

Math 120 Spring 2022
Final Exam
June 4, 2022

Name: _____

Student ID no. : _____

Signature: _____

Section: _____

1	10	
2	10	
3	10	
4	10	
5	10	
6	10	
7	10	
Total	70	

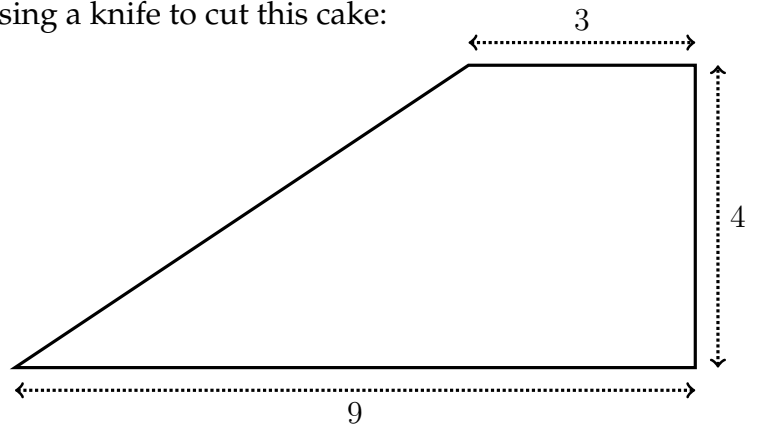
*This grid is purely decorative.
The exam is graded online.*

- This exam consists of **SEVEN** problems on **FIVE** double-sided pages. The backs of the first and last page are left blank for scratch work.
- Show all work for full credit.
- You may use a TI-30X IIS (or equivalent) calculator during this exam. Other calculators and electronic devices are not permitted.
- You do not need to simplify your answers.
- If you use a trial-and-error or guess-and-check method when an algebraic method is available, you will not receive full credit.
- Draw a box around your final answer to each problem.
- **Do not write within 1 centimeter of the edge!** Your exam will be scanned for grading.
- If you run out of room, write on one of the scratch work pages **and indicate that you have done so**. If you still need more room, raise your hand and ask for an extra page.
- You may use one hand-written double-sided 8.5" by 11" page of notes.
- You have 170 minutes to complete this exam.

You may use this page for scratch-work.

All work on this page will be ignored unless you write & circle “see first page” below a problem.

1. Mrs. White is in the dining room using a knife to cut this cake:



(a) [6 points] Suppose she makes a vertical cut x units from the left end of the cake. Write a multipart function for the area to the left of the cut.

(b) [4 points] Mrs. White wants to make two vertical cuts to divide the area of the cake into three pieces of equal area. How far in should she make those two cuts?

2. **[10 points]** Colonel Mustard is in the billiard room, and has tied two billiard balls together with an 80-inch rope.

At time $t = 0$, he knocks the first ball north at a constant speed of 4 inches per second.

Two seconds later, he knocks the second ball from the same starting position as the first ball. It travels west at a constant speed of 5 inches per second.

When does the rope become tight?

3. Professor Plum is investigating a leaky lead pipe in the conservatory. It seems to be causing the flowers to grow exponentially!

(a) [3 points] The number of forsythias doubles every 25 days.

Initially, there were 20 forsythias.

Write a function $f(t)$ for the number of forsythias after t days.

(b) [4 points] The number of geraniums is also growing exponentially.

After 16 days, there were 10 geraniums, and after 22 days, there were 13 geraniums.

Write a function $g(t)$ for the number of geraniums after t days.

(c) [3 points] When will the number of forsythias equal the number of geraniums?

Round your answer to the nearest day.

4. Mrs. Peacock is standing in the study, where a candlestick is positioned on the floor.

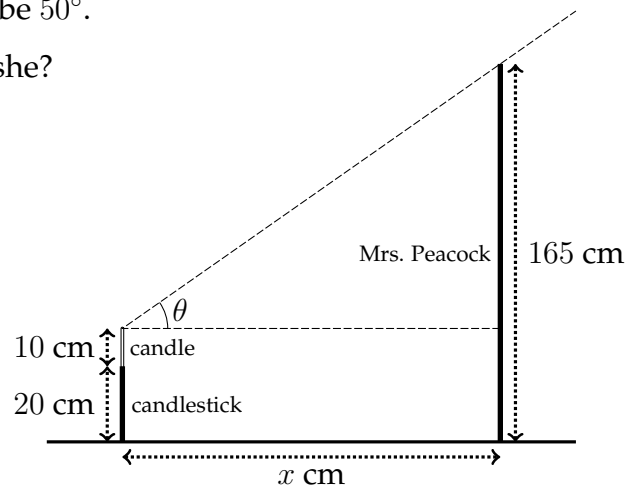
Mrs. Peacock is 165 centimeters tall. The candlestick is 20 centimeters tall, and it's holding a candle which is 10 centimeters tall.

Let θ be the angle of elevation of Mrs. Peacock's head relative to the top of the candle, as shown in the picture below.

(a) [5 points] Mrs. Peacock measures θ to be 50° .

How far away from the candlestick is she?

(In other words, what's x ?)



(b) [5 points] The candle burns at a constant speed. After 1 minute, the angle θ is 51° .

When will the candle burn all the way down?

5. Miss Scarlett is in the ballroom, dancing to a Beatles album.

Her dance proceeds clockwise in a circle of radius 20 feet at a constant speed. It takes her 17 seconds to make one complete lap, and she reaches the northernmost point 5 seconds after she starts.

(a) [3 points] Find Miss Scarlett's linear speed.

(b) [4 points] Impose a coordinate system with the center of the circle at the origin.

Write parametric equations for Miss Scarlett's coordinates after t seconds.

(c) [3 points] After 35 minutes, how far east is Miss Scarlett from her starting point?

6. [5 points per part] Mr. Green is in the kitchen, using a wrench to adjust the water pressure under the sink. The pressure is a sinusoidal function of time.

The pressure first reaches its maximum of 100 psi 13 minutes after the start.

It then decreases, reaching a minimum of 50 psi 35 minutes after the start.

(a) Find a function $f(x)$ for the water pressure (in psi) x minutes after the start.

(b) The maximum recommended water pressure in a home is 80 psi. In the first hour, for how much time (total) is the pressure above this level?

7. Mr. Boddy is in the library with a linear-to-linear rational function:

$$f(x) = \frac{3x + 2}{x + 4}$$

(a) [4 points] Find the following data about this function:

- Horizontal asymptote:

- Vertical asymptote:

- x -intercept:

- y -intercept:

(b) [3 points] Compute $f(f(6))$.

(c) [3 points] Write a formula for $f^{-1}(x)$.

You may use this page for scratch-work.

All work on this page will be ignored unless you write & circle “see back page” below a problem.