Lesson plan for *Maze Game* 1: Using vector representations to move through a maze
Time for activity: homework for 20 minutes

Learning Goals: Students will be able to:

- Maneuver through the maze controlling position, velocity, or acceleration.
- Explain game strategies using physics principles.

Background: I used this activity at the end of Unit 3 Forces and the Laws of Motion (Chapter 4). The students will have completed 1D and 2D motion as well as applying the three laws in several situations.

Lesson: I gave this for homework like Perkins' did in the CU course. The link to Perkins' activity is http://phet.colorado.edu/teacher_ideas/view-contribution.php?contribution_id=478&referrer=/teacher_ideas/browse.php

Question 3: Perkins' wrote an example of a good answer:

> Acceleration is the (change in velocity)/(time elapsed). In this game, we have control over the acceleration vector whose direction indicates the direction in which the acceleration points and whose length indicates the magnitude of the acceleration. To minimize time, the puck must travel at a high average velocity. To achieve this under the acceleration control, a good strategy is to start with a large acceleration to the left until the puck is half way across the play area and moving fast. At that moment, reverse the acceleration so that it is large and to the right. The puck will continue to move left, but slow down at a steady rate. When the puck has slowed to a stop it should be nearly directly above the goal. Now accelerate rapidly in the direction of the goal.

Question 4: On any level, a collision with a wall, then reaching the goal says "**No Goal**". However, if you backtrack over your collision icon, you erase it and then can get a **"Goal"**.

Post lesson: There are 4 clicker questions that could be used.

Student directions ***Maze Game*** activity 1: Using vector representations to move through a maze
Homework for 20 minutes

Learning Goals: Students will be able to

- Maneuver through the maze controlling position, velocity, or acceleration.
- Explain game strategies using physics principles.

Directions:

1. Use the **Practice** level of ***Maze Game*** to understand the controls for the game.

2. Play Level 1 using each of the 3 methods for control. To keep everyone on equal grounds, you must **Start Game,** from the **Reset** location. Keep track of your progress by filling out the table with at least three trials for each control. *You'll find that completing Level 1 under acceleration control is the most challenging, but is also a great way to gain an intuition for acceleration. The current record is 5.0 seconds!*

Type of control R (Position), V or A	Time or NG (no goal)	Number of Collisions	Score
R			
R			
R			
V			
V			
V			
A			
A			
A			

3. Describe your strategy for minimizing your time when using the acceleration control. Be sure to back your strategy with the physics principles.

4. Explain what you do to get **"No Goal"**. How can you get a **"Goal"** without selecting **Reset**?

5. Play with **Level 2** and track of your results in this table:

Type of control R (Position), V or A	Time or NG (no goal)	Number of Collisions	Score
R			
R			
R			
V			
V			
V			
A			
A			
A			

Maze game 1 clicker questions

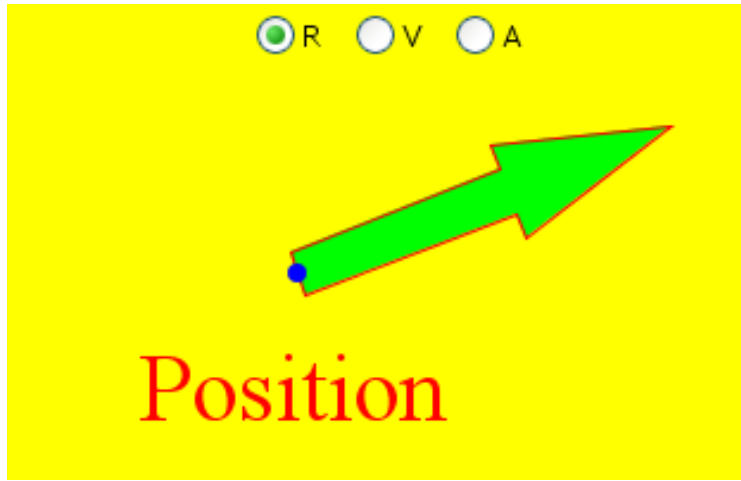
Learning Goals: Students will be able to

- Maneuver through the maze controlling position, velocity, or acceleration.

In activity, but not covered in clicker questions:

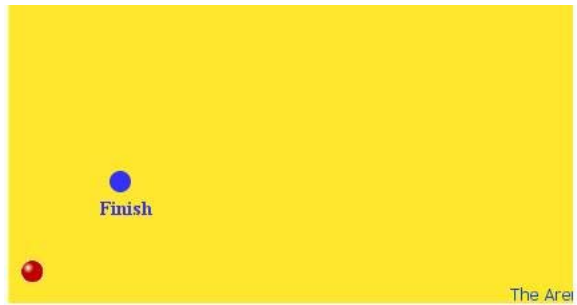
- Explain game strategies using physics principles.

1. Which one best shows where the red ball would be?



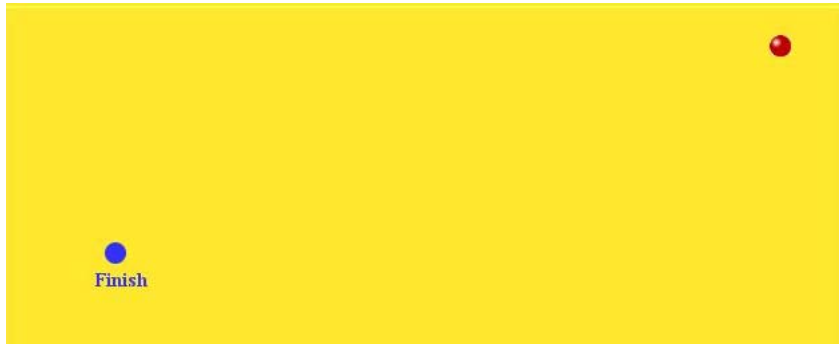
A

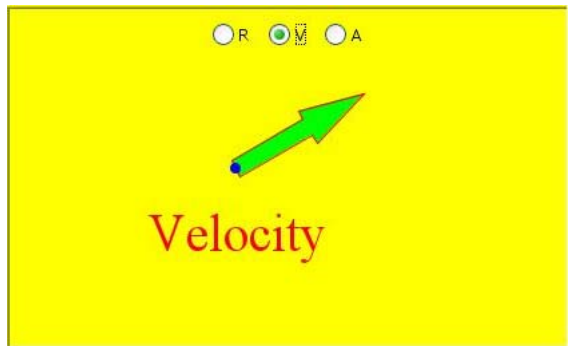
B



C

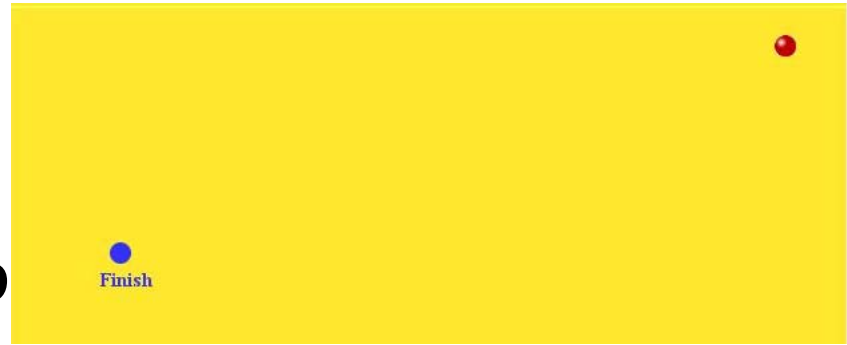
2. Which best describes how the red ball will move?



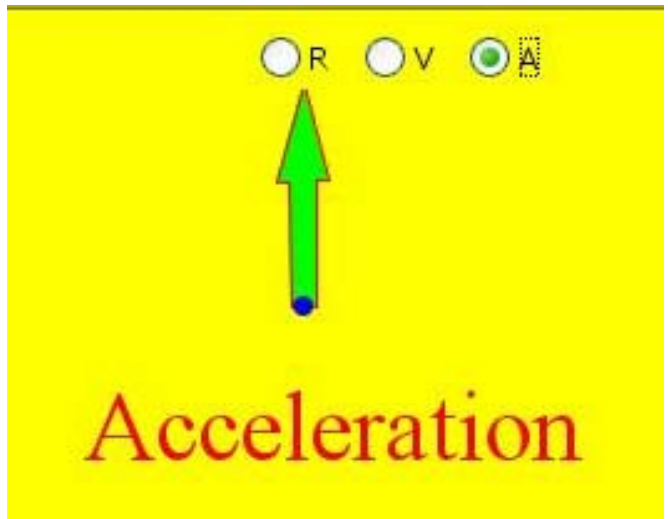


A. Up the page
B. Down the page
C. Toward the Finish
D. Away from the Finish
E. No way to predict

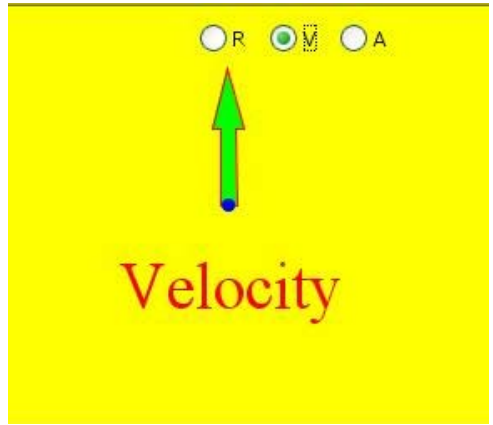
3. Which best describes how the red ball will move?



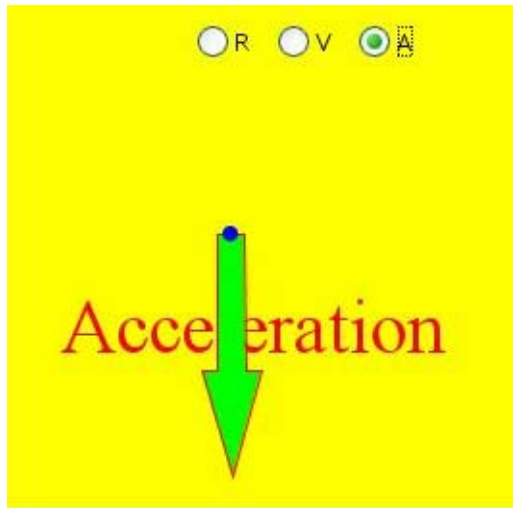
A. Up the page
B. Down the page
C. Toward the Finish
D. Away from the Finish
E. No way to predict



4. If you made the ball up down the page with this velocity vector, and the changed the acceleration to this vector, what would the ball do?



A. Change direction and go down the page immediately
B. Go up the page faster
C. Go up the page slower



Lesson plan for *Maze Game* 2: Vector controls for circular motion
Time for activity: homework for 20 minutes

Learning Goals: Students will be able to draw controlling vectors (position, velocity, or acceleration) when the red ball is moving in circles.

Background: I have not used this activity and plan to put it at the end of Unit 5 Rotational Motion (Chapter 7). The students will have completed the Lady Bug activity

Lesson: I think students will need to work in pairs.

Student directions ***Maze Game*** activity 2: Vector controls for circular motion
Homework for 20 minutes

Learning Goals: Students will be able to draw controlling vectors (position, velocity, or acceleration) when the red ball is moving in circles.

Directions:

1. I used the Position Arrow control (

selected) to make the Red ball move in concentric circles and the trace of the position vectors looked like Figure 1. Draw what you think the green arrow would have looked like when the **red ball** was at the locations shown in Figure 2

Figure 1

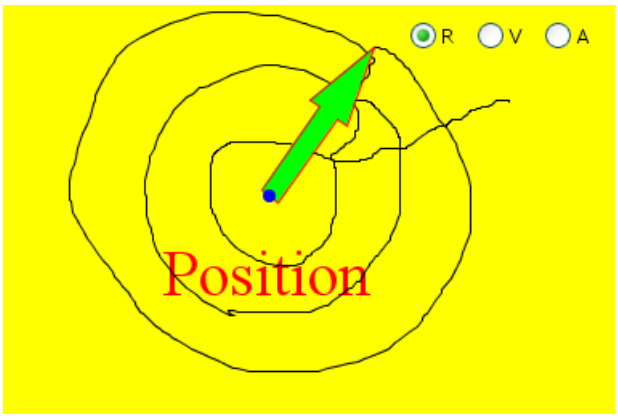


Figure 2

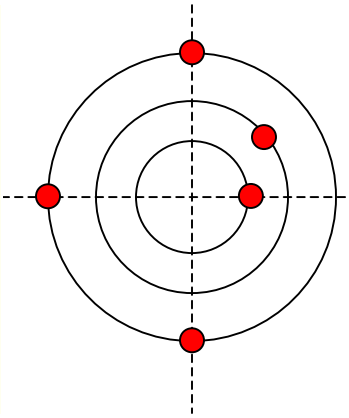
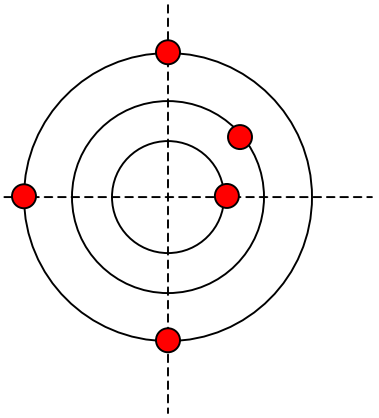


Figure 3



2. Use the **Practice** level of ***Maze Game*** with the window maximized for more play area. Check your ideas. Have a partner help you watch the red ball while you control the vector. You can **Pause** the simulation to help. Make corrections on Figure 3.

3. Draw what you think the green arrow would have looked like when the red ball was at the locations shown in Figure 4 and the velocity control 

was on. Remember that vectors can be drawn anywhere in space, so draw the vector with the tail on each of the red balls to help organize your ideas.

Figure 4

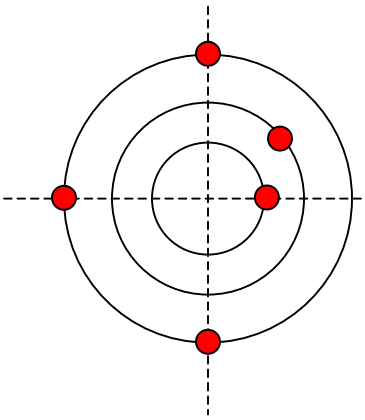
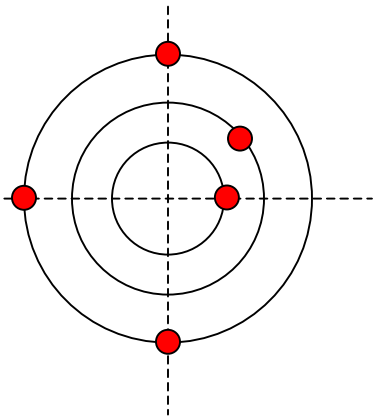


Figure 5



4. Check your ideas and make corrections on Figure 5.

5. Draw what you think the green arrow would have looked like when the red ball was at the locations shown in Figure 6 and the acceleration control 

was on. Check your ideas and make corrections on Figure 7.

Figure 6 **Figure 7**