

APPM 1345

Exam 1

Spring 2023

Name	
Student ID	
Instructor Richard McNamara	Section 150

This exam is worth 100 points and has **4 problems**.

**Make sure all of your work is written in the blank spaces provided.** If your solutions do not fit, there is additional space at the end of the test. Be sure to **make a note** indicating the page number where the work is continued or it will **not** be graded.

**Show all work and simplify your answers.** Name any theorem that you use. Answers with no justification will receive no points unless the problem explicitly states otherwise.

Notes, papers, calculators, cell phones, and other electronic devices are not permitted.

### End-of-Exam Checklist

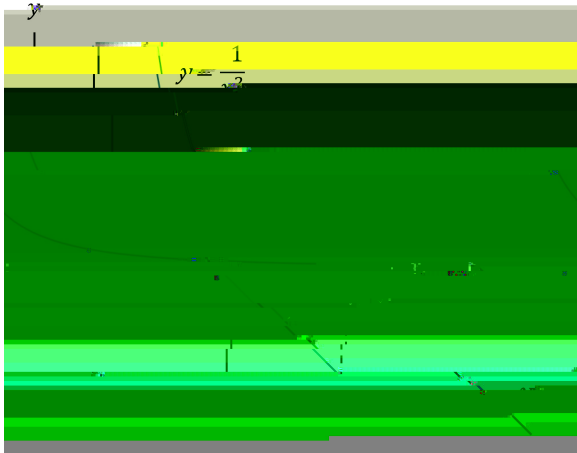
1. If you finish the exam before 7:45 PM:
  - Go to the designated area to scan and upload your exam to Gradescope.
  - Verify that your exam has been correctly uploaded and all problems have been labeled.
  - Leave the physical copy of the exam with your proctors.
2. If you finish the exam after 7:45 PM:
  - Please wait in your seat until 8:00 PM.
  - When instructed to do so, scan and upload your exam to Gradescope at your seat.
  - Verify that your exam has been correctly uploaded and all problems have been labeled.
  - Leave the physical copy of the exam with your proctors.

1. (26 pts) Parts (a) and (b) are unrelated.

(a) Find the most general form of  $u(x)$  such that  $u'(x) = \sec^2 x + (2 - \frac{1}{x})^2$ .

(b) Suppose the acceleration function of a particle is given by  $a(t) = 4 \cos t - 3 \sin t + 5t$ , and the particle's initial velocity and position are  $v(0) = 4$  and  $s(0) = 5$ , respectively. Find the particle's position function  $s(t)$ .

2. (13 pts) Let the function  $D(x)$  represent the vertical distance between the curve  $y = 1-x^2$  and the line  $y = x$  at a given value of  $x$ . What is the minimum possible value of  $D(x)$  on the interval  $(0; 1)$ ? Use the Second Derivative Test to confirm that the result is indeed a local minimum value of the function  $D(x)$ .



3. (17 pts) Suppose Newton's Method is used to estimate the value of a root of  $y = p(x) = x^3 - 5x$  using an initial estimate of  $x_0 = 1$ .

(a) Write the expression for Newton's Method for the specified function  $p(x)$

4. Parts (a) and (b) are not related.

(a) (22 pts) Let  $f(x) = x^{1-3} - x^{4-3}$ .

- i. Identify all critical numbers of  $f(x)$ .
- ii. For which values of  $x$  is  $f(x)$  increasing and for which values of  $x$  is  $f(x)$  decreasing? Express your answers using interval notation.
- iii. Identify the  $x$ -coordinate of each local maximum and minimum of  $f(x)$  (if any). Use the First Derivative Test to classify each one.

(b) (22 pts) Let  $g(x) = 3x^5 - 5x^4$ .

- i. For which values of  $x$  is  $g(x)$  concave up and for which values of  $x$  is  $g(x)$  concave down? Express your answers using interval notation.
- ii. Identify the  $x$ -coordinate of each inflection point of  $g(x)$  (if any). Justify your answer.

END OF TEST

Your Initials \_\_\_\_\_

ADDITIONAL BLANK SPACE

If you write a solution here, please clearly indicate the problem number.