Exam II
Review Topics

1. Exponential Functions 2.4:31-34(31,32)
   a. Properties
      Graph
      Domain, Range, Asymptote, Monotonicity
   b. Algebraic Properties
   c. Solving Exponential Equations

2. Logarithm Functions == Inverses of Exponential Functions 2.4:23-26,39-40(39,40)
   a. Properties
      Graph
      Domain, Range, Asymptote, Monotonicity
   b. Algebraic Properties
   c. Solving Logarithmic Equations
   d. Natural Logarithm Properties

3. Exponential Growth/Decay 2.4:66

4. Derivative of $y = f(x)$ at a point $x = a$ 3.1:13-16,20-23(22,23)
   a. Slope of the secant line to the graph of $y = f(x)$ over $[a, a + h]$
   b. Slope of the tangent line to the graph of $y = f(x)$ at $x = a$
   c. Average rate of change of $y = f(x)$ over $[a, a + h]$
   d. Instantaneous rate of change of $y = f(x)$ at $x = a$
   e. Difference quotient for $y = f(x)$ over $[a, a + h]$
   f. Definition of derivative of $y = f(x)$ at $x = a$

5. Equation of the tangent line to $y = f(x)$ at a point $x = a$ 3.1:29-30; 3.2:27-31(28,30);
   $3.3:45-50(45,49); 3.5:41-45(41,45); 3.6:33-36(34)$
   a. Point-slope formula

6. Relationship between the graphs of $y = f(x)$ and $y' = f'(x)$ 3.1:6-9

7. (Non-)Existence of a derivative for a function $y = f(x)$ at a point $x = a$
a. Function $f$ undefined at $x = a$

b. Function $f$ discontinuous at $x = a$

c. Graph of $y = f(x)$ has a corner at $x = a$

8. Differentiability of $y = f(x)$ at $x = a$ implies continuity of $y = f(x)$ at $x = a$

9. Rules for differentiation
   a. Constant rule
   b. Power rule
   c. Sum rule
   d. Difference rule
   e. Product rule
   f. Quotient rule

7. Derivatives
   a. Polynomials
   b. Rational Functions
   c. Algebraic Functions

8. Higher Order Derivatives

9. Rules of Special Functions
   a. Rules for special functions
     a. Sine function rule
     b. Cosine function rule
     c. Other trig function rules (via quotient rule)
     d. Exponential function ($e^x$)
     e. (Natural) logarithm function ($\ln x$)

10. Rectilinear Motion
    position function $s = s(t)$
    a. velocity function $v = s'(t)$
    acceleration function $a = v'(t) = s''(t)$
    b. Direction of motion determined by $v$
    c. Total distance travelled

11. Projectile Motion
    a. $g \approx 32 \text{ ft/sec}^2 \approx 9.8 \text{ m/sec}^2$
    b. $h(t) = s_0 + v_0t - \frac{1}{2}gt^2$
    c. $v = 0$ at maximum height

12. Chain rule
a. Extended derivative rules

13. Implicit Differentiation 3.6:1-12(5,6,12)
a. General procedure
   i. Equation \( F(x, y) = 0 \)
   ii. Treat (locally) \( y \) as a (unknown, but specified) function \( f(x) \)
   iii. Differentiate the equation (both sides) w.r.t. \( x \) (writing \( y' \) for the derivative of \( y \) (the unknown, but specified function \( f(x) \))
   iv. Solve (linear) equation for \( y' \)
b. Tangent line construction
c. Higher order derivatives

14. Differentiation rules for special functions 3.6:19-25(20,21)
a. Roots \( (y = \sqrt{x} = x^{\frac{1}{2}}, \ y = \sqrt[3]{x} = x^{\frac{1}{3}}) \)
b. Powers \( (y = x^r) \)
c. Exponentials \( (y = b^x) \)
d. Logarithms \( (y = \log_b x) \)
e. Inverse trig functions
   i. \( y = \sin^{-1} x \)
   ii. \( y = \tan^{-1} x \)
   iii. Others \( (y = \sec^{-1} x, \ y = \cos^{-1} x) \)

15. Logarithmic Differentiation 3.6:50-55(51,54)
a. Products, Quotients, Powers
b. Variable Base - Exponential Functions

16. Related Rate Problems 3.7:14-15, 23-30(24,26)
a. Procedure (Page 158)