

Test Number: 1010

MA 16010

Exam 3

Fall 2024

Student's Name: _____

Section Number: _____

(Without your name and section number, we will NOT be able to locate your exam booklet.)

1. Fill out your name and section number in the space provided above. On the scantron, fill in **your name, section number, test number and student ID**. Sign your name.
2. You can write on this exam booklet. Turn in both your scantron and your exam booklet when you are done. Note: **you will be graded ONLY based on your scantron answer sheet**.
3. Only a one-line display scientific calculator is allowed. NO other electronic devices are allowed. No books or notes are allowed.
4. There are 12 questions with 8 points each for a total of 96 points. You will have 60 minutes to complete the exam. Good luck!

Instructor	Time	Section	Instructor	Time	Section
Anderson, Sarah	3:30pm	019	Anderson, Sarah	4:30pm	020
Bairnsfather, Chris	3:30pm	002	Bairnsfather, Chris	4:30pm	001
Baring, Geoffrey	9:30am	030	Baring, Geoffrey	10:30am	029
Barnes, Russell	2:30pm	023	Barnes, Russell	4:30pm	024
Batavia, Manav	3:30pm	035	Batavia, Manav	4:30pm	036
Carper, Patrick	11:30am	033	Carper, Patrick	12:30pm	034
Chen, Ying	7:30am	300	Chen, Ying	8:30am	400
Chlopecki, Anna	3:30pm	011	Chlopecki, Anna	4:30pm	012
Dasiuk, Jaden	12:30pm	017	Dasiuk, Jaden	1:30pm	018
Delgado, Huimei	online	999			
Fong, Justin	3:30pm	008	Fong, Justin	4:30pm	007
Gismondi, Nick	1:30pm	021	Gismondi, Nick	2:30pm	022
Gutwein, Linda	10:30am	027	Gutwein, Linda	11:30am	028
Hong, Kyungtak	1:30pm	015	Hong, Kyungtak	2:30pm	016
Hsu, Alexander	3:30pm	009	Hsu, Alexander	4:30pm	010
Kessinger, Ethan	8:30am	004	Kessinger, Ethan	9:30am	003
LaClair, Adam	12:30pm	013	LaClair, Adam	1:30pm	014
O'Connor, Sam	9:30am	032	O'Connor, Sam	10:30am	031
Ouseph, Chrisil	10:30am	005	Ouseph, Chrisil	11:30am	006
Polak, Raechel	12:30pm	500	Polak, Raechel	2:30pm	200
Styles, Nikos	3:30pm	025	Styles, Nikos	4:30pm	026

Problem 1

Which of the following limits equals to ∞ ?

1. (A) $\lim_{x \rightarrow \infty} \frac{3x - 2}{x^3 + 1}$
- (B) $\lim_{x \rightarrow -\infty} \frac{-2x^3}{x^2 + 2}$
- (C) $\lim_{x \rightarrow -\infty} \frac{5 + x^2}{x - 1}$
- (D) $\lim_{x \rightarrow \infty} \frac{-x^2 + x - 4}{x + 9}$
- (E) $\lim_{x \rightarrow \infty} \frac{-x^4 - 8}{x^2 + 3}$
- (F) $\lim_{x \rightarrow -\infty} \frac{-x^3 + x^2}{3x^4 + 1}$

Problem 2

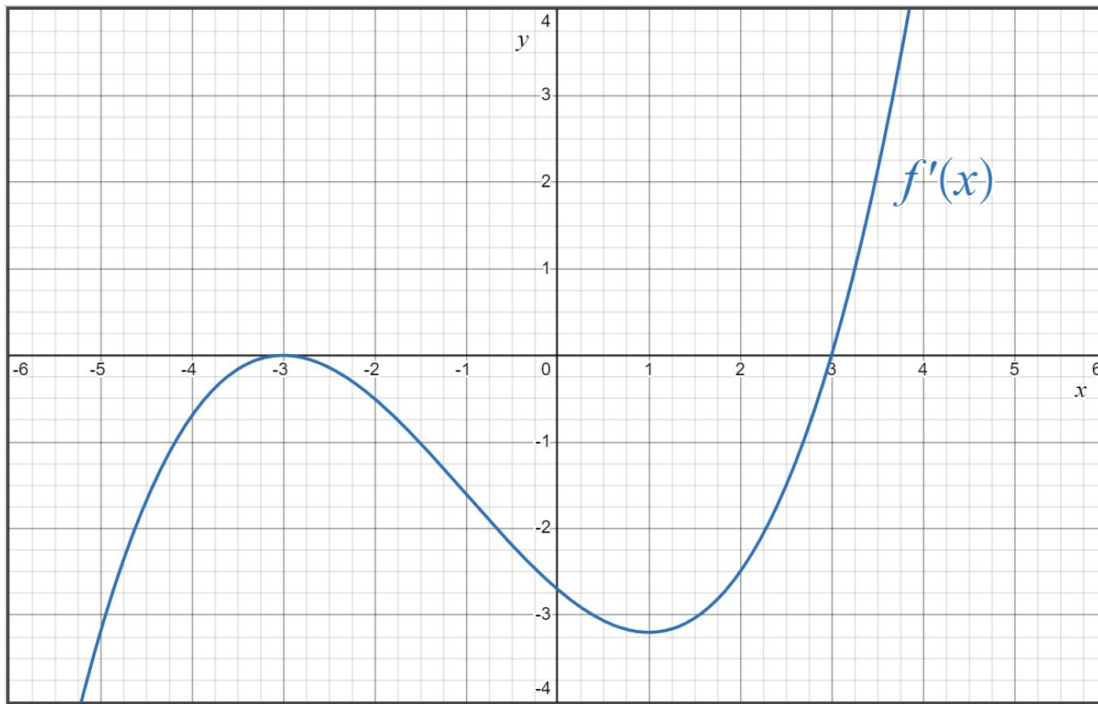
Evaluate

$$\int (\cos x - \sin x + \csc^2 x) dx$$

2. (A) $-\sin x - \cos x + 2 \csc x + C$
- (B) $\sin x + \cos x - \csc x + C$
- (C) $-\sin x - \cos x - 2 \csc x \cot x + C$
- (D) $-\sin x + \cos x + \cot x + C$
- (E) $\sin x + \cos x - \cot x + C$
- (F) $\sin x - \cos x + \cot x + C$

Problem 3

The graph of the **derivative**, $f'(x)$, of a function $f(x)$ is shown below.



Choose the correct statement(s) about $f(x)$.

I. $f(x)$ is decreasing on $(-\infty, 3)$.

II. $f(x)$ has a relative maximum at $x = -3$.

III. $f(x)$ is concave up on $(-1, \infty)$.

IV. $f(x)$ has two inflection points.

3. ☒ A I and II only
- ☐ B I and III only
- ☐ C I and IV only
- ☐ D II and IV only
- ☐ E III and IV only
- ☐ F II and III only

Problem 4

Choose the number of true statements regarding the function $f(x) = \frac{x^2 - 4}{x - 3}$.

- I. The y -intercept is $(0, \frac{4}{3})$.
- II. The x -intercepts are $(-2, 0)$ and $(2, 0)$.
- III. $f(x)$ has one vertical asymptote.
- IV. $f(x)$ does not have any horizontal asymptote.
- V. $f(x)$ has one slant asymptote.

4. ☐ A Only three statements are true.
- ☐ B No statement is true.
- ☐ C Only one statement is true.
- ☐ D Only four statements are true.
- ☐ E All five statements are true.
- ☐ F Only two statements are true.

Problem 5

For rectangles that have a fixed perimeter of 36, what is the largest possible area?

5. ☐ A 96
- ☐ B 81
- ☐ C 63
- ☐ D 72
- ☐ E 48
- ☐ F 54

Problem 6

Evaluate

$$\int \frac{\sqrt{x} + 4x^4 + 2}{x} dx$$

6. (A) $\sqrt{x} + 16x^4 + 2 \ln |x| + C$
- (B) $2\sqrt{x} + 16x^4 + 2 \ln |x| + C$
- (C) $\sqrt{x} + 16x^4 - \frac{2}{x^2} + C$
- (D) $2\sqrt{x} + x^4 + 2 \ln |x| + C$
- (E) $\sqrt{x} + x^4 - \frac{2}{x^2} + C$
- (F) $2\sqrt{x} + x^4 - \frac{2}{x^2} + C$

Problem 7Use the left Riemann sum to approximate the area under $f(x) = 2x^2 + 1$ from $x = 0$ to $x = 6$ with 3 rectangles.

7. (A) 230
- (B) 128
- (C) 86
- (D) 115
- (E) 64
- (F) 43

Problem 8

Given $y'' = 4e^x - 3$, $y'(0) = 6$ and $y(0) = 5$, find $y(2)$.

8. (A) $4e^2 - 1$
- (B) $4e^2 + 6$
- (C) $4e^2 - 6$
- (D) $4e^2 - 11$
- (E) $4e^2 + 1$
- (F) $4e^2 + 11$

Problem 9

Find the right Riemann sum that approximates the area under the curve of $y = \ln(2x + 2)$ on the interval $[0, 4]$ with 8 rectangles. Give the answer in sigma notation.

9. (A) $\sum_{i=1}^8 \ln\left(\frac{i}{2} + 1\right)$
- (B) $\sum_{i=1}^8 \ln(i + 2)$
- (C) $\sum_{i=0}^7 \ln\left(\frac{i}{2} + 1\right)$
- (D) $\sum_{i=1}^8 \frac{1}{2} \ln(i + 2)$
- (E) $\sum_{i=0}^7 \frac{1}{2} \ln(i + 2)$
- (F) $\sum_{i=0}^7 \ln(i + 2)$

Problem 10

A (closed) rectangular box with a square base will be built for \$48. The material for the top and bottom of the box costs \$2 per square foot, and the material for the sides of the box costs \$1 per square foot. What is the volume of the largest box that can be made?

10. (A) 16 cubic feet
- (B) 4 cubic feet
- (C) 24 cubic feet
- (D) 8 cubic feet
- (E) 2 cubic feet
- (F) 32 cubic feet

Problem 11

The rate of growth of a population of bacteria, $\frac{dP}{dt}$, is given by

$$\frac{dP}{dt} = 8t,$$

where P is the population size and t is the time in days. The initial size of the population is 1000. What is the population after 10 days?

11. (A) 1400
- (B) 800
- (C) 410
- (D) 1080
- (E) 2600
- (F) 4000

Problem 12

A dish-ware company is designing cylindrical containers with a bottom but **no top**. The company wants to make the containers to have a capacity of 30 in^3 . To minimize the amount of material needed to make such containers, what should the radius of the base of the containers be? Round to three decimal places.

The surface area of a cylinder with **no top** is $A = 2\pi rh + \pi r^2$ and the volume of a cylinder is $V = \pi r^2 h$.

12. (A) $r \approx 1.712 \text{ in}$

(B) $r \approx 2.122 \text{ in}$

(C) $r \approx 5.112 \text{ in}$

(D) $r \approx 6.021 \text{ in}$

(E) $r \approx 4.135 \text{ in}$

(F) $r \approx 3.187 \text{ in}$