APPM 1345
Exam 1
Spring 2025

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 Procedure

1. Go to the designated area to scan and upload your exam to Gradescope.
2. Verify that your exam has been correctly uploaded and all problems have been labeled.
3. Hand the physical copy of your exam to a proctor.
4. Have a proctor swipe your BuffOne card.

1. (30 pts) Parts (a) and (b) are not related.

   (a) Find the most general form of $u(x)$ such that $u''(x) = 3x^{-6} + 2x^{4/3} - \cos x + 8$. Fully simplify all fractions in your result.

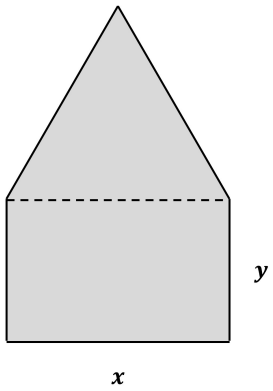
(b) Consider a particle that is moving along a linear path with an acceleration of $a(t) = 6 - 12t$ m/s^2, where $t \geq 0$. Suppose the particle's initial velocity is 12 m/s and its inital position is 5 meters.

i. At what time will the particle be at rest? Include the correct unit of measurement.

ii. What is the particle's position when it is at rest? Include the correct unit of measurement.

2. (20 pts) The shaded region depicted below consists of a rectangle and an equilateral triangle positioned adjacent to each other, as drawn. The variables x and y represent the dimensions of the rectangle. If the perimeter of the entire shaded region (which consists of the five solid lines and does not include the dashed line) is 10 inches, determine the value of x (including the correct unit of measurement) that maximizes the area of the shaded region. Use the Second Derivative Test to confirm that your result is a local maximum value of the area function.

   Note that the height of an equilateral triangle with a base length of x is $\dfrac{\sqrt{3}}{2}\,x$.



3. (20 pts) Suppose Newton's Method is used to estimate the value of the root of $y = r(x) = \dfrac{2-x}{x^2}$.

   (a) Determine the value of x_1 produced by Newton's Method for an initial value of $x_0 = 1$.

   (b) Would Newton's Method converge to a solution if the initial value was $x_0 = 4$? Explain why or why not.

   (c) Write the general expression for Newton's Method for the specified function $r(x)$. Your answer should be an expression for x_{n+1} in terms of x_n.

4. (30 pts) Parts (a) and (b) are not related.

   (a) Let $f(x) = x^{2/3}(1 - x)$.

      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) Let $g(x) = \dfrac{x^2}{4} - \cos x$.

i. For which values of x on the interval $(0, 2\pi)$ is $g(x)$ concave up and for which values of x on that same interval is $g(x)$ concave down? Express your answers using interval notation.

ii. Identify the x-coordinate of each inflection point of $g(x)$ on the interval $(0, 2\pi)$, if any. Justify your answer.

END OF EXAM

Your Initials _____

ADDITIONAL BLANK SPACE

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