APPM 1340
Final Exam
Fall 2022

Name		
Instructor Richard McNamara		**Section** 150

This exam is worth 150 points and has **6 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 9:45 AM:
   - 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 9:45 AM:
   - Please wait in your seat until 10:00 AM.
   - 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. (28 pts) The position function of a particle is given by $s(t) = -10t^2 + 40t + 50$ on the interval $[0, 5]$, where t is measured in seconds and s is measured in feet.

   (a) i. Find all critical numbers of $s(t)$ on the given interval and the corresponding function values.

   ii. Identify the absolute maximum and minimum values of $s(t)$ on the given interval and the corresponding values of t at which they occur.

(b) i. Determine the particle's velocity and acceleration at $t = 3$ seconds. Include the correct units of measurement.

ii. Determine the total distance traveled by the particle between $t = 0$ and $t = 5$ seconds. Include the correct unit of measurement.

2. (24 pts) Parts (a) and (b) are not related.

(a) Find the equations of the tangent and normal lines to the curve $5y + \sin y + 1 = x^2$ at the point $(-1, 0)$.

(b) Evaluate $\dfrac{d}{dx}[x \tan^4 x]$.

3. (35 pts) A 10-foot ladder is initally resting against a vertical wall. Suppose the bottom of the ladder slides away from the wall at a constant rate of 2 feet per second. Determine the values of the following quantities when the top of the ladder is 6 feet above the floor. Include the correct units of measurement.

   (a) The speed at which the top of the ladder is sliding down the wall

(b) The rate at which the angle between the ladder and the floor is decreasing

(*Hint:* The distance between the wall and the bottom of the ladder is related to the angle between the ladder and the floor. Start by writing an equation that represents that relationship.)

4. (20 pts) The side of a cube is measured to be 2 cm with a possible error in measurement of up to 0.1 cm.

   (a) Identify the function $V(x)$ representing the volume of the cube, where x represents the length of a side.

   (b) Find the linear approximation of $V(x)$ about $x = 2$.

   (c) Use differentials to estimate the maximum possible error in computing the volume of the cube. Include the correct units of measurement.

5. (15 pts) Verify that the hypotheses of the Mean Value Theorem are satisfied for $g(x) = x + \dfrac{1}{x}$ on the interval $[2, 3]$ and find all numbers c that satisfy the conclusion of the theorem.

6. (28 pts) Parts (a) and (b) are not related.

(a) Determine $f'(x)$ for the function $f(x) = 1/x$ by using the definition of derivative. (You must obtain f' by evaluating the appropriate limit to earn credit.)

(b) Consider the rational function $r(x) = \dfrac{5x^2 - 5x - 10}{3x^2 + 3x - 18}$.

i. Find the (x, y) coordinates of every removable discontinuity of $r(x)$, if any exist. Support your answer by evaluating the appropriate limits.

ii. Find the equation of every vertical asymptote of $y = r(x)$, if any exist. Support your answer by evaluating the appropriate limits.

iii. Find the equation of every horizontal asymptote of $y = r(x)$, if any exist. Support your answer by evaluating the appropriate limits.

$\boxed{\text{END OF TEST}}$

Your Initials _________

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