APPM 1340

Exam 2

Fall 2025

| **Name** |
| **Instructor**   Richard McNamara   **Section** 150 |

This exam is worth 100 points and has **5 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.

Potentially Useful Formulas

$\sin 2\theta = 2 \sin \theta \cos \theta$

$\cos 2\theta = \cos^2 \theta - \sin^2 \theta = 2 \cos^2 \theta - 1 = 1 - 2 \sin^2 \theta$

L'Hôpital's Rule can **NOT** be used to evaluate limits on this exam

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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. (26 pts) Parts (a), (b), and (c) are not related to each other.

(a) Is the function $f(x) = \dfrac{x^5}{x^2 + 5}$ odd, even, or neither? Justify your answer by using the definition of odd and/or even functions.

(b) For $p(x) = \dfrac{1}{x^2 - 1}$ and $q(x) = \sqrt{1 - x}$, identify the composite function $(p \circ q)(x)$ and its domain.

(c) The graph of $y = \sqrt{2x + 1}$ is to be transformed in the following three steps, in the specified order:

   i) Shifted horizontally by 4 units to the left

   ii) Reflected across the y-axis

   iii) Compressed vertically by a factor of 3

After each of the three transformations, what is the equation of the resulting graph? Only the final equation (the one that is obtained after the third transformation) needs to be simplified. Note that no actual graphing is required in this problem.

   i. Equation of the graph after transformation (i):

   ii. Equation of the graph after transformations (i) and (ii):

   iii. Equation of the graph after transformations (i), (ii), and (iii):

2. (18 pts) Evaluate the following limits. If you use a named theorem, state the name as part of your solution.

(a) $\displaystyle\lim_{x \to 5} \frac{2 - \sqrt{x-1}}{x^2 - 6x + 5}$

(b) Suppose $g(x)$ is a function such that

$$-x^2 + 2x + 2 \le g(x) \le x^3 + x^2 - 5x + 6$$

for all $x \ge 0$. Is there enough information to determine the value of $\displaystyle\lim_{x \to 1} g(x)$? If so, use the appropriate theorem to evaluate the limit.

3. (19 pts) Consider the rational function $r(x) = \dfrac{x^3 - x^2 - 6x}{x^3 + 4x^2 + 4x}$.

(a) Identify all values of x, if any, for which $y = r(x)$ has a removable discontinuity. If none exist, clearly state "none". Support your answer by evaluating the appropriate limit(s).

(b) Find the equation of each vertical asymptote of $y = r(x)$, if any exist. If none exist, clearly state "none". Support your answer by evaluating the appropriate limit(s).

$$\frac{x^3 - x^2 - 6x}{x^3 + 4x^2 + 4x}.$$

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4. (19 pts) Parts (a) and (b) are not related.

    (a) For what value of a is the following function $u(x)$ continuous at $x = \pi/6$? Fully support your answer using the definition of continuity, which includes evaluating the appropriate limits.

$$u(x) = \begin{cases} 9ax^2 & , \quad x \leq \pi/6 \\ \dfrac{\sin x}{x} & , \quad x > \pi/6 \end{cases}$$

(b) Consider the function $y = v(x) = \dfrac{5x - 6}{x - 3}$.

Given that $v(0) = 2$ and $v(6) = 8$, can the Intermediate Value Theorem be used to show that $v(x) = 4$ for some value of x in the interval $(0, 6)$? Explain why or why not.

5. (18 pts) Find all values of x in the interval $[0, 2\pi]$ that satisfy the following equation:

$$\sin(2x) = -\sqrt{3}\sin x$$

END OF EXAM

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