FYS207 LAB EXERCISE - INTRODUCTION TO MAP SCALES AND BEARINGS

MAP SCALES: The common fractional scales for 7.5-minute topographic maps is 1:24,000 or expressed as a fraction 1/24,000. This means that one unit of map measurement is equal to 24,000 units of actual ground measurement. The length units of measurement are the same in the numerator or denominator. For example 1 cm on map = 24,000 cm on the ground; 1 in on the map = 24,000 in on the ground; 2 in on the map = 48,000 in on the ground, and so on.

Fractional Scale

- The fractional scale or the representative scale expresses the scale of a map as a fraction or ratio.
  - 1/24,000 or 1:24,000
- This scale, which is read "one to twenty-four thousand", says that one unit of measurement on the map represents 24,000 units of measurement on the Earth.
- At this scale, one centimeter on the map represents an actual distance of 24,000 centimeters on the Earth, and one inch on the map equals 24,000 inches on the map.
  - Units of measurement must be the same in both the numerator and the denominator.

$$\frac{\text{Distance on the Map}}{\text{Distance on the Ground}} = \frac{2\,\text{cm}}{1\,\text{km}} = \frac{2\,\text{cm}}{100\,000\,\text{cm}} = \frac{1}{50\,000}$$

= 1/50 000 Scale

For Example: if a map or drawing has a scale of 5 inches on the map equals 5 miles on the ground, 1 inch on map = 1 mile on the ground. To determine the fractional scale:

1 inch = 1 ~~mile~~ x $\frac{(5280\ \text{~~feet~~})}{(1\ \text{~~mile~~})}$ x $\frac{(12\ \text{inches})}{(1\ \text{~~foot~~})}$ = 63,360 inches on ground

Fractional Scale: 1 inch on map = 63,360 inches on ground 1:63,360

For Example: at a scale of 1:24,000, 1 inch on the map is equal to 24,000 inches on the ground in the real world. To convert 24,000 inches into feet and miles-equivalent in the real world, see below for the math steps:

1 inch on map = 24,000 ~~inches~~ x $\frac{(1\ \text{feet})}{(12\ \text{~~inches~~})}$ = 2000 feet on ground

1 inch = 24,000 ~~inches~~ x $\frac{(1\ \text{~~feet~~})}{(12\ \text{~~inches~~})}$ x $\frac{(1\ \text{mile})}{5280\ \text{~~feet~~}}$ = 0.38 miles

Common distance unit conversion factors used in map scaling:

1 ft = 12 inches 1 mile = 5280 ft 1 meter = 3.28 feet 1 kilometer = 0.62 miles
1 meter = 100 centimeters 1 inche = 2.4 centimeters

Unit Abbreviations: inches = in feet = ft meter = m kilometer = km centimeter = cm

MAP SCALE PROBLEMS

A. Given a fractional scale of 1:24,000 (1/24,000), one inch on the map equals how many inches on the ground (show all your math work)?

One inch on the map equals how many miles on the ground (show all your math work).

One centimeter on the map equals how many centimeters on the ground (show all your math work).

One centimeter on the map equals how many kilometers on the ground (show all your math work).

B. If 5 inches on a hypothetical map equals 10 miles on the ground, determine the fractional scale of the map (show all your math work)

Step 1: determine how many inches are contained in 10 miles.

Step 2: 5 inches map = _____ inches ground.

Step 3: Divide both sides of equation by 5 inches, cancel units are both sides

Step 4: Fractional scale = 1 (map): _____ (ground)

MEASURING DIRECTIONAL BEARINGS (RELATIVE TO NORTH) USING A PROTRACTOR

How to Determine a Compass Bearing on a Map

To determine a compass bearing on a topographic map, follow the directions in FIGURE 9.5. Then imagine that you are buying a property for your dream home. The boundary of the property is marked by four metal rods driven into the ground, one at each corner of the property. The location of these rods is shown on the map in FIGURE 9.5 (left side) as points ***A, B, C,*** and ***D.*** The property deed notes the distances between the points *and* bearings between the points. This defines the shape of the property. Notice that the northwest edge of your property lies between two metal rods located at points ***A*** and ***B.*** You can measure the distance between the points using a tape measure. How can you measure the bearing?

First, draw a line (very lightly in pencil so that it can be erased) through the two points, ***A*** and ***B.*** Make sure the line also intersects an edge of the map. In both parts of FIGURE 9.5, a line was drawn through points ***A*** and ***B*** so that it also intersects the east edge of the map. Next, orient a protractor so that its 0° and 180° marks are on the edge of the map, with the 0° end toward geographic north. Place the origin of the protractor at the point where your line ***A–B*** intersects the edge of the map. You can now read a bearing of 43° east of north. We express this as a quadrant bearing of "North 43° East" (written N43°E) or as an azimuth bearing of 43°. If you were to determine the opposite bearing, from ***B*** to ***A,*** then the bearing would be pointing southwest and would be read as "South 43° West," or as an azimuth of 223°. Remember that a compass points to Earth's *magnetic north* pole (MN) rather than true north or grid north (GN). When comparing the bearing read directly from the map to a bearing read from a compass, you must adjust your compass reading to match true north or grid north (GN) of the map, as described above.

You also can use a compass to read bearings, as shown in FIGURE 9.5 (right). Ignore the compass needle and use the compass as if it were a circular protractor.

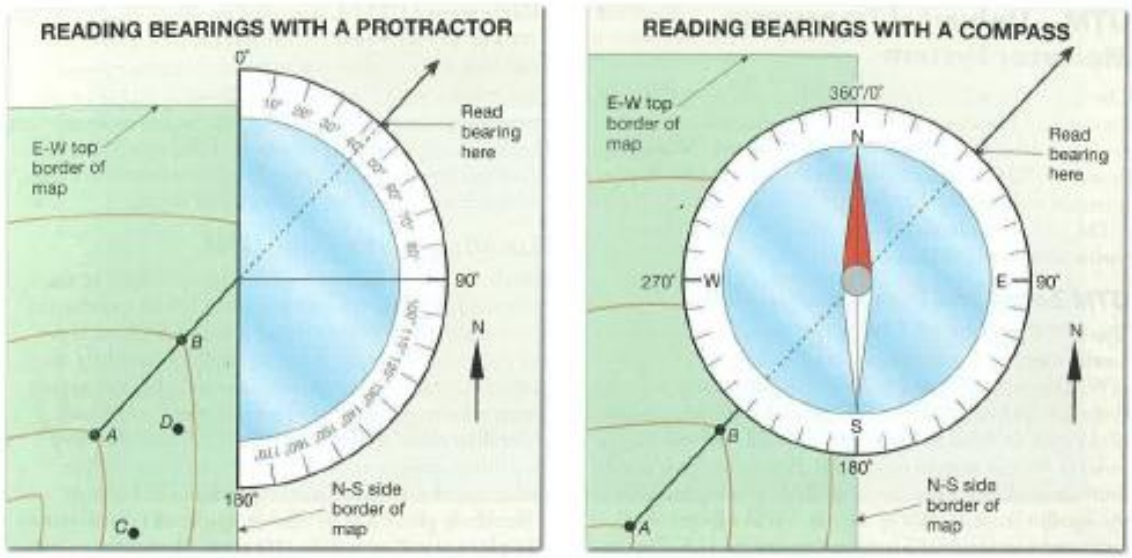
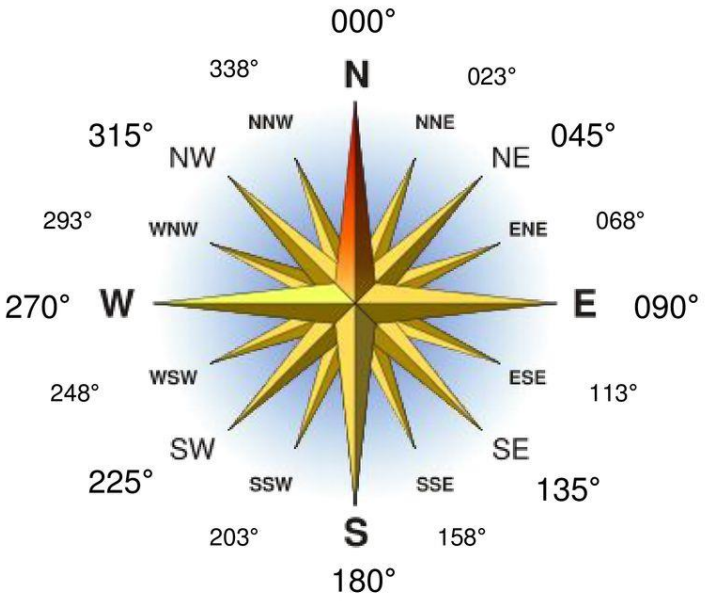


FIGURE 9.5 How to read a bearing (compass direction) on a map. A bearing is read or plotted on a map, from one point to another, using a protractor (left) or compass (right). To determine a bearing on a map, draw a straight line from the starting point to the destination point and also through any one of the map's borders. For example, to find the bearing from *A* to *B*, a line was drawn through both points and the east edge of the map. Align a protractor (left drawing) or the N-S or E-W directional axis of a compass (right drawing) with the map's border and read the bearing in degrees toward the direction of the destination. In this example, notice that the *quadrant bearing* from point *A* to *B* is North 43° East (left map, using protractor) or an *azimuth bearing* of 43°. If you walked in the exact opposite direction, from *B* to *A*, then you would walk along a quadrant bearing of South 43° West or an azimuth bearing of 223° (i.e., 43° + 180° = 223°). Remember that a compass points to Earth's magnetic north pole (MN) rather than true north (GN, grid north). When comparing the bearing read directly from the map to a bearing read from a compass, you must adjust your compass reading to match grid north (GN) of the map, as described in the text.

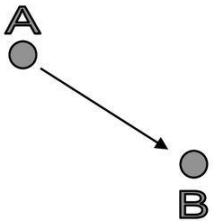
Azimuth Bearings – 0 to 360 degrees in clockwise direction from North at 0

Matching compass points…



Important!

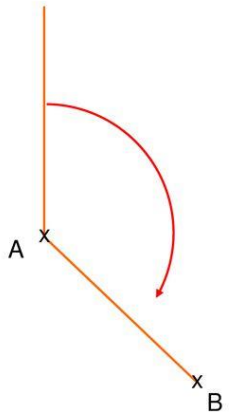
Always pay attention to the direction you will be taking the bearing from



The bearing of A to B will be completely different to the bearing B to A.

Measuring bearings…

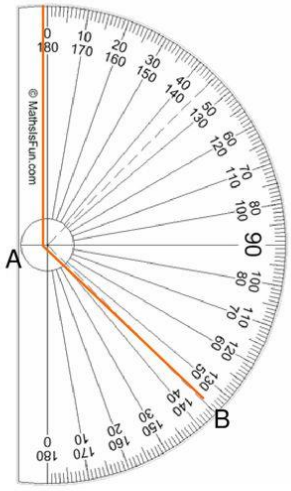
Find the bearing of B from A.



- Mark the North line on at A (if there isn't a North line draw one in)
- Draw the line connecting A to B.
- Measure the angle clockwise from the North line to B

Measuring bearings…

Find the bearing of B from A.

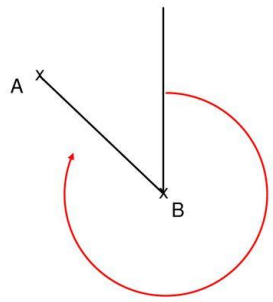


- Place your protractor over the north line with 0° at the top.
- Give the answer as a three-figure bearing

The bearing of B from A is 135°.

Measuring bearings…

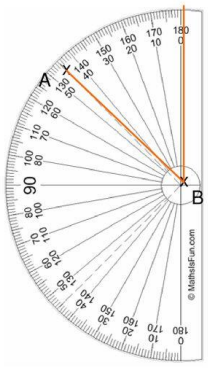
Find the bearing of A from B.



- Mark the North line on at B (if there isn't a North line draw one in)
- Draw the line connecting B to A.
- Measure the angle **clockwise** from the North line to A

Measuring bearings…

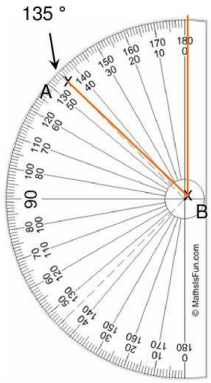
Find the bearing of A from B.



- Place your protractor over the north line with 0° at the bottom.
- Because you are measuring clockwise you need to measure the exterior angle.
- The angle has gone past 180° so you will need to add your measurement to 180°

Measuring bearings…

Find the bearing of A from B.



- The measurement from the bottom 0° is 135°.
- 135° + 180° = 315°.

The bearing of A from B is 315°.

FYS207 Map Measurement and Bearings Exercise

Task1: Using the map below, fill in the data table with azimuth and distance measurements between point A, B, and C. Note the north arrow and scale of the map. Use an engineers scale and protractor to make your measurements. The UTM coordinates of the southwestern corner of the map are: Easting = 481,000 m E. Northing = 4,956,000 m N.

From	To	Azimuth (decimal degrees)	Distance (km)
C	B	_____	_____
B	A	_____	_____
A	C	_____	_____
C	A	_____	_____
B	C	_____	_____

Task 2: Using and engineer's scale and two drawing triangles, measure, location, and draw "point D", exactly 545 m south of point A. Mark on your map and show your measurements.