



*University of California, San Diego*  
*Department of Mathematics*

Name: \_\_\_\_\_ PID: \_\_\_\_\_

Date: \_\_\_\_\_ Discussion Section: \_\_\_\_\_

1. Write your *Name*, *PID*, and *Discussion Section* in the spaces provided above.
  2. Make sure your *Name* is on every page.
  3. No calculators, tablets, phones, or other electronic devices are allowed during this exam.
  4. Put away ANY devices that can be used for communication or can access the Internet.
  5. You may use one page of handwritten notes (both sides), but no books or other assistance during this exam.
  6. Write your solutions clearly in the spaces provided.
  7. Show all of your work; no credit will be given for unsupported answers.
  8. Do not use l'Hôpital's Rule anywhere on this exam.
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**DO NOT TURN PAGE UNTIL INSTRUCTED TO DO SO**

**Question Zero:**

- (1 points) 0. Carefully read and complete the instructions at the top of this exam sheet and any additional instructions written on the chalkboard during the exam.

(This exam is worth 40 points.)

(6 points) 1. Let  $f(x) = \sqrt{x+4}$ . Compute  $f'(5)$  using the **limit definition** of the derivative.

(10 points) 2. Differentiate the following functions of  $x$ . You may use any rules you know.

(a)  $f(x) = x^\pi + e^\pi$

(b)  $g(x) = \frac{e^x + 1}{2x - 5}$

(c)  $h(x) = ax^3 - \frac{r}{x^3}$

- (7 points) 3. Let  $f(x) = x^2e^x$ . Suppose the tangent line to the graph of  $f$  at  $x = a$  passes through the point  $(2a, 0)$ . What are the possible values of  $a$ ?

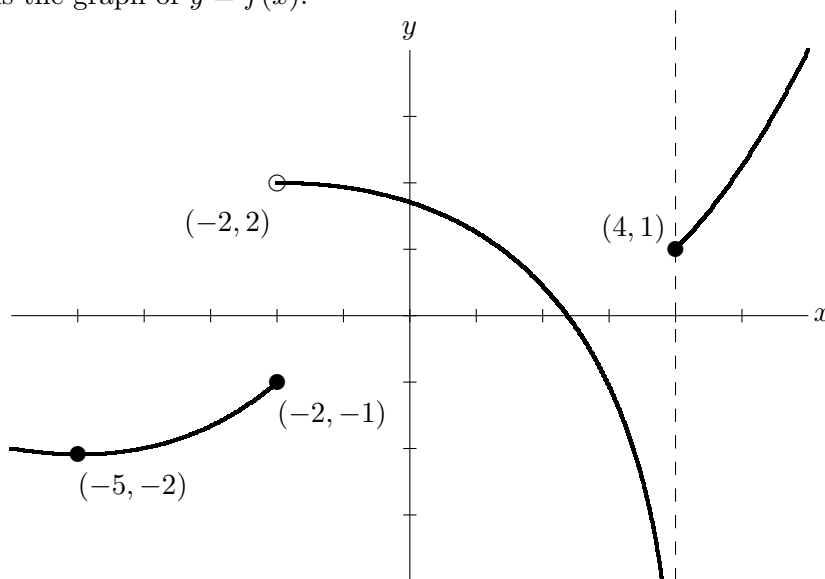
(10 points) 4. Compute the following limits or state that they do not exist.

(a)  $\lim_{x \rightarrow 3} \frac{x - 3}{x^2 - 2x - 3}$

(b)  $\lim_{x \rightarrow \infty} \frac{\cos(x)}{x^4}$

(c)  $\lim_{x \rightarrow 0} \frac{\sin(2x) \sin(7x)}{x^2}$

(6 points) 5. The following is the graph of  $y = f(x)$ .



For parts (a)–(d), use the graph to determine the following limits, or state that they do not exist (DNE). If the limit is infinite, specify if it is  $\infty$  or  $-\infty$ .

(a)  $\lim_{x \rightarrow -2} f(x) =$  \_\_\_\_\_

(c)  $\lim_{x \rightarrow 4^-} f(x) =$  \_\_\_\_\_

(b)  $\lim_{x \rightarrow -5} f(x) =$  \_\_\_\_\_

(d)  $\lim_{x \rightarrow 4^+} f(x) =$  \_\_\_\_\_

(e) At  $x = -2$ , is  $f$  left-continuous, right-continuous, continuous, or none of these?

(f) At  $x = -5$ , is  $f$  left-continuous, right-continuous, continuous, or none of these?