1. (15%) Find the derivative of the function $f(x) = 2x^3 + x$ from definition

$$f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}.$$

2. (15%) Let

$$f(x) = \begin{cases} x^2 & \text{if } x \le a \\ Ax + B & \text{if } x > a \end{cases}$$

   Find the values of A and B such that f is continuous and differentiable at a.

3. (15%) Find the second derivative of the function $h(t) = (t^2 + 1) \sin t$.

4. (15%) Find $\frac{dy}{dx}$ and equation of the tangent line to the curve $x + \sqrt{xy} + y = 6$ at the point $(2, 2)$.

5. Find the indicated limit if it exists.

   (a) (5%) $\lim_{x \to 4} \frac{x-4}{\sqrt{x}-2}$

   (b) (5%) $\lim_{x \to 3} \sqrt{x^2 + 2x - 3}$

6. (10%) Suppose that f and g are functions that are differentiable at $x = 1$ and that $f(1) = 2$, $f'(1) = -1$, $g(1) = -2$, and $g'(1) = 3$. Find $h'(1)$ if

$$h(x) = \frac{f(x)g(x)}{f(x) - g(x)}.$$

7. (10%) Find the linearization of a suitable function, and then use it to approximate the number $\sqrt{63.8}$.

8. Find $\frac{dy}{dx}$ if

   (a) (5%) $y = (x^2 + 1)^{120}$,

   (b) (5%) $y = \sqrt{2x^2 - 1}$.