

## **“Intro to Vectors” Simulation**

### **Getting Started:**

Go to the following site: <http://phet.colorado.edu/web-pages/simulations-base.html>

On the left side, scroll down to find “Math Tools” and click it. New icons appear on the right side of the screen. Scroll down on the right side until you see “Vector Addition” and click on the icon. The program may take a few minutes to load.

Play around with the program a bit to get comfortable with it.

### **Questions:**

*Before you begin these questions... under Component Display click the circle next to “Style 2” and Check the box next to “Show Grid”. These settings will not change for the rest of the activity. Answer all questions in complete sentences.*

1. Drag a vector into the grid.
  - a. What does  $R_x$  represent?
  - b. What does  $R_y$  represent?
  - c. What does  $\Theta$  represent?
  - d. What does  $|R|$  represent?
2. Why does the vector have an arrowhead? What does that arrowhead indicate?
3. Reshape your first vector so that it is completely horizontal. Move that vector to (0,0). What is the value of  $R_x$ ?  $R_y$ ?  $\Theta$ ?  $|R|$ ? Do these values make sense?
4. Drag another vector into the grid. Reshape it so it is completely vertical. Move that vector so that the tail of the arrow is touching the tip of the other vector on your screen. For this new vector, what is the value of  $R_x$ ?  $R_y$ ?  $\Theta$ ?  $|R|$ ? Do these values make sense?
5. What have you begun to create? Draw what you see on the screen TO SCALE on your own paper.
6. Click on the “Sum” button. A new vector appears on your screen. Drag it so that the tail of the vector is at (0,0). What is the value of  $R_x$ ?  $R_y$ ?  $\Theta$ ?  $|R|$ ? Do these values make sense?
7. Draw the new vector TO SCALE on the picture you drew for #5. How do you believe the value for  $|R|$  was determined? Calculate it on your own to verify the computer’s result. SHOW ALL YOUR WORK!
8. Does the method you used work for *all* triangles? If not, what special types of triangles does this method work for?
9. Drag all of your vectors to the trash. Create a new vector that starts at (0,0) and is not completely horizontal or completely vertical. What are the values of  $R_x$ ?  $R_y$ ?  $\Theta$ ?  $|R|$ ? Do these values make sense?

10. What type of triangle is made? Draw what you see on the computer screen on your own page TO SCALE. Using the value of  $|R|$  and  $R_y$ , how would you calculate  $R_x$ ? Verify the value of  $R_x$  by calculating it on your own. SHOW ALL YOUR WORK!
11. Create another vector that is not completely horizontal or completely vertical. Drag it so that its tail is touching the tip of the vector from #9. What are the values of  $R_x$ ?  $R_y$ ?  $\theta$ ?  $|R|$ ? Do these values make sense?
12. Add the vector from #11 to your picture. Be sure to draw it TO SCALE on your paper. Click the "Sum" button. Move the new vector so that its tail is at (0,0). Draw this vector to scale on the drawing you made in #9 and 11.
13. For your newest vector, what are the values of  $R_x$ ?  $R_y$ ?  $\theta$ ?  $|R|$ ? Do these values make sense?
14. For your newest vector, how was  $R_x$  determined? How was  $R_y$  determined? How was  $|R|$  determined? Try to verify the results the computer gave you by calculating the  $|R|$  yourself. SHOW ALL YOUR WORK!
15. In general, if you know the measurements of the horizontal parts (components) of vectors and you know the measurements of the vertical components of vectors, how can you find their sum (resultant)?