Patterning Math Lab 6

Part 0: Quiz 4 Revision Discussion Sign-Up

- If you are prepared for a Quiz 4 Revision Discussion, sign up for a slot using the Quiz Revision Discussion Sign-up sheet, located in CAL East.
  - There are 5 time windows: 10:00 – 10:30, 10:30 – 11:00, 11:00 – 11:30, 12:00 – 12:30, and 12:30 – 1:00.
  - Sign up during one time window; you will have the opportunity for your short Quiz Revision Discussion during your time window.
  - Only sign up for a Quiz Revision Discussion if you are fully prepared:
    - You have completed a Quiz Revision using the Revision Version of the quiz.
    - You have brought your original Quiz.

Part I: Circular Motion

a) Launch LoggerPro. Using Insert: Movie, insert the movie turntable (located in the program file share under Handouts: Week 6 Lab). You're not doing video analysis, but the video player in LoggerPro provides useful features. Note that there's an issue with the movie file that results in skipping some frames near the end; however, if you use the slider or the previous/next buttons you can see each of the frames.

b) Watch the movie and verify that it takes 5.205 seconds for the yellow block to make 3 full revolutions (recall that the time stamp is in the upper right hand corner of the movie window).

c) Calculate the angular speed of the yellow block in revolutions per second (for this and remaining parts, assume constant angular speed. note: if you observe carefully it does not look like it is exactly constant angular speed; however this does seem a reasonable approximation).

d) What is the angular speed of the blue block? The green (light blue?) block? Briefly explain how you can answer this question without doing any other calculations.

e) Assuming the angular speed is constant, calculate how long will it take the blocks to complete 2 full revolutions. Verify your answer using the movie.

f) There are other units for angular speed. Convert your answer from part b) from rev/sec to RPM (revolutions per minute), degrees/sec, and rad/sec. Clearly show your calculations, and organize your answers into a tidy final form (such as a table).

g) The center of the yellow block is 12 cm from the center of the turntable. Determine the speed of the yellow block (note: if there is no further prompt than "speed" or "velocity", it is likely the case that the intention is linear (translational) speed or velocity. However, if it is not clear from context, you should ask for clarification. Here, it does mean the translational speed, as you will see in the next sentence). Determine the yellow block's speed in 2 ways: by determining the total distance the yellow block traveled in some known time and using $v = d/t$ (you will need to recall/use the formula for the circumference of a circle) and by using the relation $v = \omega r$. (be careful with your choice of units for angular speed).

h) Assume the center of the innermost block is 5 cm from the center of the turntable. Determine the (translational) speed of that block. Check your answers to g) and h) with a neighbor.

i) If you have already completed the Analysis in Physics Lab 9, you have done the following steps – in that case, just read over the following but then move on to the next part. Otherwise, complete the following. If you don't have data, obtain it from a classmate (make sure to reference the source of your data).

j) In parts g) and h) above, the angular speed of the turntable and the objects on it was constant, but the translational speeds of the objects at different turning radius were different. In Physics Lab 9, you coupled the motion of a constant speed tumble buggy to a rotary motion sensor. Complete steps g) – k) in the Analysis portion of Physics Lab 9.

Part II: Circle Trig Workshop

a) Complete Monday's **Circle Trig Workshop** if you have not already.

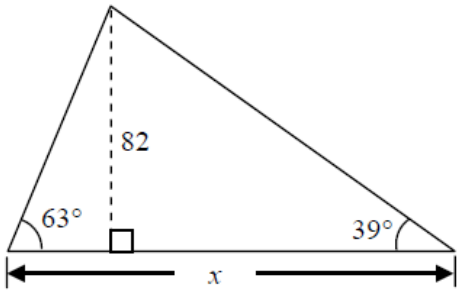
i) In part 2 of this workshop, you should first be using the Pythagorean theorem to calculate the exact values (leave the results as fractions) of the cosine and sine column entries. NOTE: In WAMAP, when it asks for exact values, it requires you to enter the exact value. Then, calculate the decimal equivalents for the exact value fractions using your calculator. In part 2, you should only be using your protractor to measure the angle. After completing the part 2 table, you should check your table entries with the trig table handout.

ii) In part 3, collaborate with your neighbor to confirm your general formula for calculating the x and y components of an angle θ on a circle of radius r.

b) Open this Desmos file: **https://www.desmos.com/calculator/g1hsqxlyle**. Change the angle a and see what happens. Use this to check/confirm your results from this workshop.

Part III: Triangle Trig

For the figure shown, determine the length x. If you're not sure how to get started, use the strategy described below.



- If possible, draw the figure accurately to scale. This will give you a good estimate for the answer. Identify the right triangle(s).
- Identify and indicate which angles and side lengths you know (e.g. adjacent, opposite, hypotenuse).
- For unknown angles and side lengths, invent useful symbols.
- Where possible, use the Pythagorean theorem to link known and unknown side lengths. For each right triangle, this will give you one equation.
- Where possible, use sine = opposite/hypotenuse, cosine = adjacent/hypotenuse, and tangent = opposite/adjacent to link known and unknown angles and side lengths. For each right triangle, this will give you several equations.
- You should now have a set of equations. Start with any equations that only have one unknown, and solve for the unknown. Use these values in other equations to reduce those to equations with only one unknown. Keep going until you have enough information to answer the relevant question.

Part IV: Circling back to Circles

a) Start the Ladybug Revolution simulation seen in Monday's lecture **http://phet.colorado.edu/en/simulation/rotation**, press the green Run Now! button.

b) Play around with this simulation to see what more you can learn about circular motion. Use both the Intro tab and the Rotation tab. Some suggestions – see the relationship between the direction of the velocity vector and the direction off the acceleration vector. Explore the various graphs. Verify the relation $v = r\omega$. Investigate the relationship between velocity, acceleration, and radius and see if you can deduce the relationship between them.

If you finish early, you may continue to work on your analysis for Physics Lab 8 or Physics Lab 9, or on your Problem Sets for this week. We encourage you to use your time wisely.