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Centripetal acceleration physics lab report

The #12A from advanced physics with Vernier – The mechanics of a typical answer when a person hears the word acceleration is to think of an object changing its speed. You also learned that speed has both size and direction. So an object traveling at a constant speed in a circular track passes by acceleration. In this experiment, you develop an expression for this type of acceleration. GoalsIn this experiment, you analyze the object's speed vectors by going through a single circular motion to determine the direction of the acceleration vector at any given time. Collect data on strength, speed and radius for mass passing through a uniform circular motion. Analyze strength vs. speed, strength vs. weight, and force vs. radius charts. Determine the relationship between the force, weight, speed and radius of an object that passes through a single circular motion. Use this relationship and Newton Second Act to determine the expression for centripetal acceleration. This experiment includes the following sensors and devices. Additional equipment may be required. PhotogateDual-Range Force SensorCentripetal Force Apparatus If you've ever been on a theme park ride that travels in curved or circular roads, then you've experienced a force, called centripetal force, pushing you into driving. Whether it's a rear wall roundup or rotor, a ride where the floor drops from under your feet, or a roller coaster seatbelt that adds power, you're constantly accelerating toward the center of curvature. If – what you are most afraid of on such a journey – this force was suddenly removed, you would move towards the circular road. This is what happens when you go over a hill on a roller coaster just before the seat belt takes effect. Figure 1 compares movement in the presence of centripeal force with the resulting movement of the body should the centrelal force suddenly stop. Figure 1: Object in circular motion As an additional example, consider the ball attached to the string and swirled in a circle as shown in Figure 2a. The tension in the chain applies centripetal force to the ball, causing it to move in a circular path. String pulls the ball toward the center circle, while the ball pulls out on the string and therefore on the hand in accordance with newton law's third action and reaction. So this external force does not purpose on the ball, although it is commonly and incorrectly referred to as the centrifugal force acting on the ball. When the centripeal force is interrupted, for example, in Fig. speed at that moment. This direction is tangential to the circle at this point. Figure 2: The top view of the ball on the shoelace before and after the centripetal break of the power that keeps you driving can be determined by several measurements and calculations. In this experiment, you determine what variables must be known to determine the centripetal force needed to keep matter moving in a circular path at a constant speed. Newton's second law states that the net force applied to a moving body is equal to the overlap of body weight and its acceleration (1) Fnet = ma When applying Newton's Second Law to circular motion, it is advisable to use coordinates that are parallel and perpendicular to the movement of the object. For the body moving in a straight line, acceleration is caused by a change in speed size. For the body moving in a circular path with a constant speed size | In the case of The New York speed does not change, but the direction of the vi vector speed in constantly changes. In this case, the object does not accelerate in a direction parallel to its movement and in Eq. (2) is zero. This movement is called a single circular motion – movement in a circular path at constant speed. As the vector speed changes over time, the object in a single circular motion accelerates. Conceptually, the use of parallel and perpendicular coordinates is appropriate because the parallel force is responsible for changes in speed and the perpendicular force (or centrel force) is responsible for direction changes. What acceleration is it necessary to keep the body moving in a circle with constant speed? See Fig. Fig. At some point, the particle is located at the tip of the vector of the radius r. At another point, the particle is located at the tip of the vector of the radius r'. In a small time interval, the body moves along the arc of length . If it is small enough, the length of the arc shall be approximately equal to the distance between the position of the bodywork at the beginning of the interval and the position at the end of the interval. This straight-line segment, together with two radii, forms the equililioric triangle shown in Figure 3a. Figure 3: Geometrical reflections Figure 3b shows the velocity vectors in these two positions. Note that the size of the speed vector does not change. In 3c, the two velocity vectors are rebiased without changing their length or orientation. The arrow connecting the tip of the velocity vectors represents a change in particle speed due to a change of direction over a time interval. Note that when it shrinks, the angle between the direction and the two and approaches the right angle of 90°. Since the contactor to the circle is perpendicular to its radius, it follows that the angle between and as shown in Figure 3a. must be the same. So we can write the following expression Dividing both sides gives of course there is an acceleration of the body, and it is in the direction . From fig 3c we can see that acceleration is directed to the center of the circle. The size of centripetal acceleration is given and centripetal strength is due to the fact that it is difficult to measure the speed of the body directly, you will instead calculate the speed from quantities that are easier to measure. The size of the speed vector can be determined by measuring the distance the object passes per unit of time. If the period (the length of time it takes for an object to make one complete revolution) then the speed is equal to the distance travelled in the same revolutionary divided by the time. They'll replace it in Eq. (6) for centripetral acceleration, (9) ac = 4π 2f 2r = 4π 2T −2r, where the number of revolutions per second is measured in Hertz. Now Eq. (7) can be written in terms of measurable quantity, and as in this experiment you will measure the period of rotation for the object and calculate the centripetal forces acting on it. You compare this centreletal force with the equivalent force needed to keep an object within the same radius. Circular Motion Device Various Weights Bubble Level Balance Stop Watch Meter Stick Jar Although it might be more fun to conduct this study on medium drive, a simple laboratory device listed in Fig. With the centripetal force device, you can measure the frequency of rotation of an object moving within a circular path of a known radius. Eq. (10) it can then be used to calculate the centripetal force applied to the object. Description of the apparatus Figure 4 shows the apparatus and its various components. The lower part of the base is a liner with adjustable screws that can be used to level the entire device. The partition with the counterweight at its end may be moved to change the position of the rotating mass. The pointer can be moved along the slot and placed just below the tip of the rotating mass. This helps to measure the radius of the circular path of the rotating mass. Figure 4: Sketch showing the components of the apparatus In this apparatus, the centrifumatic forces are provided by the spring. When the spring is attached to the rotating mass, it shall be pulled back as shown in Figure 6b. In order for the rotating mass to return above the indicator or radius indicator, the string shall be transferred through the pulley and sufficient mass shall be added at the end of the chain to return the rotating mass above the radius indicator. Figure 5: Sketch showing the initial setting Figure 6: Photo of the initial setting Fig. C. with the same radius as set out in Figure 5b. The size of the two forces and should be in close agreement, since both forces produce the same extension of spring. Figure 7: Sketch showing the circular path of the object Procedure A: Measuring the rotation time 1 Align the instrument with three adjusting screws in the base. The device is aligned when the partition remains fixed in any position. If necessary, use the bubble level to help you in the process. 2 Weigh the rotating weight and enter this value in the worksheet. 3 Set the radius indicator for the smallest radius and measurement. The radius shall be measured from the centre of the floor (axis of rotation) to the centre of the radius indicator. Record in a data table on a worksheet. 4 Slide the partition until the tip of the rotating mass is above the radius indicator. 5 Attach the spring to the rotating mass. Attach the string to the rotating mass, pass the string through the pulley and attach it to the bulk hanger at the other end. Add to the mass hanger until the tip of the rotating mass is above the radius indicator. Record the value of the total hanging weight in the data table 1 on the worksheet. 6 Remove the masses and hanger and turn the partition. Make sure that the tip of the rotating mass hits the radius indicator of each speed. You may need to practice a little before you start taking the data. It is important to spin the shaft evenly. CAUTION: Protect hair and clothing away from the appliance when moving! Use the timer to record the time required for 50 revolutions. Record this time in the data table 1 on the worksheet. 7 Boil the spring and move the radius indicator out by about 1 cm. Measure and record this new radius value in data table 1.8 Repeat steps 4 through 6 and enter the values in data table 1.9 Repeat step 7 for the next three positions of the radius indicator, a total of 5 radii. Checkpoint 1: Before proceeding, ask ta to check the values of the data table 1.10 Calculate and record the rotation period in data table 2.11 Calculate and record the rotation frequency in the data table 2.12 Calculate and record centripetal acceleration in data table 2.13 Calculate centrelet strength. 14 Calculate the percentage difference between the experimental centripetal force and the force of the hanging mass and record the values in data table 2. See Appendix B. Note: If your percentage difference is greater than 15% for a single trial, you must make this trial. Checkpoint 2: Ask TA to check the values and calculations of data table 2. Procedure B: Plot versus 15 Using Excel, Chart vs. . See Appendix G. 16 Use a trendline in Excel to find a slope. See Appendix H. 17 Determine the rotating mass value from the slope. 18 Compare the value of the rotational mass obtained from the slope with the measured value by calculating the difference in percentage. Checkpoint 3: Ask your TA to check the graph and calculations. Calculations.