This is not an exhaustive review. In other words, this does NOT cover everything in Chapter 1 and there may be more (or less) of these concepts on your Unit II Exam.

1. The graph of $f(x) = \begin{cases} |(x-2)^2 - 4| & \text{if } x \neq 2 \\ 2 & \text{if } x = 2 \end{cases}$ is shown below. Using the graph of f answer the following questions about the differentiability and continuity of f.

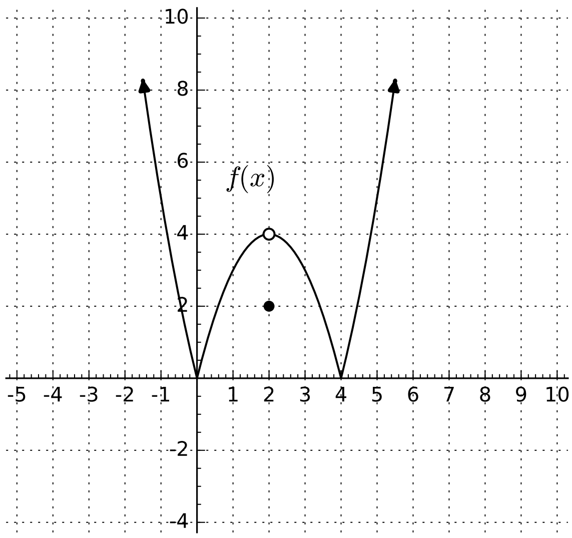

Figure 1: Graph of $f(x)$

(a) Determine all of the x-values where f is NOT differentiable.

(b) Determine all of the x-values where f is discontinuous.

(c) Determine if $f'_-(0) = f'_+(0)$. Does this mean that $f'(0)$ must exist? (The same argument can be made for $x = 4$.)

(d) Explain why f is not continuous at $x = 2$, but it is differentiable at $x = 2$.

2. Use the limit definition of the derivative to calculate the following derivatives. Remember that the limit definition of a derivative is $\lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$.

(a) $f(x) = x^2 - 5x + 1$

(b) $g(x) = \frac{6}{x}$

(c) $h(x) = \frac{x+2}{x-2}$

3. For the following functions, find the equation of the line tangent to its respective graph at the given x-value.

(a) $f(x) = x^2 + \sqrt{x-2}$; $x = 4$

(b) $g(x) = x^2(x-5)$, $x = -2$

(c) $h(x) = |(x+3)^2 - 7|$; $x = -2$

(d) $l(x) = \dfrac{1}{x+7}$; $x = -6$

4. Each figure below contains two graphs: a function and its derivative. Label the function and its derivative correctly using prime notation.

   (a) Use Figure 2

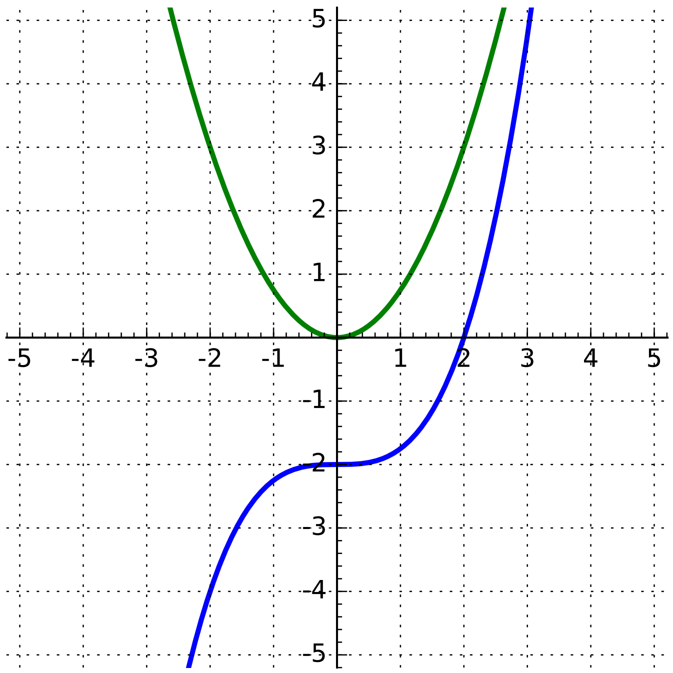

Figure 2: Graph of $f(x)$

   (b) Use Figure 3

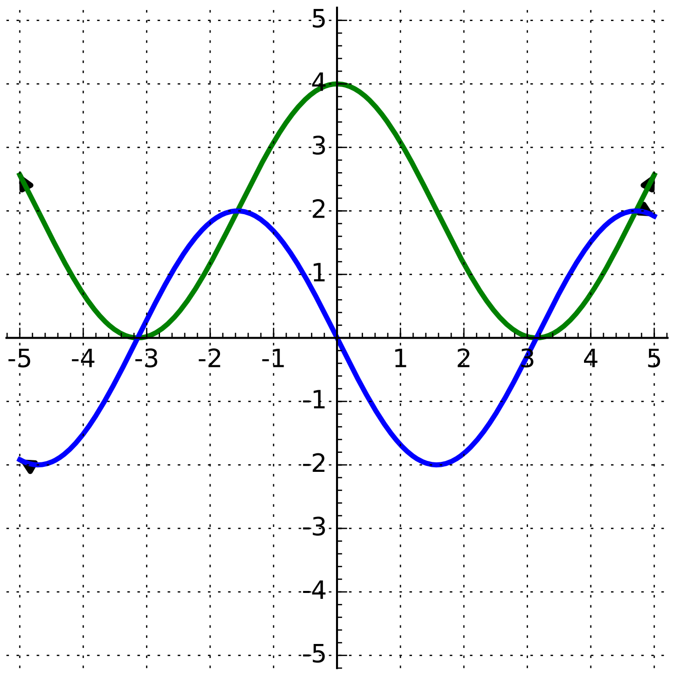

Figure 3: Graph of $f(x)$

5. Using derivative rules, algebra, or other methods discussed in Chapter 2, find the derivatives as indicated.

(a) $\dfrac{d}{dx}\left((5x^2+8)(x^2+3x-1)\right)$

(b) $\dfrac{d}{dx}\left(2x^3\cos x\right)$

(c) $\dfrac{d}{dx}\left(x\sqrt{1+sin^2(x)}\right)$

(d) $\dfrac{d}{dx}\left(\dfrac{\sin(x^2-9x+2)}{\csc(2x)}\right)$

(e) $\ln\left(2e^{7x}-|x^2-9|\right)$

6. Find $\frac{dy}{dx}$ by implicit differentiation.

(a) $2x^3 + xy - y^4 = 20x$

(b) $\cos(x^2 + y^2) = x$

(c) Find the equation of the line(s) tangent to the curve in part (a) at $x = -1$.

7. Consider the vector-valued function defined below that models the position of a particle in three-space.

$$\vec{r}(t) = \left\langle -\sin(\ln(t)),\, t^2 + 4t - 1,\, t \right\rangle$$

(a) Find the vector-valued function for the velocity of the particle.

(b) Find the velocity of the particle at $t = 3$. Leave your answer in exact form.

(c) Find the equation of the line that is tangent to the curved traced out by $\vec{r}(t)$ when $t = 3$.

Final Note: Be sure to study other information from Chapter 2, the True/False questions at the end of the chapters, and the labs associated with this Unit.