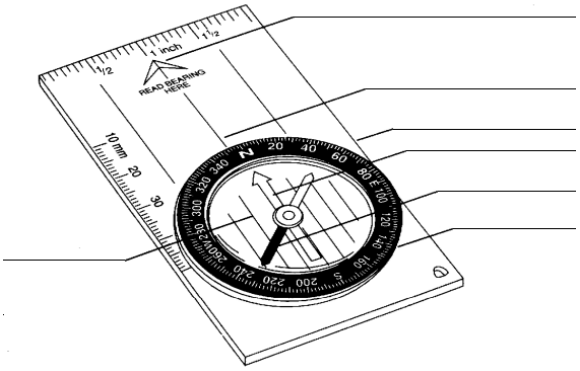
Name:_____

Basic Navigation Class Exercises (All numbered questions have an answer key following)

Exercise 1: Compass Basics 2019

Identify the parts (and their function) of your compass including: • Magnetic needle • Orienting arrow • Index line • Meridian lines • Bezel • Direction-of-Travel arrow • Transparent baseplate	

Question /1: Identify the amount, (in degrees), of the smallest graduation on your compass bezel / (or graduated ring).

Question /2: What is a bearing?

Question /3: What is declination?

Question /4: What is the local declination near Bellingham this year? _____

2019 students skip this unless you can do it quickly: use answer key if you skip and do this later at home.

Using a smartphone, look for NOAA Declination, then find NOAA mobile magnetic field calculator, app will use smartphone location and give you local declination.

Question /5: What is the local declination in the Mt Baker/ Shuksan area this year? _____

2019 students skip this unless you can do it quickly: use answer key if you skip. Do this at home later however as the ability to search for declination using the name of a peak or city is useful.

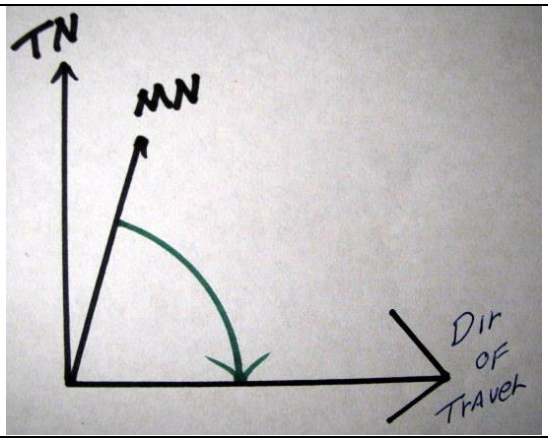
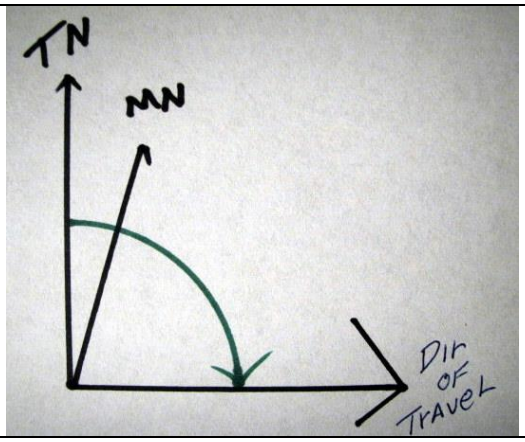
Using the same NOAA app, choose "calculator" / "go to full site" / enter name of city or mountain / tap get and add lat long / enter "calculate".

Question /6: About how much and in what direction does our local declination change in one year?

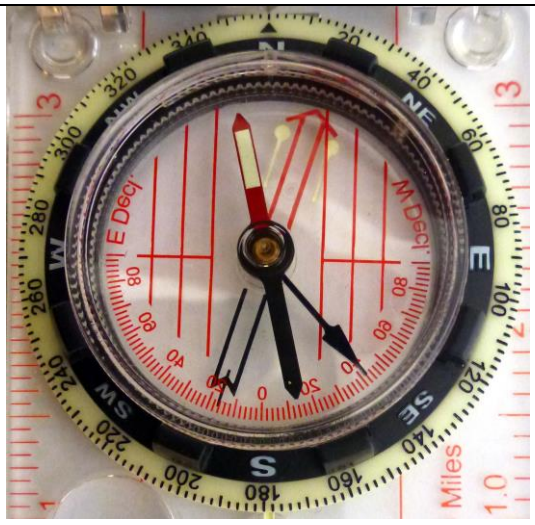
Question /7: About how much and in what direction does our local declination change as you travel from Bellingham to Mount Baker, (about 50 miles)?

Question /8: About how much time must elapse for the local declination to change by 1 degree?

Question /9: Closest whole degree to set your declination in the Baker Shuksan area in 2019?

Question /10: Magnetic bearing: A clockwise angle from _____ to _____	**Question /11: True bearing**: A clockwise angle from _____ to _____
	

There are 2 key types of compasses in terms of which of the bearings they produce by default:

Compass with orienting arrow fixed parallel to the meridian lines.	Compass with an adjustable orienting arrow. This arrow should be set to vary from 0 / 360 degrees by an amount equal to the local declination.
	
Question /12: If you hold the above compass level in the field and turn until the red/ north seeking end of the magnetic needle lies in the orienting arrow, or “in the shed”, what sort of bearing results, true or magnetic?	**Question /13:** If you hold the above compass level in the field and turn until the red/ north seeking end of the magnetic needle lies in the orienting arrow, or “in the shed”, what sort of bearing results, true or magnetic?

Exercise 1 Key:

/1: Smallest graduation should be 2 degrees	/7: about the same amount, 9' W
/2: a clockwise angle from a reference direction to a direction of sight or travel	/8: At the current rate of change, about 7 years.
/3: The difference in degrees east or west that local magnetic lines of force vary from true north.	/9: 16 degrees
/4: In Degrees Minutes: 15° 52' E changing by 0° 9' W per year; or in Degrees decimal minutes: 15.87° ' E changing by 0.15 Degrees W per year	/10: from magnetic north to direction of travel
/5: In Degrees Minutes**:** 15° 43' E changing by 0° 9' W per year; or in Degrees decimal minutes: 15.72 degrees E changing by 0.15 Degrees W per year	/11: from true north to direction of travel
	/12: Magnetic bearing
/6: about 0.15 degrees 9' W per year	/13: true bearing

Exercise 2: Map margin information; scales, colors, grids:

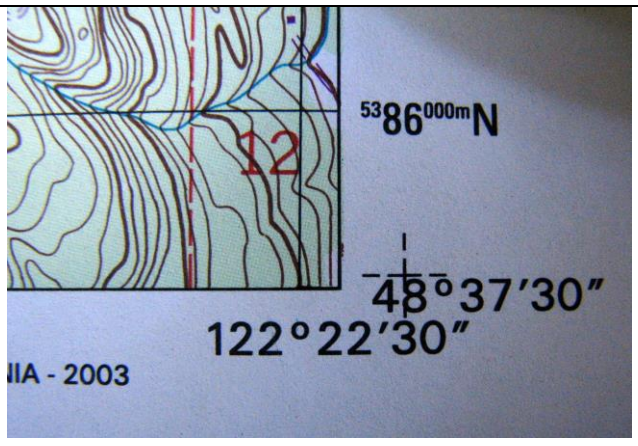
Maps needed: USGS 7.5" map Bellingham South; GreenTrails #13: Shuksan Arm

Tools needed: Compass with base-plate, ruled straight edge or paper edge and pen

(That "margin information" per se is becoming an outdated concept is more of our map access becomes digital display of a seamless database. Nevertheless, the map grid and symbolism discussed in this section are still useful.)

Locate and identify the following:

Quadrangle name and revision date. **Question: /1:** How are quadrangle names derived?	
Question: /2: Quadrangle location key; (Map bottom): what 7.5 min quad is directly east of Bham South?	

Note: Traditional lat long is written in the format: Degrees(°) Minutes(') Seconds(") This is abbreviated as DMS by map and GPS software. The Coast Guard would express 122º 22' 30" in the format DM.M which would appear as: 122º 22.5' Some applications give or ask for lat long in Degrees and decimal degrees, D.D. This format is particularly useless when it comes to estimating your location on a map.	

Question: /3: Note scale; how many inches equals one mile?	
Question: /4: Note the lat-long marks the side of the map. How many minutes between marks?	

Locate the UTM (Universal Transverse Mercator) marks along the edge of the map. **Question: /5:** How many meters / Kilometers between UTM grid lines on the 7.5 minute map? On a GreenTrails map?	
Question: /6: What do the red lines with marks like "T.36N" etc indicate? Are these useful?	
Question: /7: What do the colors red, blue, black, green, brown, and purple indicate? White with blue contour lines? White with brown contour lines? White with blue contour lines?	
Question: /8 Find the brown contour lines. What is the altitude between two successive index contour lines, _____(the dark ones). Calculate the contour interval between each of the lighter regular contour lines._____ Find where this contour interval is marked on a 7.5 minute or Greentrail map.	

Exercise 2 key:

/1: The most significant man made or natural feature in the quadrangle.	/7: • Red: Highways & Range-township lines • Blue: Water • Black: Man-made • Green: Vegetation • Brown: Contour lines • Purple: Revisions • Blue on white: Glacier or permanent snowfield
/2: Lake Whatcom	
/3: about 2.5 inches	
/4: 2 and ½ minutes or 2 minutes, 30 seconds	
/5: 7.5-Minute Map: 1 kilometer (1000 meters) GreenTrails Map: 2 kilometers (2000 meters)	
/6: Range and township (generally useful for real estate and land boundaries, not climbing)	
/8: 100' 20' usually bottom center	

Exercise 3: Estimating elevation gain, trail length and hiking time. Orienting a map two ways.

Maps needed: USGS 7.5" map Bellingham South;

Concepts: Distance; elevation gain; hiking time estimate; terrain features

Question /1: What is approximate length of the trail from trailhead to S end of Cedar Lake? Consider the trailhead to be at the intersection of the trail and the 300' index contour line.

Question /2: What is your ending elevation at Cedar Lake? Total elevation gain?

Question /3: Using the following rule of thumb:

- Gentle trail and day pack: 2-3 Mph 3-5 Km per hour
- Steep trail with overnight pack: 1-2 Mph 2-3 Km per hour
- Firm snow moderate slope with day pack: 1000' per hour
- Breaking trail or off trail heavy vegetation moderate slope with day pack: 500' per hour

Estimate your time from trailhead to Cedar Lake (with overnight pack).

Question /4: Discuss how to orient a map two different ways.

- By aligning the map with local features shown on the map.
- By aligning the map with so that a compass needle is parallel to the approximate magnetic north on the map. (visual approximation is good enough for this purpose.)

What purpose is served by orienting a map?

Exercise 3 Key:

/1: about 2.5-2.6 mi
/2: end at 1530'; gain is about 1230'. Estimate the elevation from the nearest contour to Cedar, (1540'), to the surface of the lake to be half the contour interval, (10 feet).
/3: About 1 hour 15 minutes plus or minus.
/4: An oriented map allows you to correlate visible features and features on the map. Ultimately you can estimate your location.

General rules when using the compass for mapwork:

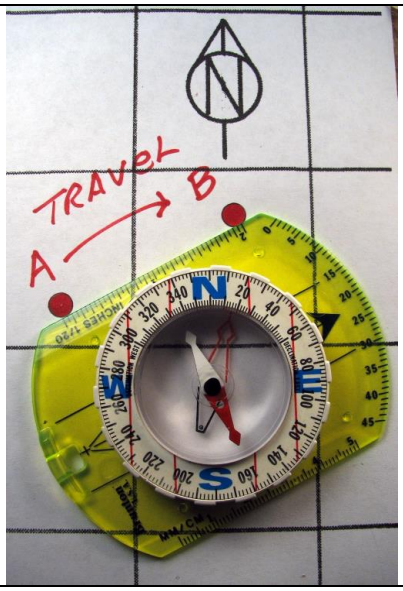
- Meridian lines parallel to true north line
- N end of bezel pointed generally north
- Edge of compass along route
- Direction of travel arrow pointed in the direction of **travel or sight**.
- Ignore the compass magnetic needle (why?)

Directions for Exercise 4:

Take a bearing between two points on a map:

(Travel A to B) Maps needed: USGS 7.5" map Bellingham South;

- Align both points along a side edge of the compass
- Direction of travel arrow toward the direction of travel
- Turn the bezel ring until the meridian lines are parallel with a north/south line
- Make sure the north point on the bezel is pointed north on the map
- Read the bearing at the index line/ direction of travel arrow



Exercise 4:

Using Bellingham South: **Take a bearing from the map**:

Question /1: From the top of hill 1870, what is the bearing to the southern tip of Pine Lake?

Question /2: What is the distance in meters between these two positions?

Question /3: Estimate the elevation of the surface of Pine Lake.

Exercise 4 key:

/1: 127 degrees true
/2: 730 meters
/3: 1570'

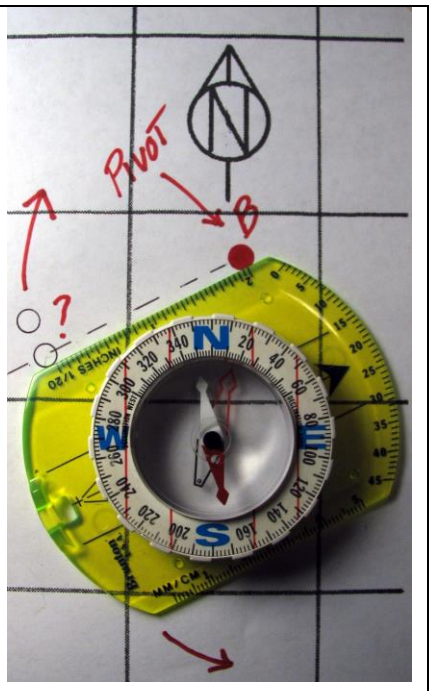
Directions for Exercises 5 and 6: Maps needed:

USGS 7.5" map Bellingham South;

Identify your line and point location by taking a bearing on a known feature.

Sighted feature "B" is known.

- Take a bearing on a visible, known feature (B) (which is shown on your map). Leave the bezel oriented to that bearing.
- Place the front / side of the compass on the map next to the known feature. Front = end with the direction of travel arrow.
- Rotate the compass using the known feature as a pivot point until the meridian lines are parallel with a north-south line.
- Make sure the north point on the bezel is pointed north
- Draw a line along the side of the compass extending back from the known feature toward your location. You will be somewhere along this line.
- If you are on a linear feature, (trail, contour line, etc), your location is the intersection of the line just drawn and that linear feature.



Exercise 5: **Locate your approximate position using a bearing up a uniform slope toward a summit or hilltop and altitude**.

Question /1: You are somewhere on the side of hill elevation 1665' near Pine lake. Your altimeter indicates 1500' elevation. Your bearing toward the summit is 283 degrees true. Where are you?

Exercise 5 key:

/1: You are in a stream gully east of hill 1665 at the intersection of the 1500' contour line and the stream bed.

Exercise 6: (Bellingham South quad): **Locate your position on the map using a bearing to a known feature and a linear feature** (ridge, trail, contour line, etc.).

Question /1: You are on the trail to Pine and Cedar and you sight hill 1665 at 190 degrees true. Your altimeter shows 1625'. Locate your position on the map. Describe the terrain feature you are on.

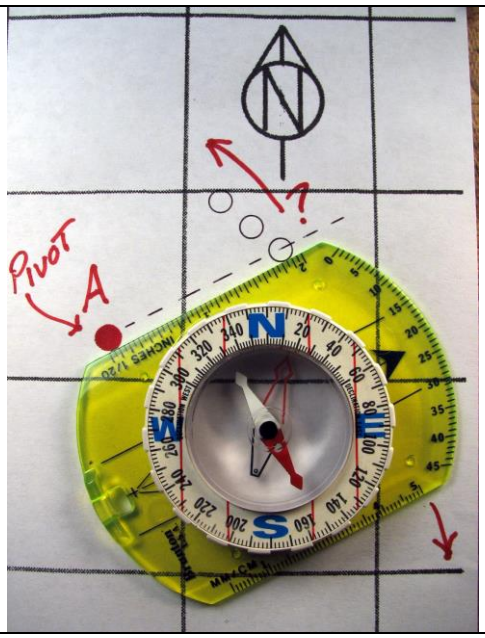
Exercise 6 Key:

/1: You are on a saddle just west of Hill 1870.

Directions for Exercise 7: (Identify a distant feature) maps needed: GreenTrails #13: Shuksan Arm

Identify a distant feature. (I know my location on the map "A"):

- Take a bearing on the distant feature. Leave the bezel oriented to that bearing.
- Place the rear / side of the compass on your location (A), on the map. (Rear of compass = farthest away from direction of travel arrow.)
- Rotate the front of the compass using your location (A) as a pivot point until the meridian lines are parallel with a north-south line
- Make sure the north point on the bezel is pointed north
- Draw a line along the side of the compass extending out from your location. That line will cross the feature that you have taken a bearing on.



Exercise 7:

Shuksan Greentrails map
Take and plot bearings on a map & triangulation

/1: Shuksan Greentrails: (plot bearings): From Mount Sefrit (7191'), identify peaks at these bearings: • 140° • 66°	
/2: Shuksan Greentrails: (triangulation): You've sighted these two landmarks: American Border Peak at 54° and Winchester Mountain at 110°. Where are you?	

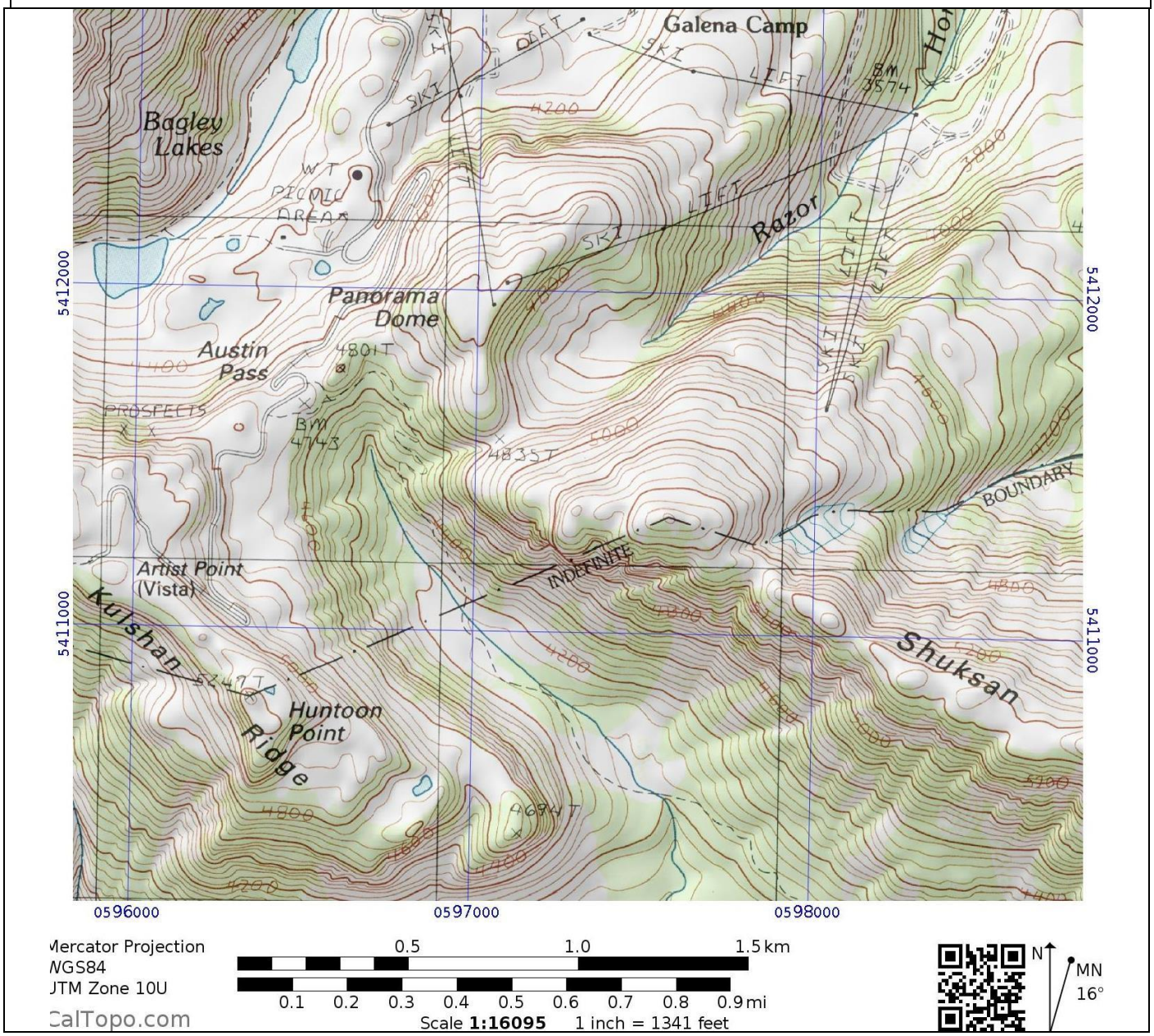
Exercise 7 key:

/1; • Icy Peak (7060') • Granite Mt (6688')
/2: Tomyhoi summit

Exercise 8: Contour lines; Features; UTM; Route finding

Using the map below printed from Caltopo:

/1: Identify contour lines and contour interval. Explain how to identify valleys vs. ridges.
/2: Identify the following features: flat areas; gentle slope; steep slope; vertical cliffs; gully or couloir; ridge; summit; cirque or bowl; saddle, pass or col. There is a major vertical cliff on this map. What is the elevation loss of this cliff?
Identify the UTM coordinates of: Note use the UTM grid that connects to the map edge UTM numbers. WGS 84 /1; 4835T benchmark between Panorama Dome and Shuksan Arm /2: 5247T benchmark at the summit near Huntoon point see key at bottom of page



Exercise 8 key:

/1: 597100 meters E 5411600 meters N (instructors visual estimate)	/2: 596350 meters E 5410800 meters N (instructors visual estimate)