Instructions:

Write the answers and show all your work in the blue books. There are 6 problems. Make sure you do all 6. No books, notes, or collaboration with others.

Problem 1. (5 points) Use the limit definition of the derivative to find $f'(x)$ if $f(x) = \frac{x}{2} - x^2$.

Problem 2. (15 points) Find the indicated derivatives:

$$\frac{dy}{dx} \text{ if } y = \frac{1 + \sin(x)}{\cos(x)}$$

$$f'(x) \text{ if } f(x) = \sin(\cos(2x))$$

$$\frac{dy}{dx} \text{ if } y = (1-3x)^{-\frac{1}{2}}$$

$$f''(1) \text{ if } f(x) = \frac{2}{x} - x^3 + 2$$

Problem 3. (5 points) Using implicit differentiation to find $\frac{dy}{dx}$, find the equation of the line tangent to the curve $x + y^2 = x^2 y + 3$ at $(1, 2)$.

Problem 4. (5 points) The area of a circle is growing at a rate of 4 square feet per minute. At what rate is the radius increasing at the instant when the radius is 8 feet?

Problem 5. (5 points) A ball is thrown straight downward from the roof of a building that is 100 feet tall. If the ball hits the ground after exactly 2 seconds, with what initial speed was it thrown?
Problem 6. (5 points) Suppose $x^2 = y^3$. If $x$ is increased by 15%, by approximately what percent does $y$ change? Is the change in $y$ an increase or decrease?