Physics 231: General Physics I **Names:** _____
Lab 4 – Feb. 12, 2004 _____

Circular Motion

We examine a toy plane moving in uniform circular motion. We calculate the acceleration and compare it to what is expected from the forces on the plane.

Part I Kinematics – describing motion

1. Use a stopwatch to measure the time required for the plane to complete one revolution by averaging the time taken for ten revolutions.

   t = _____

2. Measure the radius of the circle around which the plane is traveling (use the location where the plane is attached to the string).

   r = _____

3. Calculate the speed of the plane. Show your work.

   v = _____

4. Calculate the centripetal acceleration of the plane. Show your work.

   a = _____

Part II Dynamics – explaining acceleration with forces

5. Measure the length of the string attached to the plane.

   L = _____

6. Determine the angle that the string made with vertical when the plane was in motion. Do not attempt to directly measure the angle, calculate it from other information you know. Show your work (a picture will be helpful).

   θ = _____

7. Measure the mass of the plane.

m = _____

8. **Pre-lab** Draw and label a free-body diagram for the plane as pictured from the front. (Don't worry about the forces in the forward and backwards directions due to the propeller and air resistance; they are equal when the plane is moving at a constant speed.)

9. **Pre-lab** Use the free-body diagram and Newton's Second Law in the vertical direction to derive a formula for the tension. Show your work.

10. Plug in your measured values for m, L, and ?.

T = _____

11. **Pre-Lab** Use the free-body diagram to derive a formula for the net force in the radial direction.

12. Plug in measured values to find the net force. Do not use anything from part A for this calculation!

$$\sum F_{\text{radial}} = \_\_\_\_\_$$

13. How do the mass times the centripetal acceleration and the net force in the radial direction compare? (Calculate the percentage difference.)

Pre-lab #4 Name: _____

8. **Pre-lab** Draw and label a free-body diagram for the plane as pictured from the front. (Don't worry about the forces in the forward and backwards directions due to the propeller and air resistance; they are equal when the plane is moving at a constant speed.)

9. **Pre-lab** Use the free-body diagram and Newton's Second Law in the vertical direction to derive a formula for the tension. Show your work.

11. **Pre-Lab** Use the free-body diagram to derive a formula for the net force in the radial direction.