1. Find the domain and sketch the function

(a). $f(x) = \begin{cases} -1, & x \leq -1 \\ x, & -1 < x \leq 2 \\ x^2+1, & x > 2 \end{cases}$

(b). $f(x) = \sqrt{x+4}$

2. Determine whether the $f(x) = x^{-3} + x$ is odd, even, or neither.

3. Graph $y = \frac{1}{2}\tan\left(x + \frac{\pi}{3}\right)$

4. Solve the following inequality for x: $2x^2 + x \geq 3$

5. Given $f(x) = \frac{1}{x} - 3$ and $g(x) = \sqrt{x+3}$, find the following composite functions and state their domains explicitly for x.

(a). $f(g(x))$

(b). $g \circ f$

6. Section 1.3 #3

7. Evaluate the following limits, if they exist (clearly indicate $+\infty$ or $-\infty$ in the case of an infinite limit). If the limit does not exist, **explain the reason why**.

(a). $\lim\limits_{x\to 0} \frac{x-3}{x(x+4)}$

(b). $\lim\limits_{x\to -4} \frac{x^2+2x-8}{x+4}$

(c). $\lim\limits_{x\to 0} \frac{\sqrt{3x^2+4}}{x-4}$

(d). $\lim\limits_{x\to 0} \frac{x-3}{x^2(x+4)}$

(e). $\lim\limits_{h\to 0} \frac{\sqrt{x+h}-\sqrt{x}}{h}$

(f). $\lim\limits_{x\to 1} f(x)$, where $f(x) = \begin{cases} 3, & x \leq 1 \\ 1, & x > 1 \end{cases}$

8. Given that $\lim\limits_{x\to 1} f(x) = 2$, $\lim\limits_{x\to 1} g(x) = 4$, $\lim\limits_{x\to 1} h(x) = 0$, find the following limits if they exist.

(a). $\lim\limits_{x\to 1} f(x) - g(x)$

(b). $\lim\limits_{x\to 1} f(x) \cdot g(x)$

(c). $\lim\limits_{x\to 1} h(x)/g(x)$

(d). $\lim\limits_{x\to 1} g(x)/h(x)$

9. Given the function $f(x) = x^3 - 2x^2 + 8x - 1$, use the Intermediate Value Theorem to show that there is a number c where $0 < c < 2$, such that $f(c) = 6$.

10. For each of the following functions,
(i) find all of the x-values, if any, where g(x) is discontinuous and
(ii) indicate whether it is a removable, infinite, or jump discontinuity.

(a). $g(x) = \frac{x^2-x-6}{x(x^2-9)}$

(b). $f(x) = \begin{cases} x^2-1, & x \leq 1 \\ 1-x & x > 1 \end{cases}$

11. Suppose $f(1) = 3, f'(1) = -2, f(5) = 8$, and $f'(5) = 15$. Let P be the point on the graph $y = f(x)$ where $x = 1$. Let Q be the point on the graph of $y = f(x)$ where $x = 5$.

(a). Find the equation of the secant line PQ.

(b). Find the equation of the tangent line to $y = f(x)$ at P.

12. Suppose the position of a particle at time t seconds is given by $s(t) = \sqrt{t}$ meters. ***Use the limit definition*** of the derivative to find the velocity of the particle at time $t = 5$.

13. ***Use the limit definition*** of the derivative to find $f'(x)$ for the following: [You **must** use the limit definition.]

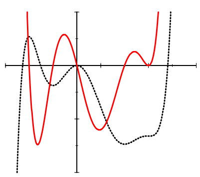
(a). $f(x) = \frac{1}{x^2}$ ***Simplify your answer.***

(b). $f(x) = 2x^2 + 3x$

14. Find the equation of the tangent line to the curve $y = 2x^2 + 3x$ at the point (1,5).
[Hint: See (b) in previous problem.]

15. Section 2.1 #49

16. Both the function f and its derivative f' are plotted on the same set of axes below. Which curve represents the function and which curve represents the derivative? ***Justify your answer.***



17. Section 2.2 #3, 15, 39.

18. Differentiate the following using ***Differentiation Rules*** [i.e Do ***NOT*** use the limit definition] [Do not simplify!]

(a). $y = 10x^3 - 3x + 7$

(b). $f(x) = \pi^2$

(c). $y = (3x)^3$

(d). $y = \frac{x + 4x^3 - 3}{x^3}$

(e). $s(t) = t^2(3t - 4t^3)$

(f). $f(x) = \frac{3}{x^2} - \sqrt{x}$

(g). $y = \frac{2x^2(3x^2 + 5)}{x^3 + 2x - 1}$

19. Find the the second derivative of $s(t) = t^2(3t - 4t^3)$. [Note: You already found $s'(t)$ in the previous problem.]

20. Find the equation of the tangent line to the curve $y = 10x^3 - 3x + 7$ at $x = -1$.
[Note: This is the same function as part (a) of a previous problem.]

21. Given the following information, find the values of the remaining trigonometric functions.

$\tan\theta = 3, \quad \pi < \theta < \frac{3\pi}{2}$.

22. Solve the following equations or inequalities for x.

(a). $2\sin^2 x - \sqrt{2}\sin x = 0$ (x in $[0, 2\pi]$)

(b). $\cos\frac{x}{2} = 0$ (x in $[0, 2\pi]$)