Find each limit below.

1. $\lim\limits_{x \to 2}(3x^2 + 5)$

2. $\lim\limits_{x \to 2} \dfrac{x-2}{x^2-4}$

3. $\lim\limits_{x \to 2^-} \dfrac{1}{x-2}$

4. At which values of x is $f(x) = \dfrac{x^2 - 2x - 3}{x - 2}$ discontinuous?

5. Use a graphing calculator to graph $f(x) = x^3 - 2x - 5$. Then use this graph to find the interval for which the Intermediate Value Theorem guarantees the existence of at least one number c in that interval for which $f(c)=0$.
    a. [-1, 1]   b. [1, 2]   c. [2, 3]   d. [3, 4]   e. None of these

6. If $f(x) = 2x^2 + 4$, which of the following will calculate the derivative of $f(x)$?

   a. $\dfrac{[2(x+h)^2 + 4] - (2x^2 + 4)}{h}$

   b. $\lim\limits_{h \to 0} \dfrac{(2x^2 + 4 + h) - (2x^2 + 4)}{h}$

   c. $\lim\limits_{h \to 0} \dfrac{[2(x+h)^2 + 4] - (2x^2 + 4)}{h}$

   d. $\dfrac{(2x^2 + 4 + h) - (2x^2 + 4)}{h}$

   e. None of these

7. Find dy/dx for $y = x^3\sqrt{x+1}$.

8. Find $\dfrac{d^2 y}{dx^2}$ for $y = \dfrac{x+3}{x-1}$.

9. Find $f'(x)$ for $f(x) = \sin^3 4x$.

10. Find $\dfrac{dy}{dx}$ if $x^2 + y^2 = 2xy$.

11. Find the horizontal asymptote of $f(x) = \dfrac{5 + 6000x^2 - 2x^3}{18x^3 + 3}$ if one exists. How is this related to limits?

12. Find the values of x that give relative extrema for the function f if $f'(x) = \dfrac{(x+1)(x-2)}{x+3}$.

    a. Relative maximum: x = -3, x = 2; relative minimum: x = -1
    b. Relative maximum: x = 1, -2; relative minimum: x = 3
    c. Relative maximum: x = 1; relative minimum: x = -1
    d. Relative maximum: x = -1; relative minimum: x = -3, x = 2
    e. None of these

13. Find all points of inflection for $f(x) = x^3 - 12x$.

14. Show all steps involved to find the derivative of $y = \sin^2(\cos 3x)$.

15. Find the **equation** of the tangent line to the curve $y = x^2 + 4x$ at the point (1, 5).

16. What is the instantaneous rate of change of R with respect to x if $R(x) = 4x^3 - 2x - 5$?

17. Use your answer to #16 to find the instantaneous rate of change of R at x = 1.

18. What is the average rate of change for the function R on the interval [0, 2].

19. Find (a) the intervals on which f is increasing, (b) the intervals on which f is decreasing, (c) the open intervals on which f is concave up, (d) the open intervals on which f is concave down, and (e) the coordinates of all inflections points. $f(x) = x^4 + 3x^3 + 5.$

20. Find the slope of the tangent line to $-10xy - 5x^2 = 5x^4$ at the point (-1, 1). Then write the equation of the tangent line at that point.

Concepts to study:
1. limits (all types we've covered….study your notes)
2. continuity and differentiability (types of discontinuity, reasons for nondifferentiability)
3. intermediate value theorem
4. average vs. instantaneous rates of change(secant vs. tangent)
5. unit circle
6. all derivative rules and formulas
   a. power rule
   b. product rule
   c. quotient rule
   d. chain rule
   e. trig and inverse trig
   f. logs, natural logs, and exponentials
7. implicit differentiation
8. related rates
9. first and second derivatives→increasing, decreasing, constant, concavity, inflection points, relative max/min points
10. derivative of inverse