

Math 107 Section 1 and 2  
Spring 2023  
Exam II Written Portion  
April 12, 2023  
Time Limit: 50 Minutes

Name (Print): \_\_\_\_\_

Student ID: \_\_\_\_\_

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This exam contains 7 pages (including this cover page) and 6 problems. Check to see if any pages are missing. Enter all requested information on the top of this page, and put your initials on the top of every page, in case the pages become separated.

You may *not* use your books or notes on this exam. However, you may use a *basic* calculator.

You are required to show your work on each problem on this exam. The following rules apply:

- **Organize your work**, in a reasonably neat and coherent way, in the space provided. Work scattered all over the page without a clear ordering will receive very little credit.
- **Mysterious or unsupported answers will not receive full credit.** A correct answer, unsupported by calculations, explanation, or algebraic work will receive no credit; an incorrect answer supported by substantially correct calculations and explanations might still receive partial credit. This especially applies to limit calculations.
- If you need more space, use the back of the pages; clearly indicate when you have done this.

Do not write in the table to the right.

Problem	Points	Score
1	10	
2	10	
3	10	
4	10	
5	10	
6	10	
Total:	60	

1. (10 points)

Consider the following lines of MATLAB code. Determine the final values of the variables  $k$  and  $x$ . Carefully show your work by filling in the missing values in the table below. Note that not all rows will necessarily be used!

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```
N = 4;  
k = 1;  
x = 0;  
  
for k = -N:N  
    if k > 1  
        x = x*k;  
    else  
        x = x - k;  
    end  
end
```

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loop iteration	$k$	$x$
1	-4	4
2	-3	
3		
5		

- Final  $k$  value:
- Final  $x$  value:

2. (10 points)

Solve the following problems by hand and carefully show your work.

(a) Let  $z = 2 - 3i$  and  $w = -5 + 2i$ . Rewrite the complex number  $\frac{w}{z}$  in  $a + ib$  form.

(b) Let  $z = 3 + 3i$ . Rewrite  $z$  in the form  $z = re^{i\theta}$  for some real numbers  $r > 0$  and  $0 \leq \theta < 2\pi$ .

(c) Calculate the value of  $(3 + 3i)^{20}$  in  $a + ib$  form.

3. (10 points)

- (a) Write down the value of a  $2 \times 2$  matrix  $A$  corresponding to the transformation of the  $x, y$  plane which reflects everything across the line  $y = x$ .

- (b) Describe the transformation which corresponds to the matrix

$$\begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$$

- (c) Consider the matrices

$$A = \begin{bmatrix} -2 & -2 & 4 \\ 1 & 1 & 0 \end{bmatrix} \quad B = \begin{bmatrix} 4 & -2 & 3 \\ 0 & 5 & 2 \\ 3 & 2 & -1 \end{bmatrix}$$

Compute  $AB$  and  $BA$ . If one of the products is undefined, explain why.

4. (10 points)

Consider the following situation

The cost of a ticket to the Aquarium is 7 dollars for a child 12 dollars for a senior and 20 dollars for an adult. On a particular day, the aquarium sells twice the number of children's tickets as the number of adult and senior tickets combined. The total number of tickets sold that day is 300 and the total revenue generated from the sale of tickets is 3200 dollars.

(a) Set up a linear system of equations for the following story problem

(b) Write down an augmented matrix describing the linear system of equations in (a)

(c) Solve the linear system in (a) by row reducing the augmented matrix in (b)

5. (10 points)

For each of the following statements, write TRUE if the statement is always true or FALSE if the statement can be false. There is no need to justify your answers.

(a) If a linear system of equations has more than one solution, then it must have infinitely many solutions.

(b) If  $A$ ,  $B$ , and  $C$  are nonzero  $2 \times 2$  matrices and  $AB = AC$  then  $B = C$ .

(c) The linear system of equations corresponding to the following augmented matrix for three equations and three variables is inconsistent:

$$\left[ \begin{array}{ccc|c} 2 & 3 & 7 & 1 \\ 4 & 2 & 3 & 9 \\ 0 & 0 & 0 & 2 \end{array} \right]$$

(d) If  $A$  and  $B$  are two  $2 \times 2$  matrices then  $AB = BA$

(e)  $3 + 2i$ ,  $8i$  and  $\sqrt{2}$  are all examples of complex numbers

6. (10 points)

Consider the following linear system of equations

$$\begin{cases} x + 2y + 3z &= -3 \\ 2x + 4z &= -6 \\ 4x + 4y + 10z &= -12 \end{cases}$$

(a) Rewrite this linear system as an augmented matrix

(b) Put the augmented matrix in row reduced echelon form

(c) Determine which variables are free and which variables are dependent. How many solutions does this system have?