Name: _____

Measuring with a Brunton compass

A. Initial definitions

1. Direction measured in a horizontal plane: trend or bearing, or trend/bearing unit vector

2. Orientation of a line in space: plunge and trend, or plunge unit vector

3. Orientation of an inclined plane in space: strike and dip, or dip vector, or unit normal vector

   --complete components are strike azimuth, dip angle, and dip direction

   --Right-hand rule strike and dip

4. Orientation of a line on a plane: rake (or pitch) plus the orientation of the plane.

B. The different types of compasses geoscientists use to determine direction in the field

1. **Quadrant compass** (0-90°-0-90°-0)
   a. Examples of a bearing or trend: S64E or N15E or N48W or S72W
   Draw the examples, with north toward the top of the page

   b. Examples of plunge and trend: 42, S78E or 65, N14E or 16, N48W or 52, S18W
   Draw the examples, with north toward the top of the page

c. Examples of strike and dip: N23W, 32NE or N23W, 45SW or N58E, 16NW or N58E, 78SE

Draw the examples, with north toward the top of the page

2. **Azimuth compass** (0-360°)

a. Examples of a bearing or trend: 15° or 134° or 213° or 332°

Draw the examples, with north toward the top of the page

b. Examples of plunge and trend: 42, 142 or 65, 35 or 16, 327 or 52, 234

Draw the examples, with north toward the top of the page

c. Examples of strike and dip:

(1) Freeform examples: 15, 56NW or 195, 56NW (the same plane)

Draw the examples, with north toward the top of the page

(2) Right-Hand Rule (RHR) examples: 48, 16 or 113, 78 or 197, 62 or 223, 37

Draw the examples, with north toward the top of the page

C. Bearing vectors

1. How to find the bearing vector (non-unit vector, as in pace-and-compass mapping)

$$v_1 = \{l_o \sin[\theta_1], l_o \cos[\theta_1]\}$$

where l_o is the length of the vector and θ_1 is the angle from the north-directed vector, measured clockwise from north.

PRACTICE: What is the vector associated with a 114 m straight path toward 213°?

2. How to find the bearing vector (unit vector)

$$v_2 = \{\sin[\theta_2], \cos[\theta_2]\}$$

where l_o is the length of the vector and θ_2 is the angle from the north-directed vector, measured clockwise from north.

PRACTICE: What is the unit vector associated with a bearing of 123°?

3. You are dropped by aliens on a perfectly horizontal grassy field that stretches for kilometers in all directions. If you go 100 m toward 38° and then 230 m toward 79°, and you want to return by the most direct (straight-line) route, how far would you walk and in what direction?

a. Add the vectors together

b. Find the length of the resultant vector

c. Find the unit vector that coincides with the vector result of step b

d. Find the azimuth of the vector result of step c.

C. Trend and plunge ...

Note that it is the unfortunate convention in the geosciences that a positive plunge is down and a negative plunge is up. This proves that paleo-geoscientists were not good at either math of physics, as if we needed more proof.

1. ...of a line (non-directional)

QUESTION What is the unit vector along a line plunging 52° and trending 207°

a. Draw a vertical cross section that includes the vector.

b. Find the mathematical expression for the -z component (downward component) of the vector.

c. Draw a horizontal map (or plan) view

d. Determine the 3D vector components of the vector

2. ... of a vector (directional)
QUESTION What is the unit vector along a line plunging -23° and trending 48°
a. Draw a vertical cross section that includes the vector.

b. Find the mathematical expression for the z component (upward component) of the vector.

c. Draw a horizontal map (or plan) view

d. Determine the 3D vector components of the vector

D. Coordinates of a unit dip vector (always has a downward directed component) with a plunge & trend of 63, 142?

E. Given a dip vector with a plunge & trend of 63, 142, what is the reference strike vector and azimuth, using the RHR?

F. Given the RHR strike and dip, what is the down-directed vector normal to the plane? What is its unit vector? What is the unit vector of its inverse?