

MATH 241, Fall 2008
Final Exam: December 12

NAME _____

INSTRUCTOR _____

Arrange your work as clearly and neatly as possible, and cross out incorrect work. **Unless otherwise noted, you must justify all answers and show work to receive full credit.** You may not use calculators, notes, or any other kinds of aids.

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"Just a darn minute! — Yesterday
you said that X equals two!"

1. Evaluate $\lim_{x \rightarrow \infty} \frac{3x^4 - 2x^2}{x^4 + 5}$.

2. Find the value of c that makes this function continuous at $x = -3$.

$$f(x) = \begin{cases} \frac{x^2 - 9}{x + 3}, & x < -3 \\ cx + 2, & x \geq -3 \end{cases}$$

3. Differentiate $(\tan x)(x^{-1} + e^x)$. (No need to simplify the result.)

4. Find $\frac{d}{dx} \left[\frac{x + \sin x}{1 + 10^x} \right]$. (No need to simplify.)

5. Find y' , if $y = [\ln(x^2 + 1)]^5$.

6. Find the tangent line at $\left(\frac{\pi}{2}, \frac{\pi}{2}\right)$ for the curve defined by $x \sin y = y \sin x$.

7. Two boats leave a small Pacific island at the same time. Jack's ship goes north at 15 miles per hour, and Kate's ship goes east at 20 miles per hour. At what rate is the distance between the ships changing after two hours?

8. Find the linearization of $y = \sqrt{x+1}$ at $a = 0$.

9. Suppose $y = 2e^{-x} - e^{-2x}$. Find (or write NONE):

(a) intervals of increase _____ and decrease _____

(b) intervals of concavity up _____ and concavity down _____

10. Find the absolute (global) min and absolute (global) max values of $x^3 - 3x + 1$ on $[-3, 0]$.

11. A farmer wants to use 400 m of fencing to make three sides of a rectangle adjoining a river, which will act as the fourth side. What is the maximum area she can enclose?

12. The half-life of bismuth-210 is 5 days. How long will it take for an 80 mg sample to be reduced to 5 mg? (You do not need to simplify the resulting number, but do give its units.)

13. Find the most general antiderivative of $f(x) = 2e^x + \frac{1}{x}$ for $x > 0$.

14. Evaluate $\int \frac{x^3}{\sqrt[3]{x^4 + 5}} dx$.

15. Evaluate $\int_0^\pi (\cos x + \sin 2x) dx$.