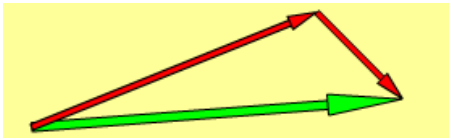
Name: _____
Date: _____ Period _____

CP Physics: Vector Sim Lab / 50

Procedures: Go to https://phet.colorado.edu/en/simulation/legacy/vector-addition, the "Vector Addition" sim.

To get a vector (arrow), grab an arrow from the bucket. The length (size) of the vector is found in the |R| box. The angle of the vector is in the θ box. Place the vectors you wish to add "**head to tail".** To get the resultant vector, hit the big "SUM" button. Move the green sum vector so that the tail touches the tail of your first vector.



Data: Answer the following questions using the simulation. ***For each question, draw (and label with size and direction) the vectors you used in the sim on a separate piece of paper. Use the graph paper in my "carousel" near the front of the room to write all of your answers. Be sure to answer each question thoroughly and use a protractor and ruler to draw the vectors accurately, and label the sum vector. Protractors and rulers are located on my desk at the front of the room***. *Turn in all graph paper LABELED CLEARLY FOR EACH QUESTION 1-6.*

1. You go for a walk and take 20 steps in the north direction (90°). Use the simulation to represent your path. Draw and label your vector on your lab write-up.

a) Explain why this vector could also represent traveling at 20 mph in the north direction.

b) Next, you turn left and walk 10 steps to the west. Add the two vectors using the "sum" button. How far from where you started did you end up?

c) In math, 2+3=3+2. What is this property called? _____

Does this property hold for vector addition? _____

Try it again with the scenario above by first walking 10 steps west and then walking 20 steps north. Compare the result to the sum in part b).

Name: _____
Date: _____ Period _____

2. You are going for a drive, but a detour takes you out of the way of your destination. You drive north for 10 miles, turn right and drive east for 5 miles, turn to the north and drive for 3 miles, drive west for 10 miles, and arrive at your destination.

   a) How far from where you started did you end up?

   b) If you wanted to travel directly to your destination without following the streets ("as the crow flies"), what angle would you take?

      What direction would a compass read?

   c) Now try adding the vectors in a different order. For example, start with the 5 miles east, then 3 miles north, etc., as long as you add all four vectors. Compare the result to the sum in part a). Draw the vectors in the order you used.

3. You are flying a hang glider at 14 mph in the northeast direction (45°). The wind is blowing at 4 mph from due north.
   a) What is your airspeed?

   b) What angle (direction) are you flying?

   c) The wind increases to 14 mph from the north. Now what is your airspeed and what direction are you flying?

      If your destination is to the northeast, how would you change your speed or direction so you might make it there? Test your answer using the sim.

Name: _____
Date: _____ Period _____

4. A baseball weighing 4.9 N (0.5 kg) falls from the sky. You hit it with a bat with a force of 41 N at an upward angle of 45°.

   a) Draw a new free-body diagram for when you are hitting the ball and use the sim to determine the net force on the ball.

5. You push on a 5 kg box with a steady force of 30 N. The sliding friction between the floor and the box is 8.0 N.

   a) Use the sim to determine the net force on the box. In the sim, include *all* the forces acting on the box. Draw the vectors that you used.

6. You hike for 1.9 hours at a speed of 3 mph in the southwest direction (-135°). Then you head ESE (-16º) for 7.3 miles at the same speed.

   a) How many miles have you *hiked*?

   b) Use the sim to find how many miles your destination is from your starting point (as the crow flies).

   c) What direction is your destination from your starting point? What would a compass read?

   d) For how many hours have you hiked?

Name: _____
Date: _____ Period _____

7. Review question – Which of the following are "vector" quantities and which are "scalar": fill in the blank with the correct term.

mass _____

weight _____

velocity _____

speed _____

force _____

friction _____

displacement _____

length _____

time _____

acceleration _____

temperature _____