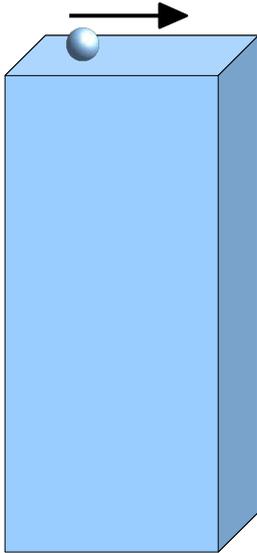
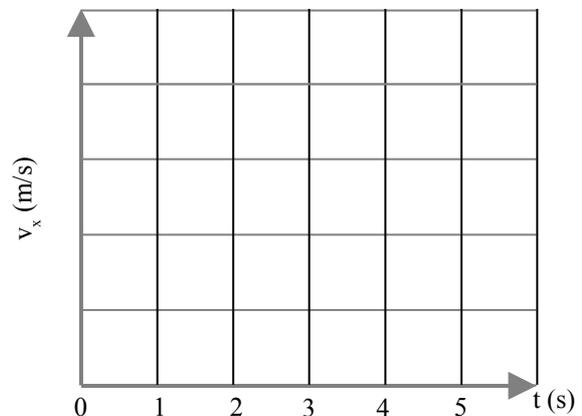
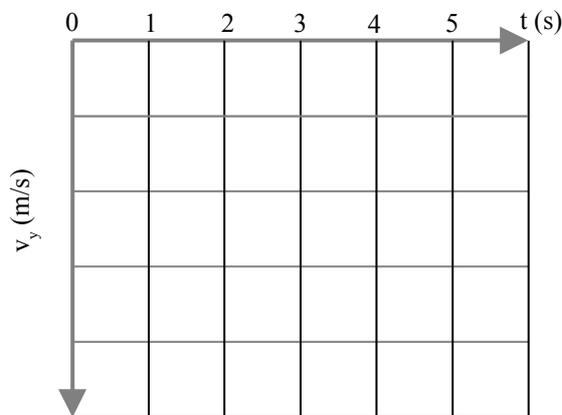


Whiteboard Problems – Horizontal Projectiles

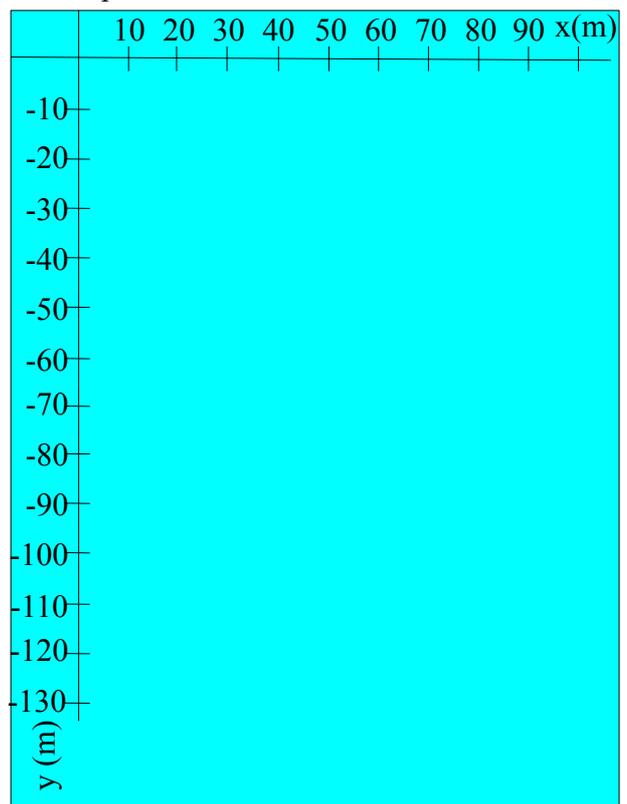


1. A ball rolling at 20m/s on a very tall, level platform falls off of the edge. (a) Draw a quantitatively accurate *vertical* velocity vs. time graph for the first five seconds of the fall. From this graph, determine the ball's vertical position at each second. Show your method with a visual aid and at least one sample calculation. (b) Draw a quantitatively accurate *horizontal* velocity vs. time graph for the first five seconds of the fall. From this graph, determine the ball's horizontal position at each second. Show your method with a visual aid and at least one sample calculation.



All arrows should start at or near the dot showing the ball's position at that instant in time. Use half arrow-heads and a different color for acceleration arrows. \rightarrow

- (c) Lay out an x and y axis on your whiteboard using a scale of 5cm represents 10m , as shown at right. (d) Add horizontal and vertical velocity arrows at each point, using a scale of 5cm represents 10m/s . (e) Add horizontal and vertical acceleration arrows at each point, using a scale of 5cm represents 10m/s^2 .

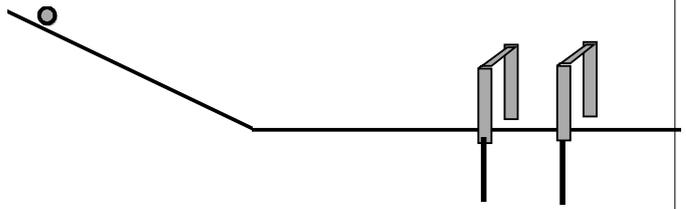


Problem 1 (continued) (f) Show how to obtain the vertical velocity arrow for the fourth second by vector adding the vertical velocity and acceleration arrows for the third second. Draw your vector addition diagram to scale.

(g) Show how to vector add the horizontal and vertical velocity at the third second to obtain the angle and total speed at the third second. Draw the total velocity vector on the motion map. How does the direction of this arrow relate to the curved path of motion?

For each problem, draw quantitatively accurate velocity vs. time graphs, and use them to answer the questions. *You may neglect all forces from the air.*

2. A student finds that it takes 0.20s for a ball to pass through photogates placed 30 cm apart on a level ramp. The end of the ramp is 92 cm above the floor. How long is the ball in the air? Where should a coin be placed so that the ball strikes it directly on impact with the ground?

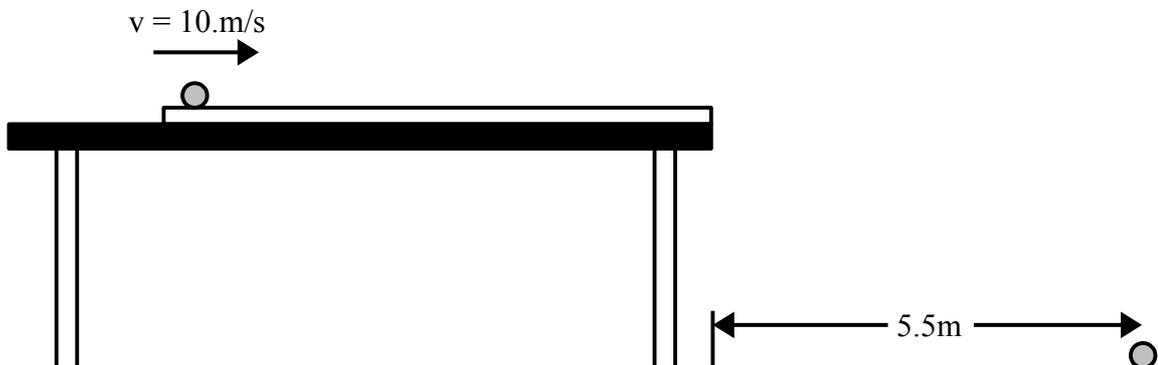


<p>vertical</p>	<p>horizontal</p>	<p>solution</p>
-----------------	-------------------	-----------------

(b) Suppose instead that the ball takes 0.40s to pass between the gates. How would this change your answers?

(c) Suppose instead that the ball is held at ramp height just past the edge and dropped. How would this change your answers?

3. The ball shown below rolls off the table and lands 5.5m from the edge. What is the height of the table?



<p>vertical</p>	<p>horizontal</p>	<p>solution</p>
-----------------	-------------------	-----------------

4. A ball player wishes to determine her pitching speed by throwing a ball **horizontally** from an elevation of 4.0 m above the ground. She sees the ball land 25. m down range.

<p>vertical</p>	<p>horizontal</p>	<p>solution</p>
-----------------	-------------------	-----------------

