

Name:

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Do not begin your test until instructed to do so. You will have 45 minutes to complete the test. The **only** items you are permitted to use are a pencil, eraser, and calculator. Any use of any other item will result in getting a 0 on the test. Keep your eyes on your own test. Getting answers in any form from others will result in getting a 0 on the test. Each problem is worth 4 to 6 points: most for showing your work (when appropriate), and the rest for the right answer. Box your answers. Talking while any test is out will result in a 10 point penalty.

Good luck! (Even though this is a matter of skill, not luck.)

Page	Points	Score
2	37	
3	36	
4	27	
Total:	100	

1. Using the limit definition of derivative, find  $f'(x)$  given

(a) (6 points)  $f(x) = 2x^2 + 2x - 1$ .

(b) (7 points)  $f(x) = \sqrt{2x + 1}$ .

(c) (7 points)  $f(x) = \frac{1}{3x - 1}$

2. (5 points) Find the derivative of  $y = \frac{\pi}{2} \sin \theta - \cos \theta$ .

3. (7 points) Find the derivative of  $f(x) = \frac{x^3 - 3x^2 + 4}{x^2}$ .

4. (5 points) You launch a potato straight up from a height of 3 feet at a rate of 40 feet per second. Its distance from the ground is given by  $d(t) = -16t^2 + 40t + 3$  (negating air resistance). Find its velocity two seconds after it is launched.

5. (6 points) Find the derivative of  $f(x) = \sqrt{x} \csc x$ .

6. (7 points) Find the derivative of  $f(x) = \frac{x+1}{\tan x - x}$ .

7. (6 points) Find the third derivative of  $f(x) = \frac{2x+1}{\sqrt[3]{x}}$ .

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

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

(b) (5 points) Find line tangent to the graph at  $(-1, 1)$ .

(c) (6 points) Find  $\frac{d^2y}{dx^2}$ .

9. (5 points) Find the derivative of  $g(x) = \sqrt[3]{x^2 + 2x + 1}$ .
10. (7 points) Find the derivative of  $f(\theta) = 2 \sin^2(2x^2 + 2)$ .
11. (7 points) A spherical balloon is inflated with gas at the rate of 800 cubic centimeters per minute. How fast is the radius of the balloon increasing at the instant the radius is 30 centimeters?
12. (8 points) An airplane flies at an altitude of 5 miles toward a point directly over an observer. The speed of the plane is 600 miles per hour. Find the rate at which the angle of elevation is changing when the angle is  $30^\circ$ .
13. (10 points (bonus)) Using the limit definition, show  $\frac{d}{dx} \sin x = \cos x$ . You may use for free that  $\lim_{h \rightarrow 0} \frac{\sin h}{h} = 1$ .