# APPM 1345
# Exam 2
# Spring 2026

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| **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.

**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.

**Formulas**

$$\sum_{i=1}^{n} i = \frac{n(n+1)}{2} \qquad \sum_{i=1}^{n} i^2 = \frac{n(n+1)(2n+1)}{6} \qquad \sum_{i=1}^{n} i^3 = \left[\frac{n(n+1)}{2}\right]^2$$

1. (16 pts) Suppose Newton's Method is used to estimate the value of a root of $y = f(x) = \sin x + \cos x + 0.5$.

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

   (b) Determine the value of $x_1$ produced by Newton's Method for an initial value of $x_0 = \pi/2$.

   (c) Find a value of $x_0$ on the interval $[0, \pi]$ for which Newton's Method would not converge to a solution. Explain why the method would not converge for that value of $x_0$.

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

(a) Evaluate $\int x(2\sqrt{x} - 3)\, dx$.

(b) Suppose the acceleration function of a particle is given by $a(t) = 2\sin t - t + 4$ meters per second squared, and the particle's initial velocity and position are $v(0) = 3$ meters per second and $s(0) = 7$ meters, respectively. Find the particle's position function $s(t)$. Include the correct unit of measurement.

3. (24 pts) Parts (a) and (b) are unrelated.

   (a) Consider the function $g(x) = x - \dfrac{1}{x}$ on the interval $[1, 5]$.

      i. Determine the numerical value of the Riemann sum $R_2$ for $g(x)$ on $[1, 5]$ using **right** endpoints and 2 equally-sized subintervals. Express your answer as a simplified single fraction.

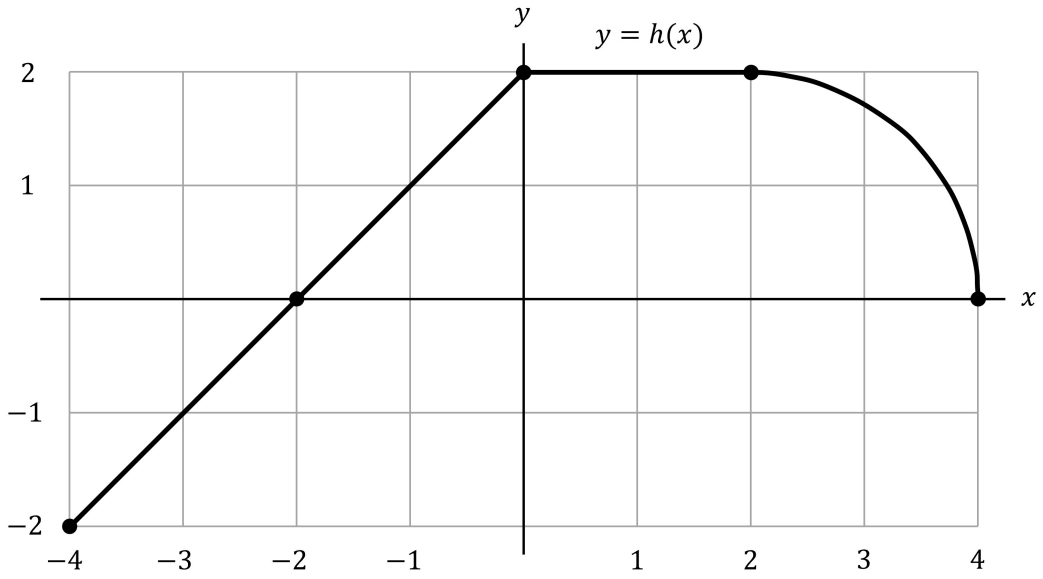
      ii. Write an expression for the general Riemann sum $R_n$ for $g(x)$ on $[1, 5]$ using **right** endpoints and $n$ equally-sized subintervals. Your answer should involve sigma notation and it should be in terms of $i$ (or some other suitable index of summation) and $n$. Do **not** simplify the expression inside the summation.

(b) Evaluate the following limit using steps (i) and (ii) below: $\lim_{n\to\infty} \sum_{i=1}^{n} \left(\frac{2i}{n}\right)^3 \cdot \frac{2}{n}$

i. Evaluate the given sum to obtain an expression in terms of $n$ that does not involve sigma notation.

ii. Evaluate the limit of the expression obtained in step (i). Do **not** use a dominance of powers argument or L'Hôpital's Rule as part of your limit evaluation.

4. (19 pts) The following function graph $y = h(x)$, which consists of two line segments and a quarter circle, is depicted below on the interval $[-4, 4]$.




Evaluate the following integrals.

(a) $\int_{-2}^{2} h(x)\,dx$

(b) $\int_{-4}^{-1} h(x)\,dx$

(c) $\int_{-4}^{4} h(x)\,dx$

5. (16 pts) Evaluate the following derivatives. Do **not** simplify your answers.

(a)

$$\frac{d}{dx}\int_{2x}^{8}\frac{\cos t}{t^2}\,dt$$

(b)

$$\frac{d}{dx}\int_{x^2}^{\sqrt{x}}\csc^3 t\,dt$$

END OF EXAM

Your Initials _____

ADDITIONAL BLANK SPACE

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