

This test consists of 100 points and 5 pages, none of which is intentionally left blank. Take a few seconds right now to be sure you have all the pages. The point value of each question is to the left of the question number. Show all your work in the space provided. If you run out of room for an answer, continue working on the back of the page. Your answers must be justified by your work.

NO GRAPHING CALCULATORS

- (24) 1. Show that you know the basic derivatives. Fill in the following table.

$f(x)$	$f'(x)$
x^n	
e^x	
$\ln(x)$	
$\sin(x)$	
$\cos(x)$	
$\tan(x)$	
$\cot(x)$	
$\sec(x)$	
$\csc(x)$	
$\sin^{-1}(x)$	
$\tan^{-1}(x)$	
$\sec^{-1}(x)$	

2. Show that you know the fundamental rules. Suppose f and g are differentiable functions. Suppose, in addition, $f(2) = 5$, $g(2) = 9$, $f'(9) = 6$, $g'(5) = -1$, $f'(2) = -3$, and $g'(2) = 3$.
- (3) (a) If $h = f + g$, what is the value of $h'(2)$?
- (3) (b) If $h = fg$, what is the value of $h'(2)$?
- (3) (c) If $h = \frac{f}{g}$, what is the value of $h'(2)$?
- (3) (d) If $h = f \circ g$, what is the value of $h'(2)$?
- (10) 3. A curve \mathcal{C} in the plane is given parametrically as
- $$x = t^2 \sin(t) + t$$
- $$y = 2t \cos(t).$$

Find an equation of the tangent to the curve \mathcal{C} at the point $(0, 0)$.

4. Find the derivative of each of the following functions:

(6) (a) $f(x) = (x^2 + 2x - 4)(x^3 - 2x^2 + x - 3)$

(6) (b) $f(x) = x \sin^{-1}(x)$

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

(6) (d) $f(x) = \ln(x + \sqrt{x^2 - 1})$

(6) (e) $f(x) = e^{3x^2+2}$

5. The following equation implicitly defines y as a function of x .

$$x^2y^2 + 2x + 2y = x^2y + 8$$

(6) (a) Find $\frac{dy}{dx}$

(6) (b) What is the equation of the tangent to the graph at the point $(1, 2)$?

- (12) 6. A right circular cylinder is changing its dimensions in such a way that the volume remains constant. If the radius is increasing at a rate of $\frac{2}{3}$ cm/sec, how fast is the height decreasing at the instant the radius is 10 cm and the height is 5 cm.