Name: ___________________________

PhET Vectors Simulations Lab

Introduction:

A vector quantity is one that has both a magnitude and a direction. For instance, a velocity vector will have a magnitude (24 m/s) and a direction (northeast or 45 degrees). These simulations will demonstrate how vectors can be summed to produce a resulting vector, and how the acceleration vector affects the velocity vector.

Part I: Motion in 2D Simulation: *http://phet.colorado.edu/simulations/sims.php?sim=Motion_in_2D*

1. Click *Stop*. Drag the object around with your mouse and notice the actions of the two vectors. Spend some time investigating the vectors. Which color vector is velocity and which is acceleration? _________________________
2. Be sure everyone in the lab group does this exercise.
3. Click on *Linear Acc 1*. Observe the motion. A larger blue vector causes what motion?

   ____
4. Click *Simple Harmonic*. Observe the motion. A larger blue vector causes what motion?

   ____
5. Click *Circular*. Observe the motion. What orientation must the vectors (to each other) have to turn the object?

   ____
6. Click Stop. Attempt to move the object like a car or runner on a racetrack (in an oval). What must the car/runner do in order to turn? ____
7. Move the object like a car moving forward, then coming to a quick stop. Describe the acceleration vector.____

Part II: Vector Addition Simulation: *http://phet.colorado.edu/simulations/sims.php?sim=Vector_Addition*

Place two vectors  in the work area. Change their direction and magnitude be dragging the heads of the arrows representing each vector. Click  to view the resultant (sum) of the two vectors. You may click the *Styles* to show the *X* and *Y components*.

Click on one vector and fill in the boxes: |R| [ ] θ [ ] R_x [ ] R_y [ ]

Click on another vector and fill in the boxes: |R| [ ] θ [ ] R_x [ ] R_y [ ]

Click the **resultant** vector and fill in: |R| [ ] θ [ ] R_x [ ] R_y [ ]

|R| = Magnitude of the vector (M) θ = angle of the vector R_x = X component R_y = Y component

Repeat: Vectors 1 and 2

|R| [ ] θ [ ] R_x [ ] R_y [ ]

|R| [ ] θ [ ] R_x [ ] R_y [ ]

The Resultant Vector

|R| [ ] θ [ ] R_x [ ] R_y [ ]

Part III: Calculating Resultant Vectors: *review of vector addition follows*

- Find the mathematical sum of each set of vectors below (with a calculator).
- Recreate (as closely as possible) the vectors in the simulation to check your work.
- To add vectors, break each vector into its X an Y components by calculating $M \cos\theta = X$ and $M \sin\theta = Y$. The components CAN BE NEGATIVE (↙ = -x, -y)
- The resultant vector's X and Y components are the sum of the X and Y's of each vectors: $X_r = X_1 + X_2$
- The resultant vector's magnitude M or |R| is found using the Pythagorean theorem using X_r and Y_r as the legs of a right triangle, where the hypotenuse is the magnitude.
- The angle θ of the resultant vector is found with the inverse tangent ($\tan^{-1}$) of the X_r and Y_r components.

Fill In All Available Boxes-Graded answers will come from calculations, use sim to check work

#1

Vector 1

M	angle, θ	X_1	Y_1
6.0	35		

Vector 2

M	angle, θ	X_2	Y_2
2.5	20.		

Resultant

M_r	θ_r	X_r	Y_r

#2

Vector 1

M	angle, θ	X_1	Y_1
1.8	15.		

Vector 2

M	angle, θ	X_2	Y_2
7.0	-25		

Resultant

M_r	θ_r	X_r	Y_r

#3

Vector 1

M	angle, θ	X_1	Y_1
		3.5	2.5

Vector 2

M	angle, θ	X_2	Y_2
		4.0	6.0

Resultant

M_r	θ_r	X_r	Y_r

#4

Vector 1

M	angle, θ	X_1	Y_1
	70	4.7	

Vector 2

M	angle, θ	X_2	Y_2
	-15		-2.0

Resultant

M_r	θ_r	X_r	Y_r
		12.1	10.8

Conclusion Questions:

1. The blue vector represented ________________________ and the green represented _________________________.
2. When the acceleration vector was in the same direction as the velocity vector, the object *slowed down / sped up.*
3. When the acceleration vector was in the opposite direction as the velocity vector, the object *slowed / sped up.*
4. Turning requires the acceleration vector to be ___p ___________________ (geometry term) to the velocity vector.
5. When a car comes to a stop, the car's brakes create an __a ________________ that is in the *same direction / opposite direction* as the velocity vector.