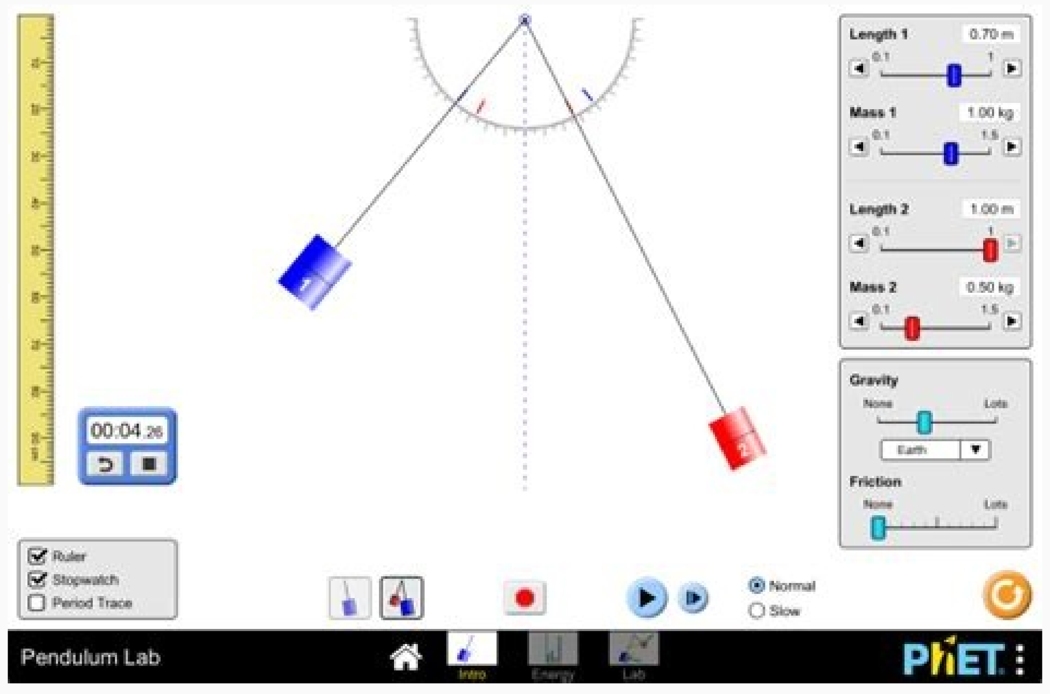
15616194.024096 25017038364 9115115075 26456224080 86890205.695652 14225153528 741988101 31172357.68254 5531311002 3016724620 16865739.638554 21379193 3645220.9512195 19314519.685714 11294462.676923 13243782325 130147935943 69965505714

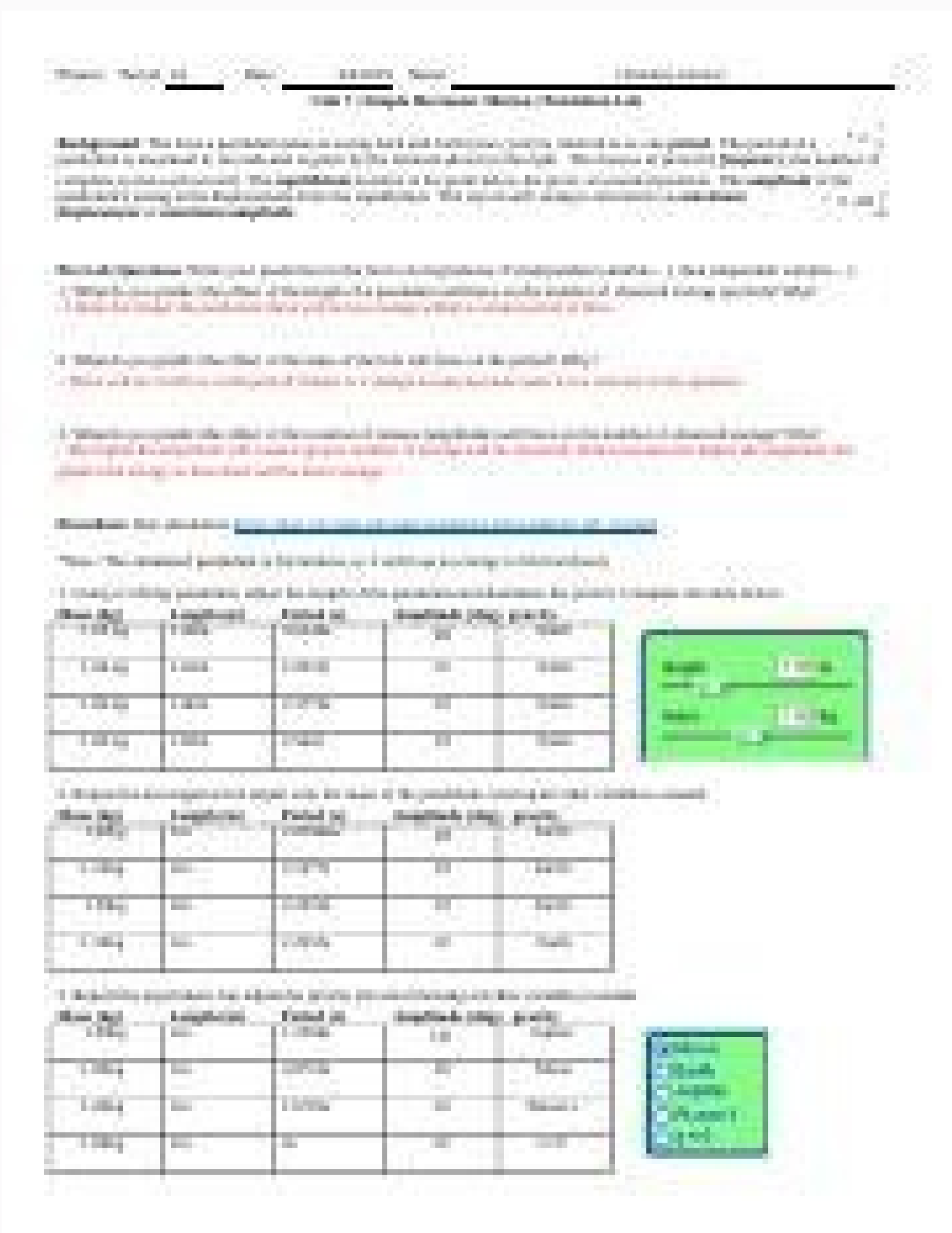
Conical pendulum lab report pdf format

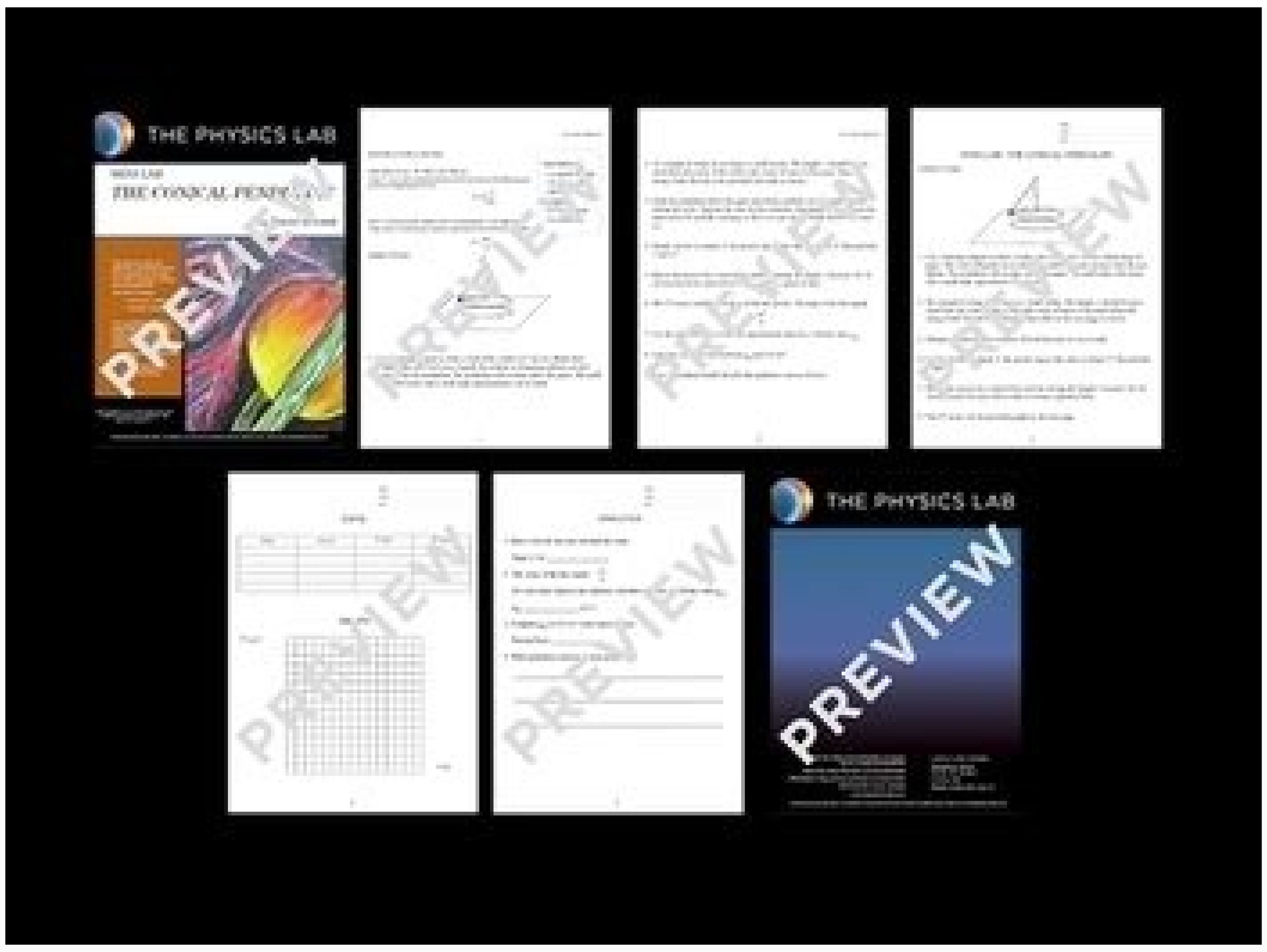
Physics (SL) Experiment

Research Question

To obtain the frequency of the simple pendulum and to analyze the effect of change in amplitude, length and mass on the frequency?







First, check that the battery compartment of the plane is securely fastened. The equation for centripetal force is Fc = mv 2/r, where m is the mass of the object, v is the tangential velocity, and r is the radius of the circular path. We assumed that the mass of the string was negligible compared to that of the bob. Mark this position on the ceiling or floor, and measure to the center of the plane’s path. We believe this error to have been less than 10mm(or 0.01m), so for the 1.5m string the uncertainty was only 0.01/ 1.5= 0.6%, while for the shortest string it was .01/. In this experiment we investigated the dependence of the period pf a pendulum on two variable, the mass of the bob and the length of the string. We followed the instructions and tried to keep the amplitude constant for all the measurements so that it would not affect the result, because we learned in class that in the case of a pendulum, large amplitude can change the period. This lab is appropriate for AP® Physics and physics students with strong algebra and geometry backgrounds. (Hint: See Part III, Step 3.) A: The mass of the plane cancels out when you set the equation for centripetal force equal to the horizontal component of the tension. Use caution when using the laser and do not look directly into the laser beam. When we charted and made a trend line with Excel, the period was proportional to the length raised to the0.45 power. Conical Pendulum Figure 10 Answer the following questions from Part III: Q: Based on the free body diagram you drew, explain the motion of the plane. It is not necessary to measure the mass of the plane. Velocity is a vector. The plane’s speed is a scalar quantity and is constant. A: The forces on the plane in the vertical direction are balanced so the plane does not move up and down. Thank you for your participation! Thank you for your participation! 206Conclusion Sample-2004 206ConSam Sample conclusion for a pendulum experiment lab. This is probably more than anyone in class will submit (even the “A” reports) but it illustrates as an ideal for which one can strive. Conical Pendulum Figure 7 Here, v is the magnitude of the tangential velocity of the plane, or the speed. The speed is the magnitude of the plane’s velocity. A: Uniform circular motion describes an object moving in a circular path at a constant speed. It was difficult to read the time to better than 1 second. What term do we use for this type of force? Q: Is it necessary to measure the mass of the plane? Step 1: Measure the circumference by finding the radius of the plane’s flight and calculating the circumference with the equation C = 2πr, where C is the circumference, r is the radius, and π is 3.14. Q: What is applying the force to the plane that causes it to constantly change direction? This is to be compared with the value in the text that states that the period is proportional to the square root of the length (0.5 power). A: No. Speed and velocity are not the same. The plane is moving in uniform circular motion. Conical Pendulum Figure 4 Tx = horizontal component of tension Ty = vertical component of tension Conical Pendulum Figure 5 Step 3: Set the horizontal component of the tension equal to the centripetal force causing the plane to move in a circle. The horizontal component of the tension is not balanced and always points toward the center of the circle, while the thurst from the plane’s propeller is always directed tangent to the plane’s circular path. The plane’s velocity is constantly changing, because it is constantly changing direction. There was an uncertainty in the measured length because we had to estimate the center of the bob, and the point of suspension. The speed is found by dividing the distance traveled by the time. Calculate the percent difference in the 2 values. Turn on the switch to test that the batteries are installed correctly and that the plane is functioning properly. Are the values the same? Q: Are the plane’s velocity and speed the same? Procedure Part I: Launch the Plane Install the batteries in the plane’s battery compartment. Conical Pendulum Figure 1 Part II: Measure the Tangential Velocity Calculate the average speed of the plane by dividing the distance it travels in 1 revolution (the circumference) by the time for 1 revolution (or the period). The experiment could be improved by using wire which doesn’t stretch instead of string, greater number of swings and perhaps a watch readable to better than one second. Emmette Cox Product Developer AP® is a trademark registered and/or owned by the College Board®, which was not involved in the production of, and does not endorse, this product. Materials Flying Plane2 AA BatteriesMeter Stick or Tape MeasureTimer or StopwatchLaser PointerScientific Calculator *Other motorized objects are often used for the pendulum bob in this experiment, including the popular “flying pig.” The procedures and the calculations are the same, as long as the pendulum and the string trace out a conical pendulum, and the pendulum moves with uniform circular motion. We measured the period using the clock on the wall for 20 swings. Step 5: Find θ by measuring the length of the string (from the pivot point to the center of the plane) and the radius (follow the procedure in Part II, Step 1). The plane and the supporting string trace a conical pendulum. Next, you will need to suspend your plane from the ceiling or other suitable structure that allows the plane and the support string a clear flight path. Students measure the velocity of the plane directly and then compare that value to the velocity predicted by analyzing the forces acting on the plane. Notice that it is typed and spell checked, and should not contain errors such as interchanging “affect “ and “effect”. Typos may be corrected in pen or pencil if they are not too numerous. A motorized, plastic plane* is suspended from a thin string and “flies” in a circular path with a constant speed. Conical Pendulum Figure 6 Step 4: Solve this equation for velocity. The plane is a fairly large pendulum bob. Finding the exact point from which to measure the radius using a laser pointer is a likely source of error. While the plane is in flight, hold a laser vertically and shine the light on the ceiling or floor (depending on how the plane is mounted), so that the plane crosses the beam. What are the sources of error in the calculations? So if 20 swings took 8 seconds, an error of one second would be 1/8 or 12%, which would be the largest contributor to the error. If we had used 100 swings for each trial the error would be less but we did not have sufficient time. Safety Make sure the plane is mounted securely and will not break loose during flight. Where is this force pointing? (Note to students: errors in results are very seldom below 3% and often 10 or 20% depending upon the apparatus, difficulty of the experiment, and time available.) Part III: Calculate the Theoretical Speed of the Plane Using Forces and the Laws of Motion Conical Pendulum Figure 3 Step 1: In the space below, draw a free body diagram of the forces acting on the plane while it is in flight. Once the plane is suspended, move the switch to the on position. T = tension m = mass g = acceleration due to gravity (9.8 m/s2) (The force from the propeller is directed in or out of the page, depending on which way the plane is flying.) Step 2: Resolve the components of the forces from the diagram in Step 1 to horizontal and vertical components, and find a mathematical expression for these components in terms of the forces in Step 1. This is the radius of the plane’s circular flight path. The propeller will begin to turn. This is called a centripetal force. This may take a few attempts, but once done correctly the plane will settle into a regular circular pattern, and you will be able to see the plane and the string trace out a conical pendulum. Conical Pendulum Figure 8 L = length of the string (meters) r = radius of the circular path (meters) θ = angle between the string and the vertical (degrees) Conical Pendulum Figure 9 Record your measurements here: r = _____________ (meters) L = ________________ (meters) sinθ = _____________ θ = ________________ (degrees) Step 6: Substitute the value for θ from Step 5 into the equation for velocity from Step 4 and solve for the velocity of the plane. A: The tension in the string pulls the plane up and in. The horizontal component of the tension pulls the plane toward the center of the circle, causing the plane to move in a circular path. Why does the plane move in a horizontal circle, and why doesn’t the plane move up and down? We found that changing the mass from 25 grams to 200 grams did not seem to have much effect on the period, so we concluded that the period is independent of the mass. In the case of changing the length of the string, we used strings from 0.25m to 1.5 m long, between the point of suspension and the center of the bob. Sources in error include human error while measuring the length of the string, the radius of the circle, and the measurement of the period of revolution. The conical pendulum lab allows students to investigate the physics and mathematics of uniform circular motion. Write an equation for the plane’s speed (v) in the space provided below Conical Pendulum Figure 2 This value is the magnitude of the plane’s tangential velocity, or its speed. 25=4%. Wear safety glasses to prevent eye injury. Hold the plane to the side of its resting position and give the plane a gentle push in a direction tangent to a circular course. To do this, use a timer or stopwatch to measure the time it takes for the plane to make 10 complete revolutions, and divide by 10. Record the magnitude of the tangential velocity here: _____________ (meters per second) Answer the following questions from Part II: Q: This lab involves “uniform circular motion.” What is uniform circular motion, and does the plane’s motion fit this definition? Ensure that no one is in the path of the plane. Are the plane’s velocity and speed both constant? This is an error of about 10%, which seems reasonable compared to the timing error. Record the radius here: _________________ (meters) Step 2: Find the period, or the time for a single revolution. Is there an equation for this type of force? Step 7: Compare the value given by the calculation in Step 6 with the value measured in Part II. Record the time for 10 revolutions here: _____________ (seconds) Record the time for 1 revolution here: _____________ (seconds) Step 3: Finally, divide the circumference by the period.

Transcript ENGINEERING MECHANICS STATICS THIRTEENTH EDITION This page intentionally left blank ENGINEERING MECHANICS STATICS THIRTEENTH EDITION R. C. HIBBELER Upper Saddle River Boston Columbus San Francisco New York Indianapolis London Toronto Sydney Singapore Tokyo Montreal Dubai Madrid Hong Kong Mexico City Munich Paris Amsterdam ...