MTH 150 **Name: _____**
Exam 2
March 8, 2007

DIRECTIONS: This is a closed book, closed notes exam. No electronic devices are allowed (this means calculators, computers, cell phones, pagers, etc.). Be neat and show all work to receive full credit. Correct answers without the supporting evidence to back it up receive only partial credit. Good luck.

1. (a) **(4 points)** Given a function $y = f(x)$, state the **definition** of the derivative.

(b) **(6 points)** Based on the definition from part (a), find $f'(x)$ for $f(x) = \sqrt{x}$. Using a shortcut rule doesn't count but you may *check* your answer via a shortcut.

(c) **(3 points)** Explain, geometrically, what the derivative represents.

For problems 2-5, find the derivatives. Simplify to a reasonable point (e.g., eliminate complex fractions, negative exponents, etc.)

2. **(7 points)** $f(x) = x^4 - 7x^2 + 3$

3. **(7 points)** $f(x) = \dfrac{1+\sin x}{1-\sin x}$

4. **(7 points)** $g(x) = x\sqrt{5-x^2}$

5. **(7 points)** $y = 4^x + \log_4 x$

Problems 6-11 are multiple choice; no work is necessary. Circle the letter of your choosing.

6. **(5 points)** Find the equation of the tangent line to the graph of $f(x)=x^2-x$ at the point $(-2,6)$.

(a) $y=-4x-2$ (b) $y=-5x-4$
(c) $y=2x-1$ (d) $y=-5x+16$
(e) $y=-2x+2$

7. **(5 points)** Find the derivative: $g(x)=\dfrac{1}{e^{3x}}$

(a) $\dfrac{1}{e^{3x}}$ (b) $\dfrac{1}{3e^{3x}}$
(c) $-\dfrac{2}{e^{3x}}$ (d) $-\dfrac{3}{e^{3x}}$
(e) $\dfrac{1}{3xe^{2x}}$

8. **(5 points)** Given $e^{xy}=2x+3y$, use implicit differentiation to find $\dfrac{dy}{dx}$.

(a) $\dfrac{5-ye^{xy}}{xe^{xy}}$ (b) $\dfrac{2}{e^{xy}-3}$
(c) $\dfrac{2-ye^{xy}}{xe^{xy}-3}$ (d) $\dfrac{e^{xy}-2}{3}$
(e) $\dfrac{2}{xe^{xy}-3}$

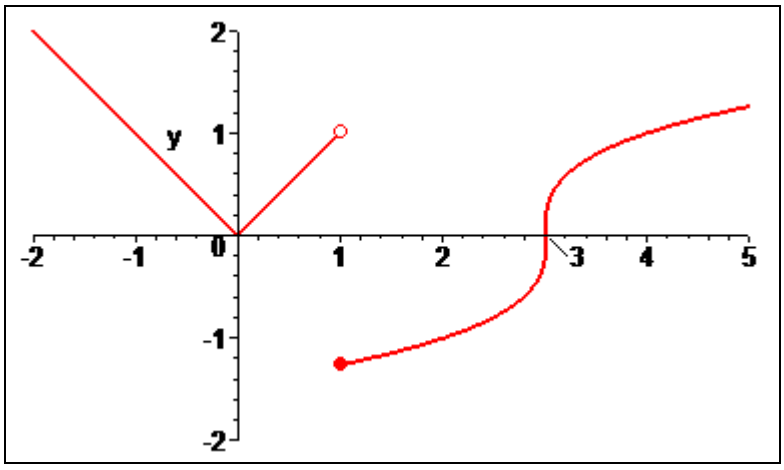
9. **(5 points)** Find the derivative: $y=\arcsin x$

(a) $\arccos x$ (b) $\dfrac{1}{\sqrt{1-x^2}}$
(c) $\dfrac{1}{\sqrt{x^2-1}}$ (d) $\dfrac{1}{|x|\sqrt{x^2-1}}$
(e) $-\dfrac{1}{\sqrt{1-x^2}}$

10. **(5 points)** Find the derivative: $f(x)=\cos^3(5x)$.

(a) $15\cos^2(5x)$ (b) $3\cos^2(5x)$
(c) $15\cos^2(5x)\sin(5x)$ (d) $-3\cos^2(5x)\sin(5x)$
(e) $-15\cos^2(5x)\sin(5x)$

11. **(5 points)** Consider the graph below:



State the *x*-value(s) where the function is **not** differentiable.

(a) 0, 1, and 3
(b) only 0 and 3
(c) only 1
(d) only 1 and 3
(e) only 0

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DIRECTIONS: Calculators are permitted on this part of the exam. However, answers based solely on calculator results are unacceptable. You must still <u>show all work</u> to receive full credit. Good luck.

12. A silver dollar is dropped from a 1300 ft building. The position of the coin is given by $s(t) = -16t^2 + v_0 t + s_0$, the basic equation for free-falling objects.

    (a) **(4 points)** Determine the position and velocity functions for the coin.

    (b) **(4 points)** Find the average velocity of the coin between its 1st and 2nd seconds of flight.

    (c) **(4 points)** Find the instantaneous velocity of the coin when $t = 2$ seconds.

13. **(8 points)** Use Newton's method $x_{n+1} = x_n - \dfrac{f(x_n)}{f'(x_n)}$ to approximate the zero of the function $f(x) = x^3 + 2x + 1$. Use $x_0 = -1$ as an initial guess and find $x_1, x_2,$ and x_3. Show the work for the computation of x_1; otherwise let the calculator do the work.

14. **(9 points)** A television camera at ground level is filming the lift-off of a space shuttle that is rising vertically according to the position equation $s = 50t^2$, where s is measured in feet and t is measured in seconds. The camera is 2000 feet from the launch pad. Find the rate of change in the angle of elevation of the camera at 10 seconds after lift-off.