

Instructor: Ann Clifton

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

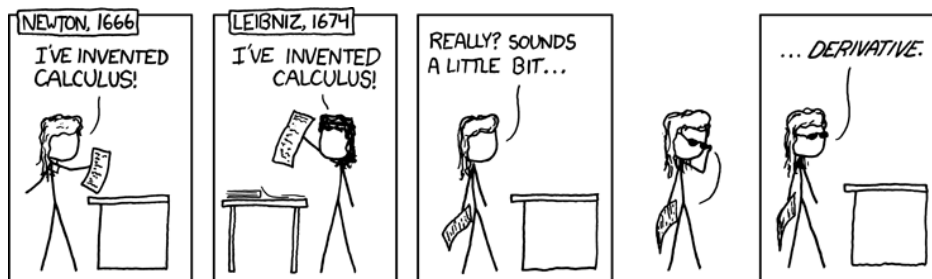
**Do not turn this page until told to do so.**

You will have a total of 1 hour and 15 minutes to complete the exam. When specified, you **must** show all work to receive full credit. **NO CALCULATOR/PHONE ALLOWED.** Draw a pumpkin on this page if you read this.

Cheating of any kind on the exam will not be tolerated and will result in a grade of 0%.

#	score	out of	#	score	out of
1		4	9		6
2		4	10		6
3		4	11		14
4		4	12		20
5		4	13		16
6		6			
7		6	EC		5
8		6	Total		100

Remember: This exam has no impact on your worth as a human being. You got this!!!



**True or False. No work/explanation required. True means ALWAYS true. 4pts each.**

1. If  $L$  and  $c$  are real numbers and  $\lim_{x \rightarrow c} f(x) = L$ , then  $\lim_{x \rightarrow c} \sqrt[n]{f(x)} = \sqrt[n]{L} = L^{1/n}$ ,  $n$  a positive integer.
2. If  $P(x)$  and  $Q(x)$  are polynomials,  $Q(c) \neq 0$ , then  $\lim_{x \rightarrow c} \frac{P(x)}{Q(x)} = \frac{P(c)}{Q(c)}$ .
3. If  $f$  is continuous at  $c$  and  $g$  is continuous at  $f(c)$ , then the composite  $g \circ f$  is continuous at  $c$ .
4. If  $f(x) \leq g(x)$  for all  $x$  in some open interval containing  $c$ , except possibly at  $x = c$  itself, and the limits of  $f$  and  $g$  both exist as  $x$  approaches  $c$ , then  $\lim_{x \rightarrow c} f(x) \leq \lim_{x \rightarrow c} g(x)$ .
5. If the function  $f$  is continuous at  $x = c$  and  $g$  is a function of  $x$ , then  $f + g$  is continuous at  $x = c$ .

**Multiple Choice. No work required. 6 points each.** Choose the best answer. There is only one correct answer but you may choose up to *two*. If you choose two and one of the answers is correct, you will receive half the points.

6. Find the limit:

$$\lim_{y \rightarrow 2} \frac{y + 2}{y^2 + 5y + 6}$$

- A. 0                      B. 1/16  
C. 1/5                     D. Does Not Exist

7. Find the average rate of change of the function over the given interval:

$$P(\theta) = \theta^2 - 4\theta + 5, \quad [1, 2]$$

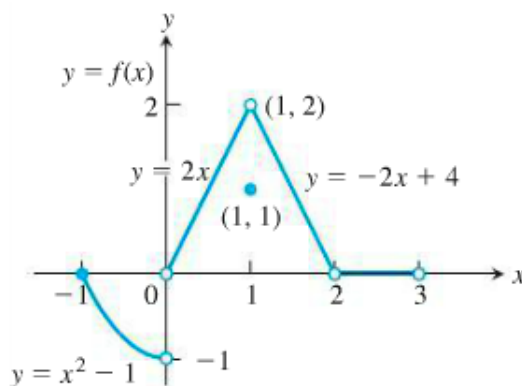
- A.  $-1/2$                   B.  $-1$   
C. 3                        D.  $3/2$

8. Find the limit:

$$\lim_{x \rightarrow -\infty} \left( \frac{x^2 + x - 1}{8x^2 - 3} \right)^{1/3}$$

- A. 0                      B.  $1/2$   
 C.  $1/9$                       D. Does Not Exist

Use the graph below for questions 9 and 10.



9. Using the given graph, find  $\lim_{x \rightarrow 0^+} f(x)$ .

- A. 0                      B. 1  
 C. 2                      D. Does Not Exist

10. Using the given graph, determine whether the function  $f(x)$  is continuous at the point  $x = 2$ . Explain why or why not.

- A.  $f(x)$  is NOT continuous at  $x = 2$   
 as  $f(2) \neq \lim_{x \rightarrow 2} f(x)$ .  
 B.  $f(x)$  is NOT continuous at  $x = 2$   
 as there is a jump discontinuity there.  
 C.  $f(x)$  IS continuous at  $x = 2$   
 as  $\lim_{x \rightarrow 2} f(x) = f(2)$ .  
 D.  $f(x)$  IS continuous at  $x = 2$   
 as  $\lim_{x \rightarrow 2^-} f(x) = \lim_{x \rightarrow 2^+} f(x)$ .

**Short Answer.** You must show all work to receive full credit. If you need more space, use the provided scrap paper and write a note indicating where to find your work.

11. (14 points) Let

$$f(x) = \frac{x^3 + x^2 - 56x}{x + 8}.$$

(a) Does  $f(x)$  have a discontinuity? If so, is it removable?

(b) Use limit laws to evaluate

$$\lim_{x \rightarrow -8} \frac{x^3 + x^2 - 56x}{x + 8}.$$

12. (20 points) Find the derivative,  $f'(x)$ , using the limit definition, for the function  $f(x) = x^2 - x$ .

13. (16 points) If

$$\lim_{x \rightarrow -2} \frac{f(x)}{x^2} = 1,$$

find

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

(b)  $\lim_{x \rightarrow -2} \frac{f(x)}{x}$

**Extra Credit** (5 points) No partial credit will be given for this problem. Give exact answers.

For the given function  $f(x)$  and values of  $L$ ,  $c$ , and  $\epsilon > 0$  determine the largest value for  $\delta > 0$  such that  $0 < |x - c| < \delta \Rightarrow |f(x) - L| < \epsilon$ .

$$f(x) = 6x + 4, \quad L = 34, \quad c = 5, \quad \epsilon = 0.6$$