

Math 19 A&B  
Fall 2019  
Final Exam  
Version 2

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

This exam contains 8 pages and 8 questions. Total of points is 100. For full credit you must show your work. Partial credit may be given for incorrect solutions if sufficient work is shown. Messy/unorganized answers may be penalized, even if correct.

Grade Table (for teacher use only)

Question	Points	Score
1	15	
2	15	
3	15	
4	8	
5	15	
6	8	
7	8	
8	16	
Total:	100	

**HONORS PLEDGE** (sign after exam is completed): I have neither given nor received aid on this exam, nor have I observed a violation of the UVM Code of Academic Integrity.

Signature: \_\_\_\_\_

1. (15 points) Evaluate the following indefinite integrals

(a) (5 points)

$$\int (5x^5 - 9x^2 + 8)dx$$

(b) (5 points)

$$\int \frac{8x^7}{\sqrt{x^8 + 3}}dx$$

(c) (5 points)

$$\int (x^4 + 11x)^7(12x^3 + 33)dx$$

2. (15 points)

(a) (5 points) Given that

$$\frac{d}{dx}(x \ln x - x) = \ln x.$$

Find the particular antiderivative of

$$f(x) = \ln x$$

which passes through the point  $(1, 12)$ .

(b) (5 points) Estimate the area under  $f(x) = 5x + 9$  on  $[1, 13]$  using  $n = 3$  right rectangles.

(c) (5 points) Compute the definite integral

$$\int_1^{13} (5x + 9)dx$$

3. (15 points) Evaluate the following limits. Make sure to briefly justify your answer. If a limit does not exist, determine if it is  $+\infty$  or  $-\infty$  (if neither, write DNE).

(a) (5 points)

$$\lim_{x \rightarrow 3} \frac{1}{(x-3)^2}$$

(b) (5 points)

$$\lim_{x \rightarrow \infty} \frac{e^x + 2x}{4x + 1}$$

(c) (5 points)

$$\lim_{x \rightarrow \infty} \frac{x^3 + 2x - 1}{7x^3 + 16x^2}$$

4. (8 points) Consider the function

$$f(x) = x^2 - 5x + 6.$$

Use the limit definition of the derivative to compute  $f'(x)$ . No credit will be given for using shortcuts on this problem.

- (a) (2 points)

$$f(x + h) =$$

- (b) (2 points)

$$f(x + h) - f(x) =$$

- (c) (2 points)

$$\frac{f(x + h) - f(x)}{h} =$$

- (d) (2 points)

$$f'(x) =$$

5. (15 points) Compute the following derivatives. You may use shortcuts.

(a) (5 points)

$$\frac{d}{dx} (6x^5 - 2\sqrt{x} + 4 + \ln x)$$

(b) (5 points)

$$\frac{d}{dx} \left( \frac{1 - 4x^6}{1 - x^3} \right)$$

(c) (5 points)

$$\frac{d}{dx} (x^2 e^{-x^3})$$

6. (8 points) Consider the function

$$f(x) = x^2(x - 5)^3$$

- (a) (4 points) Find the equation of the tangent line at  $x = 3$ .

- (b) (4 points) Find where the tangent line is horizontal.

7. (8 points) Find  $y'$  for the implicit curve defined by the equation

$$e^y - xy = x.$$

8. (16 points) For the function  $f(x) = x^3 - 12x^2 + 21x + 10$

(a) (5 points) Find the intervals where  $f$  is increasing/decreasing

(b) (1 point) Find any local maxima or minima.

(c) (5 points) Find the intervals where  $f$  is concave up/concave down

(d) (1 point) Find any points of inflection.

(e) (4 points) Find the absolute maximum and absolute minimum of  $f$  on  $[-2, 4]$ .