

# Math 131 - Test 3

November 9, 2023

Name \_\_\_\_\_

Score \_\_\_\_\_

Show all work to receive full credit. Supply explanations where necessary.

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1. (6 points) Suppose  $f$  and  $f^{-1}$  are differentiable functions. The table below shows the values of  $f(x)$  and  $f'(x)$  at selected values of  $x$ . Find  $(f^{-1})'(3)$ . Show how you got it.

$x$	0	1	2	3
$f(x)$	5	3	7	2
$f'(x)$	0	8	4	1

2. (7 points) Let  $g(x) = (\cos^{-1} x)^2$ . Find the **exact value** of  $g'(1/2)$ . Simplify your answer as much as possible.

3. (4 points) Let  $f(x) = 9x + 13$ . Find  $(f^{-1})'(x)$ .

4. (4 points) Suppose you know that  $a^8 = 4$ . Use this to find each of the following. Show how you got your answers.

(a)  $\log_a 4$

(b)  $\log_a 2$

5. (4 points) Find  $h'(x)$  if  $h(x) = \log_3[(5x + 1)^7]$ .

6. (4 points) Find  $dy/dx$  if  $y = x^2 e^{\tan x}$ .

7. (8 points) Use logarithmic differentiation to find  $dy/dx$  when  $y = (\sin x)^x$ .

8. (8 points) Determine the linearization of  $f(x) = x^{1/2} + x^{1/4}$  at  $x = 16$ . Then use your linearization to approximate  $f(16.8)$ .

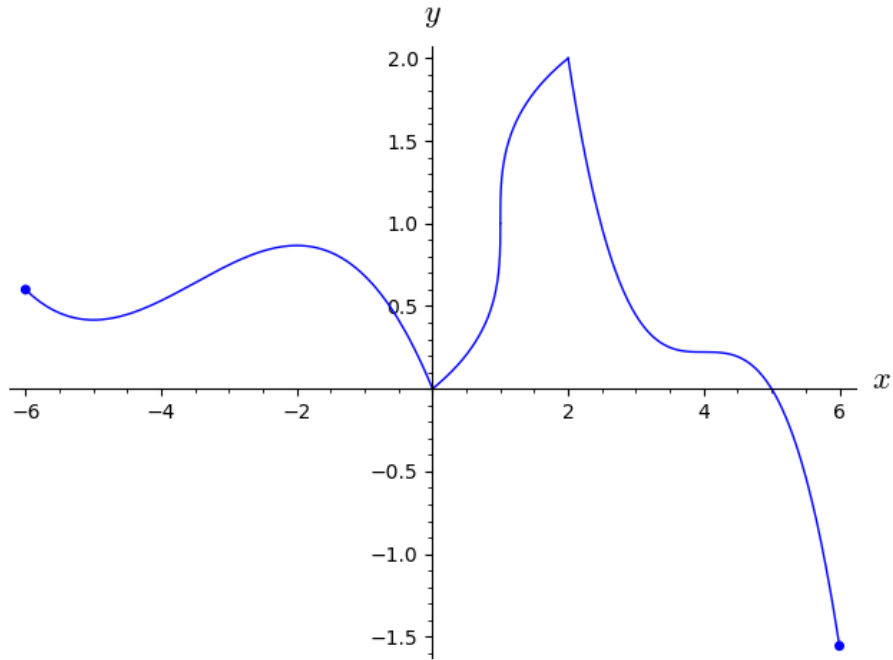
9. (6 points) Use differentials to approximate the change in  $f(x) = \tan^{-1}(2x)$  as  $x$  changes from 0.5 to 0.47.

10. (8 points) Determine the differential  $dy$ .

(a)  $y = \ln(\cos x)$

(b)  $y = 5^{x^2}$

11. (6 points) The graph of  $y = f(x)$  is shown below. Estimate the critical numbers of  $f$ . Explain your reasoning. (Pay attention to the scale along the  $x$ -axis.)



12. (2 points) Referring to the function  $f$  is the previous problem, explain why  $f(6)$  is not a relative minimum.

13. (8 points) Let  $g(x) = x^3 - 3x^2 + 1$  for  $0 \leq x \leq 4$ . Find the critical numbers of  $g$ . Then find the absolute minimum and maximum values of  $g$ .

14. (3 points) Let  $f(x) = x^2 - 18 \ln x$ . It is easy to check (don't bother) that

$$f'(x) = \frac{2(x^2 - 9)}{x}.$$

Looking at  $f'$ , Steve claimed that  $x = 3$ ,  $x = -3$ , and  $x = 0$  are the critical numbers of  $f$ . Explain where Steve went wrong.

15. (7 points) The first derivative of  $f$  is given by  $f'(x) = x^3(x - 1)(x + 3)$ . Construct a sign chart (or number line) for  $f'$  and determine open intervals on which  $f$  is increasing/decreasing.

16. (7 points) Find and classify the critical numbers of  $F(x) = x^4 - 8x^3 + 18x^2 - 11$ .

*Intentionally blank.*

The following problems are due Monday, November 13, 2023. You must work on your own.

17. (3 points) Suppose that a particle is moving smoothly along the graph  $y = e^{-5x}$  in such a way that  $\frac{dy}{dt} = 15$  when  $x = 0$ . Find  $\frac{dx}{dt}$  at that point.

18. (5 points) A fisherman on a dock 5 ft above the surface of the water is slowly reeling in fishing line so that his bobber is approaching the dock (along the water) at a rate of 3.25 ft per minute. Find the rate at which the fisherman is reeling in the fishing line at the moment the bobber is 12 ft from the dock. (This problem is similar to Example 3 in the Lecture 19 notes.)