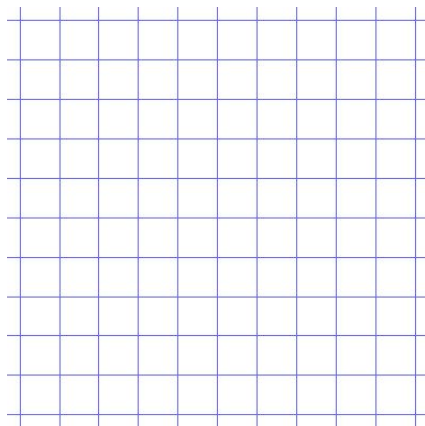
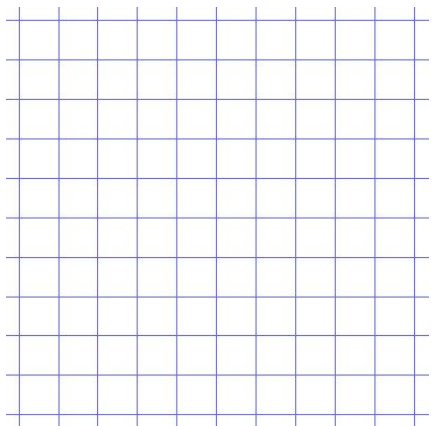
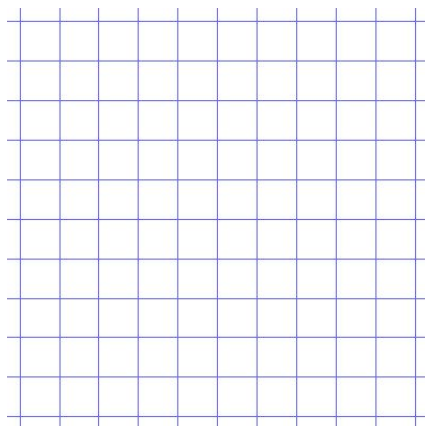
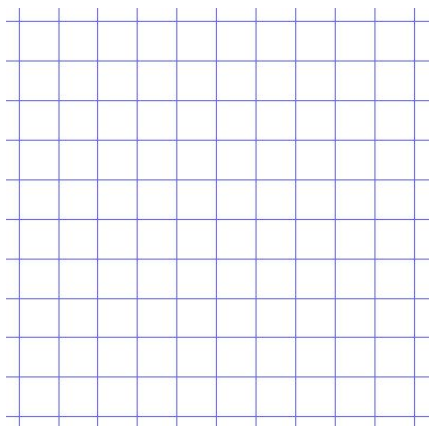




4. Sketch the  $x$  vs.  $t$  graph for the ball. Note that the initial position of the ball at  $t = 0$  is  $x = 0$ . Also, sketch the  $v_x$  vs.  $t$  graph. Label and title the graphs.



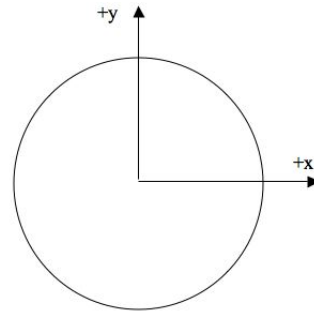
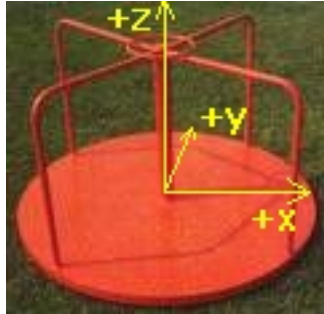
5. Sketch the  $y$  vs.  $t$  graph for the ball. Note that the initial position of the ball at  $t = 0$  is  $x = 0$ . Also, sketch the  $v_y$  vs.  $t$  graph. Label and title the graphs.



## Section 2. Momentum Principle

Questions 6–8:

6. A 20-kg girl rides on a merry-go-round. The  $+z$  axis is defined to be perpendicular to the merry-go-round, and the  $+x$  and  $+y$  axes are in the plane of the merry-go-round. (See figures below.)



At  $t = 0$ , the velocity of the girl is  $\langle 0.261, 2.99, 0 \rangle$  m/s. 0.15 s later, her velocity is  $\langle -0.261, 2.99, 0 \rangle$  m/s. What is the net force on the girl during this time interval? Calculate and sketch this vector.

7. What is the force of the merry-go-round on the girl during this time interval?

8. What is the magnitude of the frictional force (of the merry-go-round) on the girl during this time interval?

Questions 9–10: A child rides down a hill on her bicycle and applies the brakes so that she slows down from 5.0 m/s to 3.0 m/s in 4 s. The angle of the hill is  $20^\circ$ . Neglect the force of air. Define the  $+x$  axis to be parallel to the road and in the direction of motion, and define the  $+y$  axis to be perpendicular to the road. Consider the child and bike together as the system.

9. What is the net force on her and the bike?

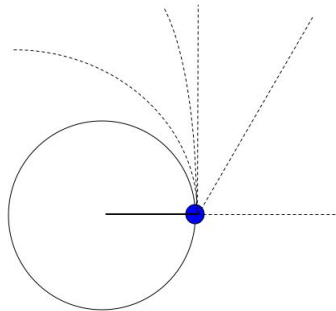
10. What is the force of the road on the bike?

Questions 11–13:

11. A pair of figure skaters execute the death spiral where the male skater holds the hand of the female skater and swings her in a circle, as shown in the image below.



The next image is a top view of the female skater as she rotates counterclockwise. Suppose that they lose their grip at the moment shown. Which path will the skater follow? Clearly indicate your answer.



12. If friction between the skater and ice is negligible, describe her motion in the moments following the skaters losing their grip. (i.e. Does she speed up, slow down, or have a constant velocity, for example?)

13. If during the death spiral, the male skater exerts a force on the female skater of magnitude  $F$ . Is the force of the female skater on the male skater less than, greater than, or equal to  $F$ ? Explain your reasoning.

# Answer Key for Exam **A**

## Section 1. Lab

1.

2.

3.

4.

5.

## Section 2. Momentum Principle

6.

7.

8.

9.

10.

11.

12.

13.