MATH 1550 **Review for Exam (3)** Fall 2001

1. Memorize the following formulas:

$$\frac{d}{dx}u^n = nu^{n-1}\frac{du}{dx} \qquad \frac{d}{dx}(u+v) = \frac{du}{dx}+\frac{dv}{dx}$$
$$\frac{d}{dx}(uv) = v\frac{du}{dx}+u\frac{dv}{dx} \qquad \frac{d}{dx}\left(\frac{u}{v}\right) = \frac{v\frac{du}{dx}-u\frac{dv}{dx}}{v^2}$$
$$\frac{d}{dx}\sin u = \cos u\frac{du}{dx} \qquad \frac{d}{dx}\cos u = -\sin u\frac{du}{dx}$$
$$\frac{d}{dx}\tan u = \sec^2 u\frac{du}{dx} \qquad \frac{d}{dx}\cot u = -\csc^2 u\frac{du}{dx}$$
$$\frac{d}{dx}\sec u = \sec u\tan u\frac{du}{dx} \qquad \frac{d}{dx}\csc u = -\csc u\cot u\frac{du}{dx}$$
$$\frac{d}{dx}e^u = e^u\frac{du}{dx} \qquad \frac{d}{dx}a^u = a^u\ln a\frac{du}{dx}$$
$$\frac{d}{dx}(\sin^{-1}u) = \frac{1}{\sqrt{1-u^2}}\frac{du}{dx} \qquad \frac{d}{dx}(\cos^{-1}u) = -\frac{1}{\sqrt{1-u^2}}\frac{du}{dx}$$
$$\frac{d}{dx}(\tan^{-1}u) = \frac{1}{1+u^2}\frac{du}{dx} \qquad \frac{d}{dx}(\sec^{-1}u) = \frac{1}{u\sqrt{u^2-1}}\frac{du}{dx}$$
$$\frac{d}{dx}(\ln|u|) = \frac{1}{u}\frac{du}{dx} \qquad \frac{d}{dx}(\log_a|u|) = \frac{1}{u\ln a}\frac{du}{dx}$$

2. Logarithmic differentiation. (Find $\frac{dy}{dx}$ for $y = x^x$, $y = x^{\sin x}$.)
3. An important fact: $\lim_{n\to\infty}\left(1+\frac{1}{n}\right)^n = e$. (Prove this fact from the definition of the number e, i.e., $\lim_{h\to 0}\frac{e^h-1}{h} = 1$. Review the class notes.)
4. Practice problems: Find the limits (1) $\left(1+\frac{3}{n}\right)^n$, (2) $\left(1+\frac{1}{n}\right)^{2n}$, (3) $\left(\frac{n}{n+1}\right)^n$.
5. Write down the definitions of the six hyperbolic functions.
6. Plot the graphs of the functions $y = \sinh x$, $y = \cosh x$, $y = \tanh x$.
7. Prove the formulas: $\frac{d}{dx}(\sinh x) = \cosh x$, $\frac{d}{dx}(\cosh x) = \sinh x$, $\frac{d}{dx}(\tanh x) = \operatorname{sech}^2 x$.
8. Solve the equations: $\sinh x = 3$, $\cosh x = 5$, $\tanh x = \frac{1}{2}$.
9. Related rates: Review class notes and work out the homework problems.
10. Linear approximation: $f(x) \approx f(a) + f'(a)(x-a)$ for x near a.
11. Define the y-differential. Find the y-differentials for $y = e^{\sin x}$, $y = \sec(x^2+3x)$.
12. Work out those seven assigned problems from Review Exercises pp. 268–270.
13. Review class notes for absolute maximum, absolute minimum, extreme values, local maximum, local minimum.
14. State the Extreme Value Theorem.
15. Define critical numbers. (Find the critical numbers of the functions given by: (1) $f(x) = x^3+x^2-3x$, (2) $f(x) = x^{1/3}(x+1)$.)
16. Fermat's theorem: If f has a local maximum or minimum at c, then c is a critical number of f.
17. Review the Closed Interval Method.
18. State Rolle's theorem and the Mean Value Theorem.
19. Increasing/Decreasing Test.
20. The First Derivative Test.
21. Explain concavity and inflection point.

22. Explain the Concavity Test.
23. The Second Derivative Test.
24. What are indeterminate forms? How many of them are there?
25. Explain L'Hospital's rule and try the following typical examples:
(1) $\lim_{x\to 0} \frac{\sin x}{e^x-1}$, (2) $\lim_{x\to\infty} \frac{\ln x}{\sqrt{x}}$, (3) $\lim_{x\to 0} x \ln x$, (4) $\lim_{x\to\pi/2}(\sec x - \tan x)$,
(5) $\lim_{x\to 0} x^{2x}$, (6) $\lim_{x\to 0} |\ln x|^x$, (7) $\lim_{x\to 0}(\cos x)^{1/x}$.

MATH 1550 **Review for Exam (4)** Fall 2001

1. Review the guidelines for curve sketching and do the homework problems in §4.5.
2. Review optimization technique and do the homework problems in §4.7.
3. Study Newton's method.
4. Define antiderivative and do homework problems from §4.10.
5. Do #21, #27, and #69 from Chapter 4 Review Exercises.
6. State the definition of area as given in the Definition on page 372.
7. Use this definition to find the area of the triangle bounded by $y = \frac{h}{b}x$, $x = b$, and the x-axis. Here b and h are positive numbers.
8. Describe a partition, a set of evaluation points, and the corresponding Riemann sum.
9. Define the definite integral $\int_a^b f(x)\,dx$.
10. Use this definition to find $\int_0^2 x^3\,dx$. (Hint: $\sum_{i=1}^n i^3 = \left[\frac{n(n+1)}{2}\right]^2$.)
11. Do #11, #15, #17, #31, #32, #36 from §5.2.
12. State both parts of the Fundamental Theorem of Calculus.
13. Do all homework problems and in addition #32, #38 from §5.3.
14. Define indefinite integral $\int f(x)\,dx$.
15. **Memorize** the indefinite integral formulas in the handout.
16. Do all homework problems from §5.4.