

## Homework 1 - Math 142, Frank Thorne (thornef@mailbox.sc.edu)

Due Friday, August 30

**Important:** As with everything else in life, being right is not enough. Please show your work, write in complete sentences, and explain your reasoning clearly.

### Required problems.

- (a) What is a function? (This is the most important question in all of mathematics.)
- (b) Suppose that  $f$  is a function whose domain and range are subsets of the real numbers. Explain how to draw the graph of  $f$ , and what the graph represents.
- (c) Explain what it means to say that

$$\lim_{x \rightarrow a} f(x) = c.$$

- (d) Define the *derivative* of a function. Define it using an equation, and also explain your definition in English. In addition, draw a picture and explain why your equation describes the tangent line to the graph.
- (e) Define an *inverse function*. Explain how to find the derivative of  $f^{-1}(x)$ , if you know the derivative of  $f(x)$ .
- (f) Define the functions  $\sin(x)$ ,  $\cos(x)$ ,  $\tan(x)$ ,  $\csc(x)$ ,  $\sec(x)$ ,  $\cot(x)$ ,  $e^x$ , and  $\ln(x)$ , and say what each of their derivatives is. For  $\sin(x)$ ,  $\cos(x)$ , and  $e^x$ , it is okay to just state the derivatives. For the other functions, explain how you got your answer. (You will want to use the derivatives of  $\sin$ , cosine, and  $e^x$ !)
- (g) State the power rule, the product rule, the quotient rule, and the chain rule for finding derivatives.
- (h) Stewart, Ch. 3 Review, pp. 262-263: 6-16, 57, 89 (do (d) without a graphing calculator), 93.
- (i) Define the *antiderivative* of a function.
- (j) Define the *definite integral*

$$\int_a^b f(x) dx.$$

Give an equation, and explain why your equation gives the area underneath the curve from  $x = a$  to  $x = b$ .

- (k) What does the fundamental theorem of calculus say? Why is it true? Explain thoroughly.
- (l) Stewart, Ch. 5.3, 19-26.

### Additional problems.

- (a) Stewart, Ch. 3 Review, 1-5, 17-22.

(b) Stewart, Ch. 5.3, 27-32.

**Bonus** (2 points).

(a) What is the Mean Value Theorem, and why does anybody care about it?