Projectile Concepts

1. Pick an initial horizontal velocity between 15 m/s and 100 m/s: _____
   Pick an initial vertical velocity between 15 m/s and 100 m/s (not the same as v_x): _____

   Now imagine that a projectile is launched across level ground ($y_i = 0$) with the initial velocity that you chose. Determine the following three things:

   a. The time to the maximum height.

   b. The maximum height of the projectile.

   c. The range of the projectile.

2. Now go to the website: https://ophysics.com/k8.html. Play around for a minute or so to see how the controls on the simulation work.
   a. When you are ready, set the initial velocity and gravity to what you used in question 1. Run the simulation to see if you got the correct answers above. Then check the appropriate box:

   ☐  ☐  ☐ 

   b. Hopefully, your answers were the same as the simulation. Now, think and predict what will happen to your calculations if you make the following changes (all with respect to your very initial conditions.) Then try them. Predict and test one at a time. Give answers like "no change," "doubles," "halves" etc.

Changing This	*Results in This*		
	Time to Max Height.	*Max Height*	*Range*
Double v_x			
Halve v_x			
Double v_y			
Halve v_y			
Double g			
Halve g			

   How did you do? ☐  ☐  ☐ 

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3. Now let's do the same thing theoretically. For a projectile with an initial velocity of $v_{xi}\mathbf{i} + v_{yi}\mathbf{j}$ that is launched across a level field, find expressions for the following:
   a. Time to Max Height

   b. Max Height

   c. Range

4. Finally, look at the expressions you just derived. Compare each of those with the results from question 2. Do the expressions support what you found? Explain.
   a. Time to Max Height

   b. Max Height

   c. Range

Does it make sense nows? ☐ ☐ ☐