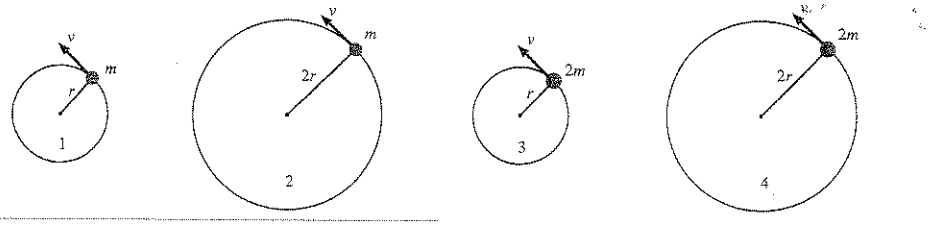
Dynamics of Uniform Circular Motion

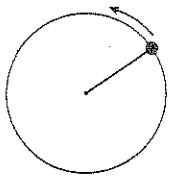
9. The figures are a bird's-eye view of particles moving in horizontal circles on a table top. All are moving at the same speed. Rank in order, from largest to smallest, the tensions T_1 to T_4.



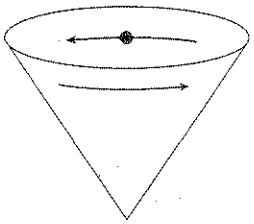
Order:

Explanation:

10. A ball on a string moves in a vertical circle. When the ball is at its lowest point, is the tension in the string greater than, less than, or equal to the ball's weight? Explain. (You should include a free-body diagram as part of your explanation.)



11. A marble rolls around the inside of a cone. Draw a free-body diagram of the marble when it is on the left side of the cone and a free-body diagram of the marble when it is on the right side of the cone.



On left side

On right side

12. A jet airplane is flying on a level course at constant velocity.

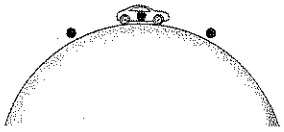
a. What is the *net* force on the plane?

b. Draw a free-body diagram and identify all of the forces acting on the plane.

c. Airplanes bank when they turn. Explain why, in terms of forces and physical laws.
Hint: What would a free-body diagram look like to an observer *behind* the plane?

13. The drawing shows a car moving clockwise at constant speed over the top of a circular hill.

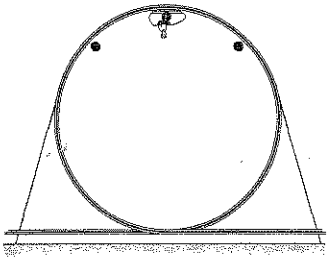
b. To the right of the sketch, draw a free-body diagram for the car when at the top of the hill and indicate the direction of the net force on the car.



d. For this situation, is there a maximum speed at which the car can travel over the top of the hill and not lose contact with the hill? If not, why not? If so, show how your free-body diagram would change, if at all, at that speed.

14. The drawing shows a car moving upside down while looping a circular roller coaster loop-the-loop at constant speed in the clockwise direction.

b. To the right of the sketch, draw a free-body diagram for the car at the top of the loop and indicate the direction of the net force on the car. (Assume the car is moving fast enough so that it would not fall, even if not attached to the roller coaster track.)



d. For this situation, is there a minimum speed at which the car can travel over the top of the loop and not lose contact with the loop? If not, why not? If so, show how your free-body diagram would change, if at all, at that speed.