Centripetal Force

Please Circle Your Lab day: M T W T F
Name: _______________________
Partner: _______________________
Partner: _______________________
Partner: _______________________

• Project #1: Does $F_{\text{centripetal}} = \frac{mv^2}{r}$?

In Parts 1 and 2 you will get the bob positioned over the pointer by completely different methods; by spinning in part 1, and by hanging masses with a string in part 2. Note that the spring force is the same in both cases since it is stretched the same distance.

Part 1 — measure the mass ($m$), speed ($v$), and radius of orbit, ($r$) of the spinning bob, then calculate $\frac{mv^2}{r}$

1. Measure the mass of the bob: $m_{\text{bob}} = \underline{\underline{\underline{\underline{}}} \text{ kg}}$
2. Make sure the base is level, the counterweight balances the bob, and the bob hangs directly over the pointer (without the spring attached).
3. Attach the spring and practice spinning the bob at a steady rate such that each time the bob comes around, it is directly over the pointer.
4. Start Logger Pro. You will use the position graph.
   Make sure the motion detector can “see” the bob as it moves in a circle (look for a dip in the position vs. time graph each time the bob is in front of the detector).
5. Record 20 revolutions (with the bob directly over the pointer). Entitle the graph (with names of group members) and print a copy for the group.

What is the total time for 20 revolutions: \underline{\underline{\underline{\underline{}}} \text{ sec}}

What is the average time for 1 revolution: \underline{\underline{\underline{\underline{}}} \text{ sec}}
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6. Measure (with a ruler) the radius of the bob’s orbit.

   radius of the bob’s orbit: _____________ m

7. With this information, calculate (show your work below) the average speed of the bob.

8. What is the calculated value of $mv^2/r$?

Part 2 — draw force diagrams and measure the force of the stretched spring

1. Attach a string to the bob and hang masses over the pulley until the bob is directly over the pointer.

   amount of mass needed to pull bob over pointer: ____________ kg

   weight of mass needed to pull bob over pointer: ____________ N

2. Draw separate force diagrams for the bob and the hanging mass. Use Newton’s second law to show that the force of the spring (pulling the bob toward the axis) is equal to the weight of the hanging mass:

Q: Does the force of the spring equal $mv^2/r$ from Part 1? Calculate the percent difference between the two values. Check with the instructor and repeat the experiment if instructed.
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**HOMEWORK**

H1. If I wanted to spin the bob faster, but keep the orbital radius the same, would I need a stronger or weaker spring? Please explain your answer.

H2. Consider swinging a rock in a horizontal circle on the end of a string. What forces are acting on the rock, and in which direction?

Q: Which path would the rock take if you let go of the string? Why?

H3. Consider identical cars, moving with the same speed, travelling around two different curves. In which case is the centripetal force larger? Why?

Q: In this situation, what provides the centripetal force?

H4. Consider the same car taking the same curve at two different speeds (say, 60mph and 80mph). In which case is the centripetal force larger? Why?