



University of California, San Diego  
Department of Mathematics

### Instructions

1. Write your *Name, PID, Section, and Exam Version* on the front of your Blue Book.
2. No calculators or other electronic devices are allowed during this exam.
3. You may use one page of notes, but no books or other assistance during this exam.
4. Write your solutions clearly in your Blue Book.
  - (a) Carefully indicate the number and letter of each question and question part.
  - (b) Present your answers in the same order they appear in the exam.
  - (c) Start each problem on a new page.
5. Show all of your work. No credit will be given for unsupported answers (even if correct).
6. Turn in your exam paper with your Blue Book.

0. (1 point) Carefully read and complete the instructions at the top of this exam sheet and any additional instructions written on the chalkboard during the exam.
1. (6 points) For each of the following, find  $\frac{dy}{dx}$ . (*You do not need to simplify.*)
  - (a)  $y = e^{-x} \ln x$
  - (b)  $y = \ln(1 + \cos 2x)$
  - (c)  $x^3 y - \tan y = 4$

2. (5 points) (a) Find the **linearization** of the function  $f(x) = \sqrt{x}$  at the point  $a = 4$ .  
 (b) Use the result of (a) to approximate the value of  $\sqrt{4.1}$ . (*Simplify your answer.*)
3. (5 points) (a) Find the critical points for the function  $g$ , if the formula for the **first derivative** is

$$g'(x) = 2^x(x-2)(x+3).$$

Identify each critical point of  $g$  as a local maximum, local minimum, or neither.

- (b) The function  $h$  has a critical point at  $x = 3$ . Determine if this critical point for  $h$  is a local maximum or local minimum if the **second derivative** is

$$h''(x) = \frac{x^2 - 2x + 7}{(x-1)^2}$$

4. (4 points) Helium is being **released** from a spherical balloon at a constant rate of  $10 \text{ cm}^3/\text{s}$ . Find the **rate of change of the radius** when the radius is 5 cm. You may use the fact that the volume  $V$  and the radius  $r$  of the balloon are related by the equation

$$V = \frac{4}{3}\pi r^3.$$

5. (4 points) If  $f(x) = x^{\sin x}$ , then what is  $f'(x)$ ?

(This exam is worth 25 points.)