Addition of Vectors Lab

Overview:

In this activity, you will use both the head-to-tail method and the analytical method of vector addition in order to determine the resultant displacement of two trips which have three individual "legs."

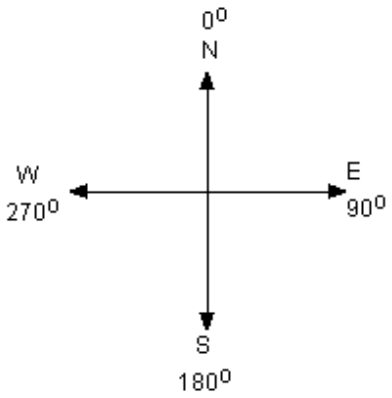
Materials:

ruler, protractor, pencil, calculator, two copies of a USA map

Trip #1:

Head-to-Tail Method of Determining the Resultant:

On the attached map, use the indicated scale to add the following three vectors (A, B, C) in a head-to-tail fashion. Include an arrowhead on each vector and label them clearly as A, B and C. Draw the resultant of A + B + C on the diagram and label it as R_1. Begin at Madison, WI. *All angles are measured clockwise from north.*



Scale on map: _____ cm = 400 km

A	B	C
1700 km at 290 degrees	1900 km at 180 degrees	925 km at 97 degrees
scale length = ____ cm	scale length = ____ cm	scale length = ____ cm

Length of resultant (Δx) = _____ cm (scale) = _____ km (actual) direction = _____°

The resultant of A + B + C is _____ (include magnitude and direction). The final destination appears to be in or at least close to the city of _____ in the state of _____.

Is this reasonable? Check your answer at http://www.convertunits.com/distance/

Analytical Method of Determining the Resultant:

Now use a calculator, trigonometric functions, and principles of vector resolution to determine the components of each vector; include both magnitude and direction for each componet. Show your work in each of the cells of the first three rows of the data table. Finally, add all the components to determine the horizontal and the vertical components of the resultant of A + B + C.

Vector	Horizontal or E-W Component	Vertical or N-S Component
1700 km at 290 degrees	_____	_____
1900 km at 180 degrees	_____	_____
925 km at 97 degrees	_____	_____
Resultant	_____	_____

Now use the components of the resultant to determine the magnitude and the direction of the resultant. Once you have determined the resultant, make a measurement on the map to determine where this displacement would place a traveler. **SHOW YOUR WORK BELOW.**

Length of resultant (Δx) = _____ km (actual) = _____ cm (scale) direction = _____^{o}

As found by the analytical method, the resultant of A + B + C is _____ (include magnitude and direction). When this resultant displacement is measured on the provided map, the final destination appears to be in or at least close to the city of _____ in the state of _____.

Compare the results of the two methods of vector addition and use a few complete sentences to evaluate the effectiveness of the methods and the accuracy of your measurements.

Trip #2:

Head-to-Tail Method of Determining the Resultant:

On the attached map, use the indicated scale to add the following three vectors (D, E, F) in a head-to-tail fashion. Include an arrowhead on each vector and label them clearly as D, E and F. Draw the resultant of D + E + F on the diagram and label it as R_2. Begin at Augusta, ME.

D	**E**	**F**
1080 km at 210 degrees	2200 km at 300 degrees	2000 km at 153 degrees
scale length = ____ cm	scale length = ____ cm	scale length = ____ cm

Length of resultant (Δx) = _____ cm (scale) = _____ km (actual) direction = _____^{o}

The resultant of D + E + F is _____ (include magnitude and direction). The final destination appears to be in or at least close to the city of _____ in the state of _____.

Is this reasonable? Check your answer at http://www.convertunits.com/distance/

Analytical Method of Determining the Resultant:

Now use a calculator, trigonometric functions, and principles of vector resolution to determine the components of each vector; include both magnitude and direction for each componet. Show your work in each of the cells of the first three rows of the data table. Finally, add all the components to determine the horizontal and the vertical components of the resultant of D + E + F.

Vector	Horizontal or E-W Component	Vertical or N-S Component
1080 km at 210 degrees	_____	_____
2200 km at 300 degrees	_____	_____
2000 km at 153 degrees	_____	_____
Resultant	_____	_____

Now use the components of the resultant to determine the magnitude and the direction of the resultant. Once you have determined the resultant, make a measurement on the map to determine where this displacement would place a traveler. **SHOW YOUR WORK BELOW.**

Length of resultant (Δx) = _____ km (actual) = _____ cm (scale) direction = _____^{o}

As found by the analytical method, the resultant of D + E + F is _____ (include magnitude and direction). When this resultant displacement is measured on the provided map,the final desination appears to be in or at least close to (use a map of the USA if necessary) the city of _____ in the state of _____.

Compare the results of the two methods of vector addition and use a few complete sentences to evaluate the effectiveness of the methods and the accuracy of your measurements.

Conclusion:

Thoroughly define or describe the following ideas or terms.

- Resultant:

- Component:

- Head-to-tail method of vector addition:

- Analytic method of vector addition:

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