# MATH 190, Lab 8: Oct 30 and Nov 1, 2018

Work through the following problem while the TAs circulate. When you have completed the problem (to the satisfactory of the facilitators) you can spend the rest of the lab working on the Prep questions for Quiz 4 on next Monday.

## Problem: Growth of a Tree Trunk

Read the given scenario carefully and answer the questions following that.

Consider a cylindrical tree trunk of radius r. Living cells occupy a thin shell just inside the tree bark with thickness d. The interior of the trunk is also cylindrical and consists of dead cells that have turned into wood. Assume that the thickness d does not change.

#### Part I. Individually

1. Draw a diagram of the cross-section of tree trunk and label your diagram with the quantities given in the scenario.

2. As the tree grows which quantities are changing and which will remain constant?

### Part II. In Groups

Share and discuss with your group your answers to the questions in Part I, then answer the following questions.

- 1. Write a formula for the volume of the entire tree trunk.
- 2. Write a formula for the volume of the interior part containing the dead cells.
- 3. Write a formula for the volume of the living tissue.
- 4. Let F be the fraction of the trunk volume that is living tissue. Find a formula for F and simplify it as much as possible.

5. Assume that the trunk radius grows at a rate of 2 cm/month. What is the rate of change in F at the instant when the radius r is 5 times the thickness d.

# Quiz 4 Prep.

One of the following problems will appear on the Quiz next Monday. The quiz will only contain one problem and will be 15 minutes in length.

1. The foliage of a bonsai tree you are tending is a perfect sphere. The radius of the foliage is increasing at a rate of  $0.5 \, mm/day$ . How fast is the volume of the sphere increasing when the radius is  $100 \, mm$ .

Note that the volume of a sphere is  $V = \frac{4}{3}\pi r^3$  where r is the radius.

- 2. Your trucker friend is  $40 \, km$  West of base at a coffee shop enjoying a break. You are currently  $80 \, km$  in your car North of base travelling North (to pick up a shipment of lumber) at a speed of  $60 \, km/h$ . How fast is the distance between you and your friend increasing at the present time?
- 3. A 20 m tree has has been bent in a storm and makes an angle of  $60^{\circ}$  with the ground. Some sap is moving down the tree moving at speed 2 m/min. How fast is the distance from the sap to the ground decreasing when the sap is half way down the tree?