Note: Exam 3 will cover more material than what is listed here and on the other sample test! Study your notes, homework, and textbook to cover all material from 5.3, 6.1-6.2, 6.4-6.5, 7.1.

1. Find the indicated higher order derivatives (5.3)
   a) \( f''(x) \) of \( f(x) = e^{2x} + 3x \)

2. Determine where the function is concave up and down and find any points of inflection on the function
   \( f(x) = x^3 - 6x^2 + 4x - 7 \) (5.3)

3. Find the absolute extrema over the given interval (6.1)
   a) \( f(x) = \frac{1}{3}x^3 + \frac{3}{2}x^2 - 4x + 1; [-5,2] \)
b) \( f(x) = \frac{1-x}{3+x}; [0,3] \)

4. The unit price of erasers, \( p \) in dollars, as a function of demand \( x \) is given by the equation

\[ p(x) = e^{-x/20}. \]

What price will give you maximum revenue? Round to the nearest cent. (6.2)

5. An ecologist is conducting a research project on breeding bunnies in captivity. She first must construct suitable pens. She wants a rectangular area with two additional fences across its width, as shown. Find the maximum area she can enclose with 3600 m of fencing. (6.2)
6. Solve for $dy/dx$ using implicit differentiation. Find $dy/dx$ at $(2,2)$.
   a) $e^{x^2y} = 5x + 4y + 2$

7. A stock has price $p(t)$ at time $t$ and the demand for it is $x(t)$. Suppose $p$ and $x$ are differentiable and $p'(t) = 0.3$, $x'(t) = -0.025$ at a time when $p = 400$ and $x = 100$.
   a) Find the rate of change of revenue at this time.
   b) Is the revenue increasing or decreasing at this time?
8. A spherical balloon is deflating. What is rate of change of its volume when the radius is 2 inches if the radius is decreasing at a rate of 1 in/s at that time? (V = \(\frac{4}{3}\pi r^3\)) (6.5)

9. Solve the following integrals. Also known as _____________________. (7.1, 7.2)
   a) \( \int (2x + \frac{4}{x^2} - 7) \, dx \)
   b) \( \int (5\sqrt{z} + \sqrt{z}) \, dz \)
   c) \( \int \left(\frac{1+2t^3}{4t}\right) \, dt \)
Extra practice:

A closed box with a square base is to have a volume of 16,000 $cm^3$. The material for the top and bottom of the box costs $3 per square centimeter, while the material for the sides costs $1.50 per square centimeter. Find the dimensions of the box that will lead to the minimum total cost. What is the minimum total cost?

Two quantities $x$, $y$ are related by $x^2y + y^3 = 10$. Suppose that $y$ is a function of $x$, i.e., $y=f(x)$ and that for $x=1$, $y=2$.

• Find $\frac{dy}{dx}$ at $x=1$ using implicit differentiation.

• Find an equation for the tangent line of the graph of $f(x)$ at $x=1$. Use the form $y=m(x-1)+b$.

• What $y$-value do you get for the tangent line equation from part (b) at $x=1.04$?
Things to Know

Properties of derivatives:

- Increasing function: \( \frac{dy}{dx} > 0 \)
- Decreasing function: \( \frac{dy}{dx} < 0 \)
- Critical numbers \( \frac{dy}{dx} = 0 \) or DNE
- Concave up: \( \frac{d^2y}{dx^2} > 0 \)
- Concave down: \( \frac{d^2y}{dx^2} < 0 \)
- Points of inflection: \( \frac{d^2y}{dx^2} = 0 \) and switches signs around

Good Equations to know:

- Pythagorean theorem (right triangles) \( a^2 + b^2 = c^2 \)
- Quadratic Formula (2nd order polynomial)
  \[ x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \]
- \( A_o = \pi r^2, A_{\Delta} = \frac{1}{2}bh \)
- Sphere: \( V = \frac{4}{3}\pi r^3, SA = 4\pi r^2 \)
- Cone or Cylinder: \( V = \frac{1}{3}Bh, B = \text{area of base} \)
- Revenue = Price \( \times \) Units sold
- Profits = Revenue - Costs
  \[ \frac{d}{dx} \text{Revenue} = \text{Marginal Revenue} \]
  \[ \frac{d}{dx} \text{Cost} = \text{Marginal Cost} \]
  \[ \frac{d}{dx} \text{Position} = \text{Velocity} \]
  \[ \frac{d}{dx} \text{Velocity} = \text{Acceleration} \]

Integration Rules:

- \( \int c \cdot f(x)dx = c \int f(x)dx \)
- \( \int x^n dx = \frac{x^{n+1}}{n+1} + C, \text{for } n \neq -1 \)
- \( \int e^{kx} dx = \frac{e^{kx}}{k} + C \)
- \( \int a^{kx} dx = \frac{a^{kx}}{lna} + C, \text{for } a > 0 \text{ and } a \neq 1 \)
- \( \int \frac{1}{x} dx = \ln|x| + C \)
- \( \int f(x) \pm g(x) dx = \int f(x)dx \pm \int g(x)dx \)

Differentiation Rules:

- Constant: \( \frac{d}{dx}C = 0 \)
- Power Rule: \( \frac{d}{dx}x^n = nx^{n-1} \)