

# MATH 190, Lab 3: Sept 25 and 27, 2018

---

*In the past three weeks of MATH 190, we reviewed some precalculus topics. We mainly studied functions and different family of functions including linear functions, quadratics, roots, trigonometric, exponential and logarithmic functions. We learned about their main properties such as their graph, domain, range or solving equations involving these functions.*

## Part 1.

- List three concepts or types of problems related to the topics covered in week 1, 2 and 3 that you particularly found difficult. Is there any common area of difficulty in your group?

## Part 2. Problems (based on Learning Objectives)

The following list is the list of learning objectives for the first three weeks of the course. It is a useful practice to check the learning objectives regularly throughout the term. They will help you direct your learning efforts appropriately, monitor your progress and self-evaluate your understanding level of the topics and concepts covered in the course. This list can be found on the course page.

Go over the list (numbered items) and find the learning objectives that match with the topics you listed in Part 1. Once you identified the learning objectives targeting your area of difficulty, solve the sample problems following them. Work in groups to solve the problems that are most common. For questions with multiple parts, do 1-2 parts only so that you get time to practice as many types of problems as possible.

### Weeks 1, 2, 3: Review of Functions

*Students will need to perform these tasks throughout the term as we study calculus.*

1. Find the equation of a line (either in  $y = mx + b$  or  $y - y_1 = m(x - x_1)$  form) given two points or one point and the slope.
2. Plot a line given its equation (including  $x$  and  $y$  intercepts).

*Sample problems:*

- Find the equation of a line that goes through the points  $(2, 5)$  and  $(-1, 2)$ . Plot this line.

- Find the equation of a line that crosses the  $x$ -axis at  $-1$  and is perpendicular to  $2x = 7 - 3y$
3. Explain what a function is.

*Sample problem:*

- Come up with two piecewise graphs such that one represents a graph of a function and the other one is not a function.
4. Find the roots of a quadratic equation either by factoring or quadratic formula.

*Sample problems:*

- Solve the following equations
    - $x^2 - 10x + 25 = 0$
    - $2x^2 - 4x - 3 = 0$
    - $x^4 - 3x^2 - 4 = 0$
    - $x^2 - 3x + 4 = 0$
  - Find the point(s) at which two functions  $f(x) = 3x^3 + 5x^2$  and  $g(x) = x^3 + x^2 + 6x$  intersect.
5. Plot the graphs of  $x^2, x^3, \sin x, \cos x, \tan x, e^x, b^x, \ln x, \log_b x$ . Plot the graph of a piecewise function with simple parts.

*Sample problem:*

- Plot the following piecewise function.

$$f(x) = \begin{cases} e^x & x \geq 0 \\ \cos x & -2\pi < x < 0 \\ 2 & x \leq -2\pi \end{cases}$$

6. Recognize a given function as a composition of two (or more) simpler functions.

*Sample problems:*

- Let  $F(x) = 2^{\sin(\frac{1}{x})}$ . Find functions  $f, g$  and  $h$  such that  $F(x) = f \circ g \circ h(x)$
  - Find an expression for  $g \circ f$  and  $f \circ g$ , given that  $f(x) = e^{2x}$  and  $g(x) = \begin{cases} \ln(x) & x > 0 \\ x^2 & x \leq 0 \end{cases}$ .
7. Explain what the domain of a function is and find the domain of rational functions, functions involving square roots and simple trigonometric, exponential and logarithmic functions.

*Sample problems:*

- Find the domain of the following functions.

a)  $f(x) = \sqrt{2x+1} \cdot (e^x - 1) \cdot \sin x$

b)  $f(x) = \frac{\sqrt{2x+1}}{(e^x - 1) \cdot \sin x}$

c)  $f(x) = \frac{x-1}{\sqrt{2x+1}-1}$

d)  $f(x) = \frac{x-1}{2x+1}$

8. Use the unit circle to compute sine, cosine and tangent of special angles as well as solve equations involving sine, cosine and tangent.

*Sample problems:*

- Evaluate  $\cos\left(\frac{23\pi}{2}\right)$ ,  $\sin\left(\frac{13\pi}{6}\right)$ ,  $\tan\left(\frac{11\pi}{4}\right)$
- Solve the following equation in  $[0, 2\pi]$

$$2 \cos^2 x - \sqrt{3} \cos x = 0$$

9. Simplify expressions involving exponents or logarithms using exponent or logarithm rules.

*Sample problems:*

- Simplify  $\frac{(\sqrt{e} e^x e^{-5x})^2}{e^8 e^x}$
- Show that

$$\log_2\left(\frac{8x^2}{y}\right) + \log_2(2xy) = 4 + 3 \log_2 x$$

10. Solve equations involving exponents or logarithms by recognizing  $b^x$  and  $\log_b x$  as inverses.

*Sample problems:*

- Solve the following equations.
  - $2^{3x} = 5$
  - $\ln(x+1) = 3$
  - $\log_3(x-1) + \log_3 5 = \log_3 20$
  - $e^{2 \ln x} = 7$
  - $\ln(3e^{2x}) = 4$