Summary for Midterm Two - Math 120

Here are some thoughts I was having while considering what to put on the second midterm. The core of your studying should be the assigned homework problems: make sure you really understand those well before moving on to other things (like the old midterms on the test archive).

- Chapter 9 - Three Construction Tools
  - You should understand horizontal and vertical **shifting**, and horizontal and vertical **scaling** (aka dilating)
  - You should understand how to derive the graph of $g(x) = af(bx + c) + d$ from the graph of $f(x)$ (see, e.g., problem 9.2)
  - I especially like problems 9.2, 9.3, 9.4, and 9.7
- Chapter 11 - Inverse Functions
  - Another very short chapter.
  - You should understand what an **inverse function** is, what conditions a function must satisfy in order to have an inverse (do all functions have inverses? can you tell if a function has an inverse by looking at its graph?), and how to find the inverse of a given function
  - You should understand what a **one-to-one function** is, and what is special about the graph of a one-to-one function
  - Problems 11.2, 11.6, and 11.8 are particularly good.
- Chapter 12 - Rational Functions
  - An important chapter, it introduced a new class of functions for modeling.
  - You should be able to find the **asymptotes** (horizontal and vertical) of a **linear-to-linear rational function**, and be able to sketch the graph of a rational function like those in problem 12.1(a) or (b).
  - You should be able to model with **linear-to-linear rational functions**. This comes down to finding a rational function of the form

    $$f(x) = \frac{ax + b}{x + c}$$

    whose graph

    1. passes through three given points
       or

2. has a given asymptote and passes through two given points
   or
3. has two given asymptotes and passes throuh one given point

You will need to translate the language of the modeling problem. Take a look at old midterm 2 exams from the archive for examples to work on.

Pay particularly close attention to the words "linear-to-linear".

Note that a linear-to-linear function is not a **linear function**.

- I especially like problems 12.6, 12.7, 12.8, 12.10, and 12.11.

- Chapter 13 - Measuring an Angle
  - You should understand how to convert between **degrees** and **radians**
  - You should understand and be able to use the relationships between **radii**, **angle**, **arc length** and **area**
  - I like problems 13.8 and 13.9 (check the electronic version of the text at the 120 Materials Website if your copy of the text doesn't show the shading well).

- Chapter 14 - Measuring Circular Motion
  - You should understand the various measures of **angular speed** (aka **angular velocity**), like rpm, radians per second, or degrees per hour
  - You should understand the relationship between **radius**, **angular speed** and **linear speed**
  - You should know how to solve a belt-and-pulley problem (e.g., the bicycle example from lecture, example 14.4.1, problems 14.8, 14.9 and 14.11)
  - I also like problems 14.5 and 14.7.

- Chapter 15 - The Circular Functions
  - This chapter introduces the **trigonometric functions**.
  - You should be able to solve problems using the idea of trigonometric functions as ratios of sides of right triangles (e.g., problems 15.4, 15.7, 15.8) and some algebra
  - You should understand the definitions of $\sin x$ and $\cos x$ using the **unit circle**; you should be able to determine certain simple properties of the functions $\sin x$ and $\cos x$ from this definition (e.g., the range, the domain, the graph, the values at certain value of x, like $x = 5\pi/2$)
  - You should be able to determine the location of an object moving circularly given information about its speed and starting location (e.g., problems 15.2, 15.5, 15.9, 15.15, and the three non-textbook Chapter 15 problems)

- Chapter 16 - Trigonometric Functions
  - This is a short chapter which adds some final touches to our knowledge of the functions $\sin x$ and $\cos x$ and related functions.
  - I like problems 16.3 and 16.4.
- Chapters 17, 18 - Sinusoidal Functions
  - You should understand the notion of a **sinusoidal function** as a shifted/dilated version of the function $\sin x$.
  - You should understand the effect of the four parameters A, B, C and D on the graph of
$$f(x) = A \sin\left(\frac{2\pi}{B}(x - C)\right) + D.$$
  - You should be able to model with sinusoidal functions. In particular, you should be able to determine the parameters A, B, C, and D from a verbal description of a quantity that varies sinusoidally with time (see problems 17.2, 17.3, 17.4,17.6)
  - You should be able to solve equations of the form $f(x) = k$ where f is a sinusoidal function; if there are any solutions, there are infinitely many, and you should be able to find them. You should be able to do this in the context of a modeling problem (e.g., problems 18.2, 18.4, 18.6, 18.10, 18.11, 18.12)
- Chapter 19 - Exponential Functions
  - You should understand the definition of an exponential function, and be able to sketch a graph of one.
  - You should be able to rewrite quotients or products of exponential functions in standard exponential form (i.e., $A_0 b^x$).
  - You should be able to rewrite horizontally shifted or dilated, or vertically dilated exponential functions in standard exponential form.
  - Problems 19.2, 19.3, 19.7, 19.9 are good practice.