APPM 1350	Name	
Final Exam	Student ID	
Fall 2022	Instructor	Lecture Section

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 Check List

- 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.

Formulas

$$sin(2\theta) = 2 \sin \theta \cos \theta \qquad cos(2\theta) = 2 \cos^2 \theta - 1 = 1 - 2 \sin^2 \theta$$

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

$$\int \frac{1}{\sqrt{1-x^2}} dx = \arcsin(x) + C \qquad \int \frac{1}{1+x^2} dx = \arctan(x) + C$$

- 1. (42 pts) The following problems are unrelated.
 - (a) Find the derivative of $y = \sqrt{5x^2 \sin x}$.
 - (b) Evaluate $\int \frac{\arcsin(x)}{\sqrt{1-x^2}} dx.$ (c) Evaluate $\int_0^{\ln\sqrt{3}} \frac{e^x}{1+e^{2x}} dx.$
 - (d) Estimate the value of $\int_{1}^{5} \ln\left(\frac{x}{x+1}\right) dx$ using a Riemann sum with right endpoints and n = 4 rectangles of equal width. Express your answer in terms of a single logarithm.
 - (e) Evaluate $\lim_{x \to \infty} 2x \sinh\left(\frac{3}{x}\right)$.

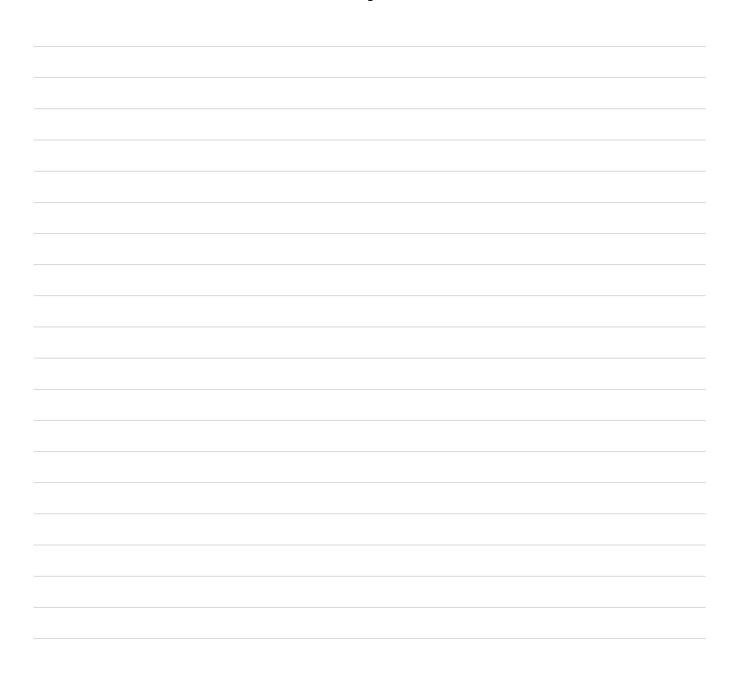


2. (12 pts)

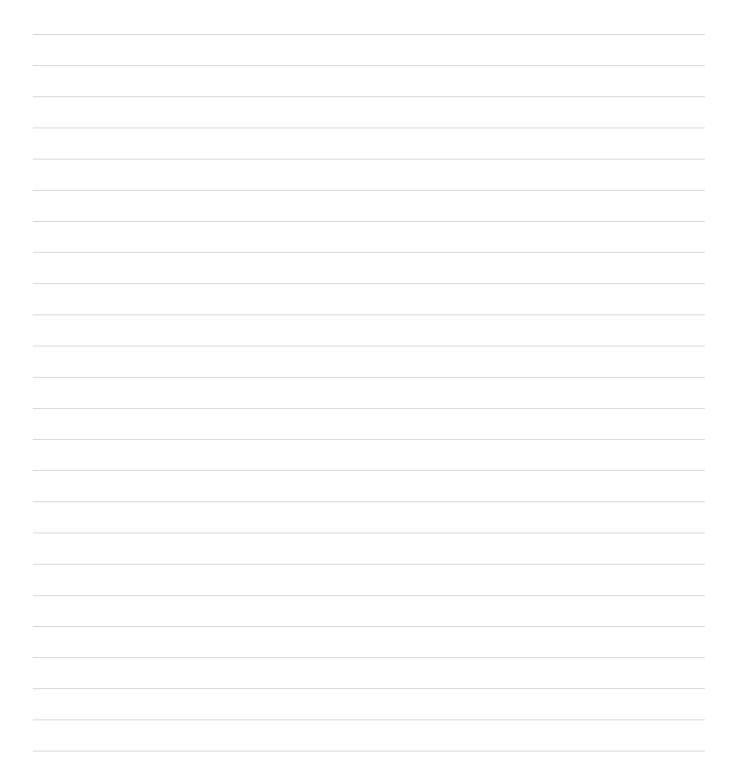
- (a) State the definition of continuity of a function, f(x), at a point, x = a.
- (b) Now consider the function f(x) defined on [-1, 1] by

$$f(x) = \begin{cases} 2\sin^{-1}(x) & \text{if } x < \frac{1}{2} \\ c & \text{if } x = \frac{1}{2} \\ \cos^{-1}(x) & \text{if } x > \frac{1}{2}. \end{cases}$$

Is there a value of c that makes f continuous at $x = \frac{1}{2}$? Justify your answer using the definition of continuity.



- 3. (18 pts) Consider the function $h(x) = 2\sqrt{x} \frac{1}{4}x$.
 - (a) Locate all local extrema of h(x). Clearly indicate which x-coordinates correspond to a local maximum (if any) and which correspond to a local minimum (if any).
 - (b) Find r'(x) when $r(x) = \int_2^{\tan x} h(t) dt$.



- 4. (32 pts) Consider $s(x) = \frac{e^{2x}}{3 e^{2x}}$.
 - (a) Determine s'(1). (Your final answer should be in terms of e.)
 - (b) Determine the inverse of s(x). Be sure to label your final answer as $s^{-1}(x)$. (You may assume without proof that s(x) is one-to-one.)
 - (c) Determine all horizontal asymptotes of s(x). Justify each with the appropriate limit.
 - (d) Determine all vertical asymptotes of s(x). Justify each with the appropriate limit.

5. (20 pts) Assume f and g are differentiable for all x, and we know the following values of f, f', g, and g'.

x	0	1	2	3	4
f(x)	-2	3	2	-4	0
f'(x)	1	3	5	-3	9
g(x)	-3	1	8	-1	1
g'(x)	0	3	1	-7	-2

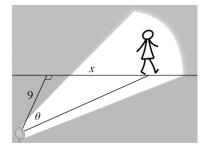
- (a) Determine the linearization of y = f(x) at x = 3.
- (b) Use your answer from (a) to approximate f(3.2).
- (c) Determine $(f \circ g)'(4)$. (That is, find the derivative of f(g(x)) when evaluated at x = 4.)

- 6. (26 points) The following problems are unrelated.
 - (a) The rate of change of atmospheric pressure, P, with respect to the elevation, h, is proportional to P. That is,

$$\frac{dP}{dh} = kP.$$

Assume the pressure at sea level is 18 pounds per square inch and the pressure at an elevation of 15,000 feet is 6 pounds per square inch. What would be the pressure at an elevation of 5,000 feet above sea level? (Remember to fully simplify your final answer. Specifically, there should be no *e* or natural logarithm in your final answer.)

(b) A girl walks along a straight path at a speed of 3 feet per second. A searchlight is located on the ground 9 feet from the path and is kept focused on the girl. At what rate is the searchlight rotating when the girl is 12 feet from the point on the path closest to the searchlight?



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