Experiment 3.2 Vector Addition ____________________

Purpose To test the trigonometry formulae experimentally

Method

1. Using the map handed to you of the USA, draw a line from
    1. Phoenix AZ to Bismarck ND
    2. Bismarck ND to Washington DC
    3. Phoenix AZ to Washington DC
2. Draw East-West lines at Phoenix AZ and Bismarck ND
3. Measure the length of the lines (in cm) from
    1. Phoenix AZ to Bismarck ND
    2. Bismarck ND to Washington DC
4. Convert these cm lengths to miles by multiplying by 180
5. Measure the angles (from the horizontal, going counterclockwise) to the lines:
    1. Phoenix AZ to Bismarck ND
    2. Bismarck ND to Washington DC
6. Calculate the flight vector from Phoenix AZ to Washington DC using vector addition
7. Check your result by measuring the length and angle of the Phoenix AZ to Washington DC line

Results

Route	Length (cm)	Length (miles) (1 cm = 180 miles)	Angle (Measured counterclockwise from x axis)
P→B			
B→W			
P→W			

*Mileage calculated using ratio 1 cm = 180 miles
(180 miles is 285 km)
(P stands for Phoenix, B for Bismark and W for Washington)

Calculation

Using formula 3.7 to get the horizontal component for the journey from Phoenix to Bismark:

$$(P \rightarrow B)_x = (P \rightarrow B).\cos(\theta_{PB})$$

= _____ x cos(___)

= ________ miles

Using formula 3.6 to get the vertical component for the journey from Phoenix to Bismark:

$$(P \rightarrow B)_y = (P \rightarrow B).\sin(\theta_{PB})$$

$= \_\_\_\_\_$ x sin(___)

$= \_\_\_\_\_\_\_\_$ miles

Using formula 3.7 to get the horizontal component for the journey from Bismark to Washington:

$$(B \rightarrow W)_x = (B \rightarrow W).\cos(\theta_{BW})$$

$= \_\_\_\_\_$ x cos(___)

$= \_\_\_\_\_\_\_\_$ miles

Using formula 3.6 to get the vertical component for the journey from Bismark to Washington:

$$(B \rightarrow W)_y = (B \rightarrow W).\sin(\theta_{BW})$$

$= \_\_\_\_\_$ x sin(___)

$= \_\_\_\_\_\_\_\_$ miles

Doing vector addition of the:

- Phoenix to Bismark horizontal and vertical components and the
- Bismark to Washington horizontal and vertical components

to get the horizontal and vertical components for Phoenix to Washington:

$$(P \rightarrow W)_x = (P \rightarrow B)_x + (B \rightarrow W)_x$$

$= \_\_\_\_\_\_\_\_\_ + \_\_\_\_\_\_\_\_$

$= \_\_\_\_\_\_\_\_\_\_$ miles

and

$$(P \rightarrow W)_y = (P \rightarrow B)_y + (B \rightarrow W)_y$$

$= \_\_\_\_\_\_\_\_\_ + \_\_\_\_\_\_\_\_$

$= \_\_\_\_\_\_\_\_\_\_$ miles

Using Pythagoras we can calculate the length of the Phoenix to Washington vector using the horizontal and vertical components of that same vector:

$$(P \rightarrow W) = \sqrt[2]{(P \rightarrow W)_x^2 + (P \rightarrow W)_y^2}$$

$= \_\_\_\_\_\_\_\_\_\_\_$ miles

Using formula 3.3 we can calculate the angle of Phoenix to Washington from the horizontal and vertical component lengths of that same vector:

$$\theta_{PW} = \tan^{-1}\left(\frac{P \rightarrow Wy}{P \rightarrow Wx}\right)$$

$= \_\_\_\_\_\_\_\_ {}^\circ$

Finally,

$$percent\ error = \frac{((P \rightarrow W)_{measured} - (P \rightarrow W)_{calculated})\ x\ 100}{(P \rightarrow W)_{measured}}$$

= (___________ - ___________) x 100

____

= _________ %

Conclusion

My calculated length was within 10% of the measurement, which is evidence that the formulae work.