The Airplane on a String

Introduction: When an object travels at constant speed along a circular path, we say it has uniform circular motion (if it's speed were changing, then it's motion would not be uniform). Any object moving in uniform circular motion is accelerated toward the center of it's circular path. This acceleration is called centripetal acceleration. Since the net force on any object equals *ma,* during uniform circular motion the net force, called centripetal force, is directed toward the center. This is what happens when an object suspended by a string moves in a circular path —a conical pendulum. The string of a conical pendulum sweeps out a right-circular cone.. In this experiment you will measure the speed and torque of an airplane and calculate the Centripetal force, Torque, Angular Momentum, Rotational Inertia, Rotational Energy & Tension of the string. Plan ahead.....What data do you need to get these calculations.

Problem: Design an experiment, using the Airplane-on-a-String to measure and calculate the Centripetal Force, Tension on the String, Required Torque, Rotational Inertia, Angular Momentum & Rotational Energy of and on the Airplane.

Equipment: Airplane, string, 2.5 Newton Spring Scale, Mass-Balance, Elastic Bands, Scissors, Stopwatch, Protractor, Measuring Tape & Batteries. (You do not need to use all the provided equipment.)

Procedure: Measure data that you'll need to solve the above problem.
Setup the Airplane on a String. Ask your instructor to check your pivot before switching on to battery power. Carefully hold the airplane by it's body and give it a slight shove about 30 degrees from the vertical, just enough so that the airplane "flies" in a circle. The goal is to launch the airplane tangent to the circle of flight. It's better to launch it to easy than too hard. If the airplane does not fly in a stable circle in 10 seconds or so, carefully grab it and try launching it again.

Once the airplane is up and flying in a circle of constant radius, measure the remaining required data to enable you to calculate the Centripetal Force, Tension on the String, Required Torque to keep it flying, Rotational Inertia, Angular Momentum & Rotational Energy of the Airplane.

Describe your procedures and reasons. Clearly label your data with units. Show your calculations in a clear format and box your results.
Provide a Free-body Diagram that shows all of your forces with components.
Do at least two trials of data. Provide tables when needed.
Check you data with % difference comparisons. (Ideal vs. Actual)

Point Rubric: (100 pts for Clear, Neat & Organized Presentation)
10 pts. = Free-Body diagram; 10 pts. = Data units; 10 pts. = Correct Centripetal Force Calculations
10 pts. = Correct Tangential Velocity Calc.; 10 pts. = Correct Torque measurement & Calculations;
10 pts. = Correct Rotational Inertia Calc. ; 10 pts. = Correct Angular Momentum Calc.;
10 pts. = Correct Rotational Energy Calc.; 10 pts. = % error comparisons; 10 pts.= String Tension