

Instructions: Work the following problems *on your own paper*; give your reasoning and show your supporting calculations. Do not give decimal approximations unless a problem requires you to do so. Your exam is due at 2:50 pm.

1. Find $f'(x)$ if

(a) $f(x) = 3x^6 - 14x^5 + 12x^3 + 7x^2 - 8x$.

(b) $f(x) = \frac{3x^2 - 5x}{x^2 + x + 1}$.

2. Find $f'(x)$ if

(a) $f(x) = \cos^3 x \sin 2x$.

(b) $f(x) = \ln [\cos^2 2x \sin^4 x]$.

3. (a) Use the definition of the derivative to find $f'(x)$ if $f(x) = 1/\sqrt{x}$.

(b) Use the derivative you calculated in part (a) of this problem to write equations for the lines tangent to the curve $y = 1/\sqrt{x}$ at $x = 1$, at $x = 4$, and at $x = 9$.

4. Let f be the function given by

$$f(x) = \begin{cases} x^2 + 2x, & x \leq 2 \\ ax^2 + b, & x > 2. \end{cases}$$

(a) What condition must the constants a and b satisfy if f is to be a continuous function?

(b) Find all pairs of values for a and b which make the function f a differentiable function.

5. A man started walking north at 4 feet per second from a point P . Five minutes later, a woman started walking south at 5 feet per second from a point 500 feet due east of P . At what rate were the people moving apart 15 minutes after the woman started walking.

6. (a) Find an equation for the line tangent to the curve $x^3 - 4x^2y + 2xy^3 + 4 = 0$ at the point whose coordinates are $(2, 1)$.

(b) Use the result of part (a) of this problem to find an approximate value for the y -coordinate of the point $(2.04, y)$ that lies on the curve $x^3 - 4x^2y + 2xy^3 + 4 = 0$ near the point $(2, 1)$.