000 meter square identifier to give you the location of YF116434. You have now correctly located a point to the nearest 100 meters by using a coordinate scale.

Grid Reference Box

The grid reference box found on topographic map sheets contains step-by-step instructions for using the grid and military grid reference systems. Mapmakers divide the grid reference box into two parts (see Figure 1.4.11).

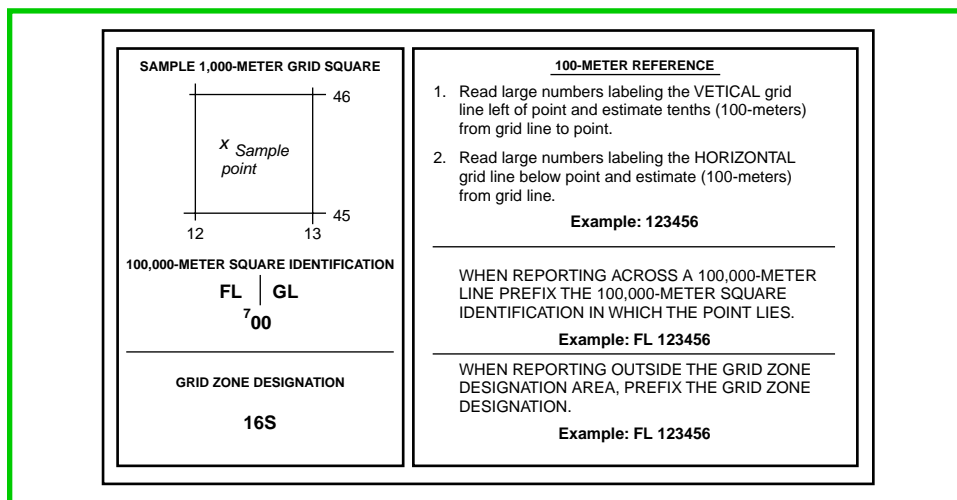


Figure 1.4.11: A grid reference box.

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The left portion identifies the grid zone designation and the 100,000 meter square identifier. If the map sheet falls in more than one 100,000 meter square, the number of the grid line that separates these squares and the 100,000 meter square identifications are given. The right portion briefly explains how to find and write a six-digit coordinate.

Conclusion

Being successful at map reading requires a thorough understanding of many basic concepts. This lesson presented several precise systems of finding locations on maps. Your ability to use these systems and to locate four- and six-digit grid coordinates can increase your confidence in identifying your location.

“Contours and Landforms,” the following lesson, will help you improve your map reading skills by introducing you to contour lines and intervals. It also explains and illustrates the 10 types of natural and man-made terrain features as well as their corresponding contour lines.

Lesson Review

- 1. What is the purpose of the Universal Transverse Mercator Grid System?**
- 2. What do the six-digit coordinates on a map tell you?**
- 3. How are the polar regions on the globe identified in the UTM Grid System?**
- 4. How are grid coordinates written?**