

Homework 2, MATH 110-001
Due date: Friday, Jan 26, 2018 (in class)

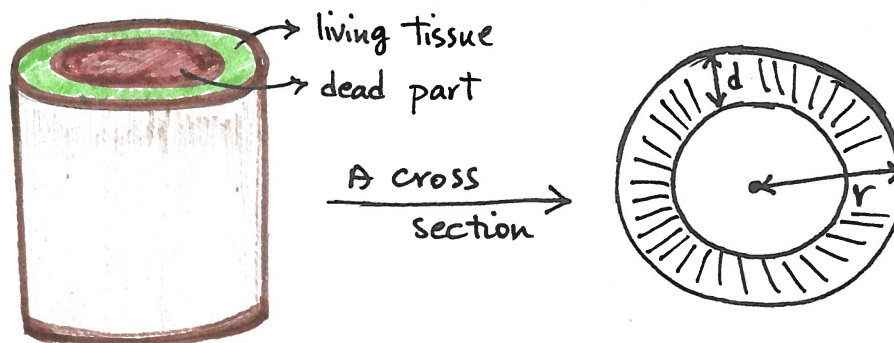
Hand in full solutions to the questions below. Make sure you justify all your work and include complete arguments and explanations. Your answers must be clear and neatly written, as well as legible (no tiny drawings or micro-handwriting please!). Your answers must be stapled, with your name and student number at the top of each page.

1. Consider a circle with radius 3 centred at the point $(-1, 1)$;

$$(x + 1)^2 + (y - 1)^2 = 9$$

- a) Find the slope of the tangent line to the circle at the point where $y = 1$ and has a positive x -coordinate.
- b) Sketch a graph of the circle and the tangent line at this point.
2. (**A Spider's Thread**) A spider moves horizontally across the ground at a constant rate of 10 cm/sec pulling a thin silk thread with it. One end of the thread is tethered to a vertical wall at height 3 m above ground and does not move. The other end moves with the spider. Determine the rate of elongation of the thread after 40 seconds?

3. (**Growth of a Tree Trunk**) 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.



- a) As the tree grows what quantities are changing?
- b) Compute the volume of the living tissue and call that V .
- c) Let F be the fraction of the trunk volume that is living tissue. Find a formula for F .
- d) Assume that the trunk radius grows at a constant 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 . (include units in your answer.)

Hint: Find the volume of the shell in between and then write down the fraction F . When differentiating F it is easier to first simplify it as much as possible and then compute a derivative.