

**Midterm Examination #3**  
Math 273 Calculus 1  
Wednesday, April 18, 2001

Name \_\_\_\_\_

**§1 Computation:**

1) Differentiate. Simplify your answer.

a)  $f(x) = 4\pi^2$

b)  $f(x) = e^{x+1} + 1$

c)  $f(x) = x\sqrt{x} + \frac{1}{x^2\sqrt{x}}$ .

2) Differentiate. Simplify your answer

a)  $y = \cos(a^3 + x^3)$

b)  $y = \left(\frac{x-6}{x+7}\right)^3$

c)  $y = \tan(x \sin x)$ .

3) Find the equation of the tangent line to the astroid  $x^{2/3} + y^{2/3} = 4$  that passes through the point  $(-3\sqrt{3}, 1)$ .

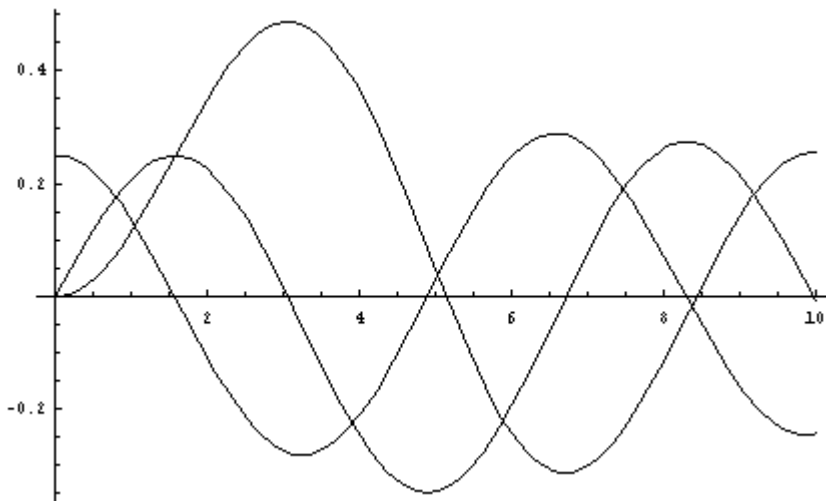
4) Differentiate  $y = x^{\sqrt{x}}$ . Simplify your answer.

**§2 Comprehension:**

5) What is the sum rule for differentiation? Prove it.

6) Use implicit differentiation to find the derivative for  $\sin^{-1} x$ .

7) Here is the graph of a function, its first derivative, and its second derivative. Identify each.



### §3 Applications:

- 8) Newton's Law of Gravitation says that the magnitude  $F$  of the force exerted by a body of mass  $m$  on a body of mass  $M$  is  $F = \frac{GmM}{r^2}$  where  $G$  is the gravitational constant and  $r$  is the distance between the bodies.
- a) If the bodies are moving, find  $\frac{dF}{dr}$ , and explain its meaning. What does the sign of  $\frac{dF}{dr}$  indicate?
- b) Suppose that it is known that Earth attracts an object with a force that decreases at the rate of 2 N/km when  $r = 20,000$  km. How fast does this force change when  $r = 10,000$  km?
- 9) A plane flying horizontally at an altitude of 1 mi and a speed of 600 mi/hr passes directly over a radar station. Find the exact rate at which the distance from the plane to the radar station is increasing when it is 3 mi away from the station.
- 10) A man starts walking north at 5 ft/s from a point  $P$ . Five minutes later, a woman starts walking south at 4 ft/s from a point 500 feet due east of  $P$ . At what rate are the people moving apart 15 min after the woman starts walking?