

APPM 1340

Exam 2

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.

L'Hôpital's Rule and dominance of powers arguments can **NOT** be used to evaluate limits on this exam

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:

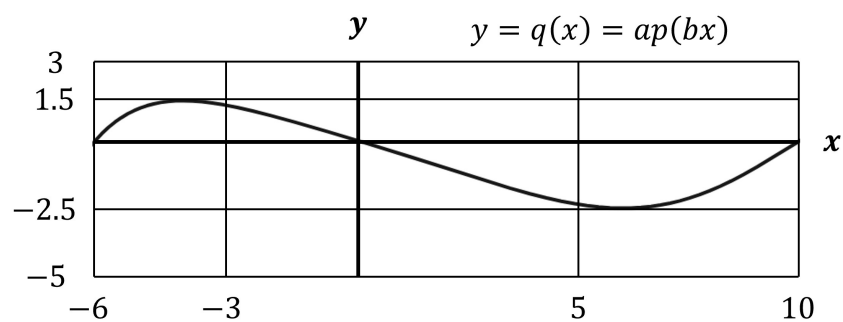
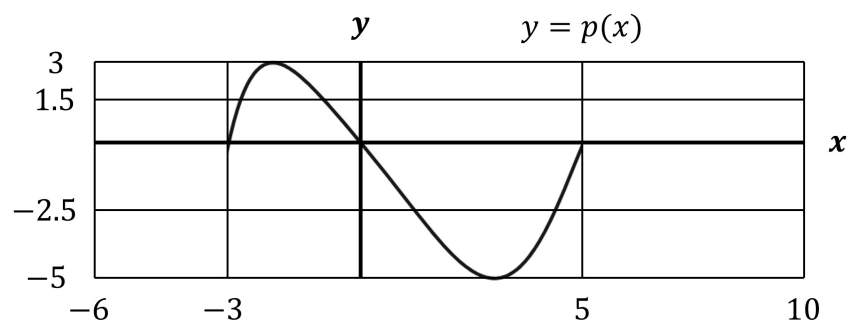
- Please wait in your seat until 8:00 PM.
- When instructed to do so, scan and upload your exam to Gradescope at your seat.
- Verify that your exam has been correctly uploaded and all problems have been labeled.
- Leave the physical copy of the exam with your proctors.

1. (20 pts) Parts (a) and (b) are not related.

(a) For $f(x) = \frac{1}{x-1}$ and $g(x) = \sqrt{2-x}$, identify the composite function $(f \circ g)(x)$ and its domain.

Express the domain in interval form.

- (b) The graphs below depict the functions $y = p(x)$ and $y = q(x)$, where q is a transformation of p of the form $q(x) = ap(bx)$. Find the values of a and b .



2. (30 pts) Evaluate the following limits. Support your answers by stating theorems, definitions, or other key properties that are used.

(a) $\lim_{x \rightarrow 0} \frac{\sin(5x)}{x^2 + 2x}$

(b) $\lim_{x \rightarrow 2} \frac{\sqrt{x+1} - \sqrt{3}}{x^2 + x - 6}$

(c) $\lim_{x \rightarrow 0} x^4 \cos\left(\frac{1}{2x}\right)$

3. (30 pts) Consider the rational function $r(x) = -\frac{3x^2 + 21x + 30}{x^2 + 2x - 15}$.

- (a) Identify all values of x at which $r(x)$ is discontinuous. At each such x value, explain why the function is discontinuous there.

- (b) Identify the type of discontinuity associated with each x value identified in part (a). Support those classifications by evaluating the appropriate limits.

- (c) Find the equation of each vertical asymptote of $y = r(x)$, if any exist. Support your answer in terms of your work in part (b).

- (d) Find the equation of each horizontal asymptote of $y = r(x)$, if any exist. Support your answer by evaluating the appropriate limits. *(Reminder: You may not use L'Hôpital's Rule or dominance of powers arguments to evaluate limits on this exam.)*

4. (20 pts) Parts (a) and (b) are not related.

- (a) For what value of a is the following function $u(x)$ continuous at $x = 4$? Support your answer using the definition of continuity, which includes evaluating the appropriate limits.

$$u(x) = \begin{cases} \frac{x-4}{x^2-16} & , \quad x < 4 \\ \frac{1}{a-x} & , \quad x \geq 4 \end{cases}$$

- (b) Use the Intermediate Value Theorem to establish that the equation $v(x) = x - 2 \cos x = 0$ has at least one solution on the interval $(0, \pi/3)$. Verify that all conditions for applying the IVT to this particular problem are satisfied prior to using it.

END OF TEST

Your Initials _____

ADDITIONAL BLANK SPACE

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