

Patterning Math Lab 6

Part I: Circular Motion

- Launch LoggerPro. Using Insert: Movie, insert the movie turntable (in the program file share under Handouts/Math Lab 6). 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).
- Calculate the angular speed of the yellow block in revolutions per second (assume constant angular speed).
- What is the angular speed of the blue block? The green (light blue?) box?
- Assuming the angular speed is constant, calculate how long will it take to complete 2 full revolutions. Verify your answer using the movie.
- 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).
- The yellow box is 12 cm from the center of the turntable. Determine the speed of the yellow box in two ways: by determining the total distance the yellow box 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 $v = r\omega$ (be careful with your choice of units for angular speed).

Part II: Circles, Angles, and Vector Components

- Complete Monday's **Circles, Angles, and Vector Components – Workshop**.

- In part 2 of this workshop, you should be calculating the cos and sin column entries using the Pythagorean theorem. In part 2, you should only be using your protractor to measure the angle. After completing the part 2 table, you should check your entries tables with the trig table handout.
- From part 3, use your trig tables to fill in the $r\cos(\theta)$ and $r\sin(\theta)$ columns of part one for the vector components.

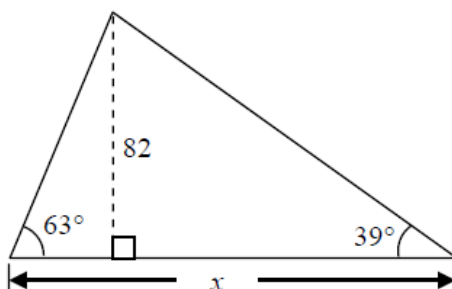
- Open this Desmos file: <https://www.desmos.com/calculator/g1hsqxllye>. Change the angle a and see what happens. Use this to check/confirm your results from this workshop.

Part III: Vector Addition

- Review Example 3.3 from physics Ch. 3.3. Pay attention to the use of the Pythagorean Theorem and the trigonometric relations for sine, cosine, and tangent. Make sure you understand all the steps in this example. Follow the process outlined in this lab session for solving vector addition problems and apply it to this example. Use the vector calculator at <http://www.mathsisfun.com/algebra/vector-calculator.html> to check your work.
- Suppose a pilot flies 40.0 km in a direction 60° north of east and then flies 30.0 km in a direction 15° north of east. If she wants to fly back to her starting position in a straight line, determine the total distance and direction she needs to fly. Use the vector calculator to check your work.

Part IV: Triangle Trig

- In 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 $\sin = \text{opposite}/\text{hypotenuse}$, $\cos = \text{adjacent}/\text{hypotenuse}$, and $\tan = \text{opposite}/\text{adjacent}$ 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 V: 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 you can learn about circular motion. Some suggestions – verify the relation $v = r\omega$. Explore the various graphs. Investigate the relationship between velocity, acceleration, and radius.