

## APPM 1340

## Exam 3

## Fall 2023

Name		
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. (30 pts) Determine  $\frac{dy}{dx}$  for each of the following.

(a)  $y = \sin^4(x^3)$

(b)  $x^2 + xy + y^3 = 4$

(c)  $y = \frac{2x^2 + 1}{x \cos x}$  After fully differentiating, do not algebraically simplify your answer any further.

2. (25 pts) Parts (a) and (b) are unrelated.

(a) The position function of Particle P is given by  $s(t) = 2/t + t/2$ , where  $s$  is in meters,  $t$  is in seconds, and  $t \geq 1$ .

i. Find the particle's velocity function  $v(t)$ . Include the correct unit of measurement.

ii. Find the distance traveled by the particle between  $t = 1$  and  $t = 8$  seconds. Include the correct unit of measurement.

(b) The velocity function of Particle Q is given by  $v(t) = \tan t - t^2/4$ , where  $v$  is in miles per hour,  $t$  is in hours, and  $3\pi/2 < t < 5\pi/2$ .

i. Find the particle's acceleration function  $a(t)$ . Include the correct unit of measurement.

ii. Find the acceleration of the particle at  $t = 2\pi$  hours. Include the correct unit of measurement.

3. (23 pts) Parts (a) and (b) are unrelated.

(a) Find the equations of the tangent and normal lines to the curve  $y = x^{3/2} - x^{1/2}$  at  $x = 4$ .

(b) Find all values of  $x$  on the interval  $[0, \pi]$  for which the curve  $y = \sin^2 x - \sin x$  has a horizontal tangent line.

4. (22 pts) Parts (a) and (b) are unrelated.

(a) Determine  $f'(x)$  for the function  $f(x) = \frac{1}{x+1}$  by using the **definition of derivative**.

You must obtain  $f'$  by evaluating the appropriate **limit** to earn credit.



- (b) Find the values of  $b$  and  $c$  for which the following function  $g(x)$  is differentiable at  $x = 2$ .

$$g(x) = \begin{cases} \frac{3}{8}x^3 & , \quad x < 2 \\ -x^2 + bx + c & , \quad x \geq 2 \end{cases}$$

You do **not** have to explicitly state the one-sided limits that are being evaluated.

END OF TEST
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Your Initials \_\_\_\_\_

ADDITIONAL BLANK SPACE

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