Uniform circular motion: Investigations

Here are some activities to help us visualize circular motion.

1. Swing the ball in a horizontal circle on the tabletop, keeping the string parallel to the table. For a *uniform circular motion* define:
    a. Period
    b. Distance traveled in one period
    c. Speed in terms of distance and period

2. Where should you let go of the string if you want the ball to go parallel to one of the table edges? Why?

3. Draw the situation in question (before you let go of the string!) Include in your drawing all the forces acting on the ball, the center of the circle it makes, and a coordinate system you would use when applying Newton's laws. What direction is the net force? Which force(s) provide this net force?

4. Let go of the string and see what happens. Does it go the direction you expect? Why/why not?

5. What is the *reaction* force of the tension on the ball?

6. Now explore what happens if we change parameters in the system. If you increase the speed of the ball, what happens to the tension? If you increase the radius but keep the speed constant, what happens to the tension? (Try it and see!)

7. Write an expression relating the *net force* to these two variables (speed and radius) based on your observations. What do you think would happen if you increase the mass? Include this in your expression.

8. You're almost there! Check the units of your equation and see if they work out. Is there anything we need extra (or fewer) of on the right hand side of the equation?

Does all this make sense? Let's do some more physical experiments.

9. Decide on a period to go around once (use your phone to time the period). Then, double the speed and see how that feels in comparison.

10. Go back to your original speed. Now, reduce the radius to ½. Do you feel more or less force than when you doubled the speed? (why did you increase v but decrease r?)

One last problem:

11. Swing the ball in a horizontal circle in the air. Does the string need to be parallel to the ground for the circle to be horizontal? What happens to the cone as you increase the speed of the ball? Draw the situation, including all forces on the ball, the center of the circle, and a coordinate system. Use these to explain why the cone changes as the speed increases. Can you ever get the string completely horizontal?