Spring 2026 **Math F113X**

Exam 3

Name:_____ **Instructor:** _____

Rules:

- Partial credit will be awarded, but you must show your work.
- You may have a 3in $\times$ 5in notecard with writing on both sides.
- Calculators are allowed.
- Turn off anything that might go beep during the exam.

Good luck!

Problem	Possible	Score
1	20	
2	8	
3	18	
4	8	
5	8	
6	14	
7	12	
8	6	
9	6	
Extra Credit	(4)	
Total	100	

1. (20 pts)

   (a) (6 pts) **Decrypt** the message NSIZHJ using a **Caesar cipher** with shift 5 (mapping A to F).

   (b) (6 pts) **Encrypt** the message ROCKET using a **progressive Caesar cipher / sequential shift cipher** starting with a shift of 4 (mapping A to E).

   (c) (8 pts) **Decrypt** the message XAPHZNCJ using a **Vigenère cipher** using the keyword FACED.

2. (8 pts.) **Encrypt** the message I LIKE TO RIDE MY BIKE using a **tabular transposition cipher** with no keyword and rows of length 6. Use extra padding if needed.

3. (18 pts. total)

   (a) (8 pts.) Encrypt the plaintext MEET AT LIBRARY using a double transposition cipher and no extra padding. The first keyword is TRIM and the second keyword is TAR.

   Ciphertext: _____

   (b) (10 pts total) A message was encrypted using double transposition with the same keywords in the same order as in part (a): keyword 1 was TRIM, keyword 2 was TAR.

   The first step of **decryption** was completed to give MWEOOCN. Answer the following about the **SECOND STAGE** of the decryption of this message.

   i. (2 pts.) What keyword should be used?

   ii. (2 pts.) How many rows (other than the one for the keyword) will be in your table? How many entries in the last row of that table will be left blank?

   Number of rows _____

   Number of blank entries in last row _____

   iii. (6 pts.) Finish the decryption to recover the plaintext.

   Plaintext: _____

4. (8 pts.) Give brief answers to the following.

   (a) (2 pts) If a short message (say, 6-8 letters) must be sent securely, is a transposition cipher a good idea? Explain why or why not.

   (b) (2 pts) A long encrypted message is found to have E and T as its most frequent letters. Assuming the plaintext was in English, does this give a clue as to which encryption method might have been used? Explain.

   (c) (2 pts) Why is TABLES a better choice of keyword for a transposition cipher than ACCESS?

   (d) (2 pts) Why is BARK a better keyword for a **Vigenère cipher** than NOON?

5. (2 pts each for 8 pts total) For each of the following encryption methods, list at least one advantage and at least one disadvantage of the encryption system.

   (a) Caesar cipher

   - Advantage:

   - Disadvantage:

   (b) Transposition with keyword

   - Advantage:

   - Disadvantage:

6. (14 pts) Imagine that at the start of a certain month, you make an opening deposit of $1500 into a savings and account and then you will leave the account alone. Every month after the opening deposit, the amount in the account will grow to be 102% of the previous month's balance.

   For each question below, **write out the calculation you are entering into the calculator in addition to the calculated value.**

   (a) (3pts) What is the amount in the account after 1 month?

   (b) (3 pts) What is the amount in the account after 2 years? (Round to the nearest penny.)

   (c) (4 pts) After 4 years, the balance is $2418.35. How much of the balance is **interest**?

   (d) (4 pts) After 5 years, the account has $2725.04. By what percentage has the account grown since the original $1500 deposit?

7. (4 pts each for 16 pts total) For each scenario, **write out the appropriate formula with numbers substituted in,** but do **not** simplify or compute a final value. No computation is necessary.

   (a) You invest \$4000 into an account that has an interest rate of 2.7% compounded quarterly. Determine the account balance after 10 years.

   (b) You plan to take out a 15-year mortgage at 5.4% annual interest compounded monthly, with a maximum monthly payment of \$800. Determine the largest loan amount you could take out.

   (c) An investment earns 8% interest compounded yearly provided you keep your money invested for 20 years. Determine how large the principal would need to be in order to have \$50,000 at the end of the 20 years.

   (d) TJ loaned a friend \$200. The friend agreed to pay an annual interest rate of 4%, **simple** interest. Six months later the friend repaid the loan. Determine how much the friend paid TJ.

8. (3 pts each for 6 pts total) You want to buy a $20,000 car. The company is offering an interest rate of 3% APR compounded monthly for 4 years. The monthly payment works out to $443. (You do not need to verify this – take it as given.)

   (a) How much total money will be paid to the loan company? Write out the calculation you are entering into the calculator in addition to the calculated value.

   (b) How much of the total money paid to the loan company is interest?

9. (6 pts) You are choosing between two savings accounts with the same annual interest rate, one of which earns **simple** interest and another earns **compound** interest. Which one will have a larger balance in 5 years? Justify your reasoning.

   (a) (2 pts) Which one is larger?

   (b) (4 pts) Justification:

Extra Credit (4 pts) You have intercepted the encrypted message below:

BCDFG NPQFZ LSCQJ PTJ

You know the plaintext was in English, and the encryption method was either some kind of substitution cipher or some kind of transposition cipher. Which must it be, and how can you tell from the ciphertext alone?

method:

how you know:

Formulas

$$A = P + I \qquad A = P(1 + rt) \qquad A = P\left(1 + \frac{r}{n}\right)^{(nt)} \qquad P = \frac{A}{\left(1 + \frac{r}{n}\right)^{(nt)}}$$

$$P = \frac{d\left(1 - \left(1 + \frac{r}{n}\right)^{(-nt)}\right)}{\left(\frac{r}{n}\right)} \qquad d = \frac{P\left(\frac{r}{n}\right)}{\left(1 - \left(1 + \frac{r}{n}\right)^{(-nt)}\right)}$$

		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
		A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**	**S**	**T**	**U**	**V**	**W**	**X**	**Y**	**Z**
0	**A**	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
1	**B**	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A
2	**C**	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B
3	**D**	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C
4	**E**	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D
5	**F**	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E
6	**G**	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F
7	**H**	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G
8	**I**	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H
9	**J**	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I
10	**K**	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J
11	**L**	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K
12	**M**	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L
13	**N**	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M
14	**O**	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N
15	**P**	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
16	**Q**	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
17	**R**	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
18	**S**	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
19	**T**	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
20	**U**	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
21	**V**	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
22	**W**	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
23	**X**	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
24	**Y**	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
25	**Z**	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y