Worksheet 12: Section 3.10

We said: "We know we have said this before; remember no one learns how to play piano by watching someone play it and no one learns how to play basketball by watching basketball games. Learning require lots of practice and math is no exception. The recommended practice time outside the class for STEM courses is twice to three times of the number of hours in class. Hang in there! Continue to work! Get help from us and other resources on campus. A good foundation in many of those courses can be set for you in Calculus I."

Solving Related Rates Problems

(1) If applicable, draw one or more figures representing the situation found in the problem.

(2) Identify the quantities in the problem. Clearly identify which are constants and which are variables.

(3) Determine which rates of change are known and which rates need to be calculated.

(4) Find an equation which **relates** the quantities whose rates you know to quantities whose rates you need to calculate.

- Often, this equation is geometric.

(5) Differentiate the equations implicitly and then substitute known quantities. Solve explicitly for the rates that need to be calculated.

Group Work Portion of the Worksheet

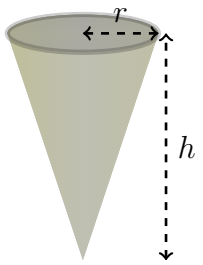
Names: _____

Work in groups to do this portion of the worksheet. Make sure to take parts in solving the problems. Your participation score is a combination of being prepared, willing to explore the problem, working in groups and contributing toward the solution.

1. The volume of a cone is given in terms of the radius and height as $V = \dfrac{\pi r^2 h}{3}$. The radius and height are changing over time. At a particular instant, $r = 5$, $\dfrac{dr}{dt} = 3$, $h = 6$, and $\dfrac{dh}{dt} = -4$.

   (a) **What is $\dfrac{dV}{dt}$ at that instant?**

   (b) Can r be expressed as an explicit function of h using the given information? *(Compare this to the next problem.)*



2. Water is leaking out of a tank shaped like an inverted cone. The tank has height 9 meters and the diameter at the top is 8 meters. If the water level is **falling** at a rate of 0.1 $\frac{m}{min}$, **when the height of the water is** 5 **meters**,

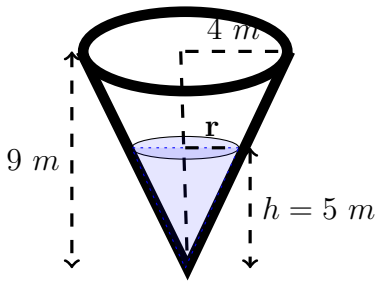
(A) *identify and name the quantities in the problem:*

(B) *what are the values of the known variables and rates?*

(C) *which equation(s)* **relates** *the quantities?*

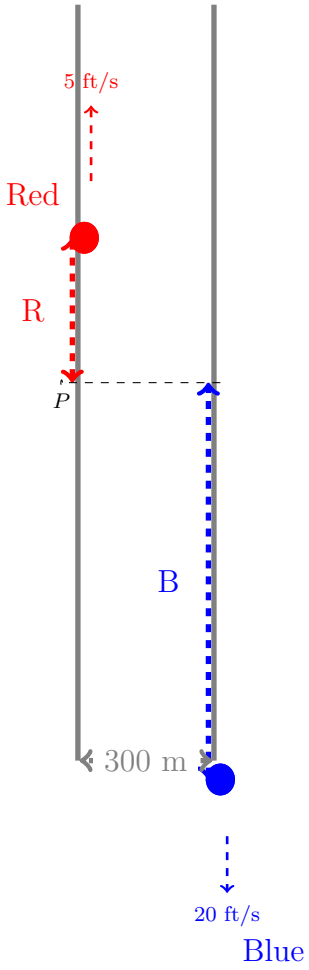
(D) at what rate is the radius of the water, r, changing?

(E) use the volume formula $V = \dfrac{\pi r^2 h}{3}$ to find the rate of change in the volume of water in the cone. *(Round to 3 decimal places.)*



3. **Red** begins walking north at 5 ft/s from a point P. 5 seconds later, **Blue** starts running south at 20 ft/s from a point 300 ft due east of P. At what rate are they moving apart 20 seconds after **Red** begins walking?

(i) *Identify and name the quantities in the problem:*



(ii) *What rate is the problem searching for?*

(iii) *What are the values of the known variables and rates?*

(iv) *Which equation(s)* **relates** *the quantities?*

(v) *Solve.*

GroupWork Rubrics:

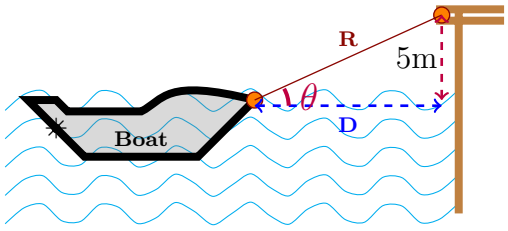
Preparedness: ——/0.5, Contribution: ——/0.5, Correct Answers: ——/0.5

Individual Portion of the Worksheet

Name: _____

Upload this section individually on canvas or turn it in to your instructor on the 2nd lab day of the week. You can ask questions in class and work in groups but you turn in the individual work. Start before the class so you can ask questions during the class. If you didn't complete the work in class, make sure to work on it outside the class and complete it. Show all your work; your score depends on the work you have shown.

4. A boat is pulled into a dock by a rope attached to the bow of the boat and passing through a pulley on the dock that is 5 meters higher than the bow.



(A) *(1.75 points)* If the boat is approaching the dock at a rate of 3 meter per second, at what rate is the **rope being pulled** when the boat is 12 meters from the dock?

(B) *(1.75 points)* How fast is the **angle of the rope above horizontal**, θ, changing at the same instant?