Math 120 Spring 2024
Final Exam
June 1, 2024

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 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.
- Clearly mark your answers by drawing a box or putting them in the provided blank.
- **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. **[5 points per part]** A bike is made up of two wheels with diameter 2 feet.

   The rear wheel is connected by an axle to a rear sprocket with diameter ¼ feet.

   The rear sprocket is connected by a chain to the front sprocket with diameter ½ feet.

   A biker pedals the front sprocket at a speed of 50 revolutions per minute.

   (a) Find the speed of the bike.

   Speed = _____ feet per minute

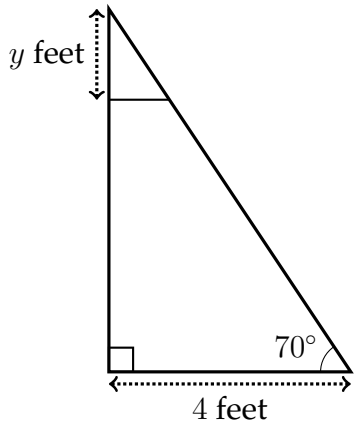
   (b) The biker is riding the bike counterclockwise around a circular track with radius 25 feet, starting at the northernmost point.

   Write parametric equations for the coordinates of the biker after t minutes.

   (Set the origin at the center of the circle, with north pointing upward.)

   Parametric equations: _____

2. **[10 points]** Steve's backyard contains a triangular hedge, as shown in the figure below. He uses hedge trimmers to trim the top y feet of the hedge. Write a function $A(y)$ for the area remaining after trimming.



$A(y) =$ _____

3. The amount of water in a well is a linear-to-linear rational function of time.

   In the year 2000, there was 7 feet of water in the well.

   In the year 2002, there was 6 feet of water in the well.

   In the year 2012, there was 5 feet of water in the well.

   (a) **[7 points]** Write a function $f(t)$ for the amount of water in the well t years after 2000.

$f(y) =$ _____

   (b) **[3 points]** In the long run, what will the water level approach?

Water level: _____ feet

4. Greg and Paul are walking around the coordinate plane.

   (a) **[3 points]** Greg starts at the point $(-2, 4)$, and walks towards the point $(4, 0)$ in a straight line at a constant speed, reaching it after 4 seconds.

   Write parametric equations for Greg's location after t seconds.

   Parametric equations: _____

   (b) **[3 points]** Paul starts at $(5, 7)$ and runs towards $(-1, -1)$ at a constant speed of 2.5 units per second. Write parametric equations for Paul's position after t seconds.

   Parametric equations: _____

   (c) **[4 points]** When are Greg and Paul closest together?

   After _____ seconds

5. For parts (a) and (b), put your answers in **standard exponential form**.

   (a) **[3 points]** A band's popularity grows exponentially over time.

   100 people will attend their concert today. The popularity grows by 7% every 5 days.

   Write a function $a(t)$ for the attendance t days from now.

$$a(t) = \_\_\_\_\_$$

   (b) **[3 points]** The cost per ticket is also growing exponentially.

   Right now, it's \$12 per ticket. The cost doubles every 30 days.

   Write a function $c(t)$ for the cost t days from now.

$$c(t) = \_\_\_\_\_$$

   (c) **[4 points]** When will the band make a total of \$10,000 per concert?

   Round your answer to the nearest day. Assume every person at the concert buys one ticket.

After _____ days

6. **[10 points]** The temperature in Lake Wavia is a sinusoidal function of time.

   2 hours from now, it will reach its minimum temperature of 70° F.

   The temperature will then rise until it reaches a maximum of 80° F, 9 hours from now.

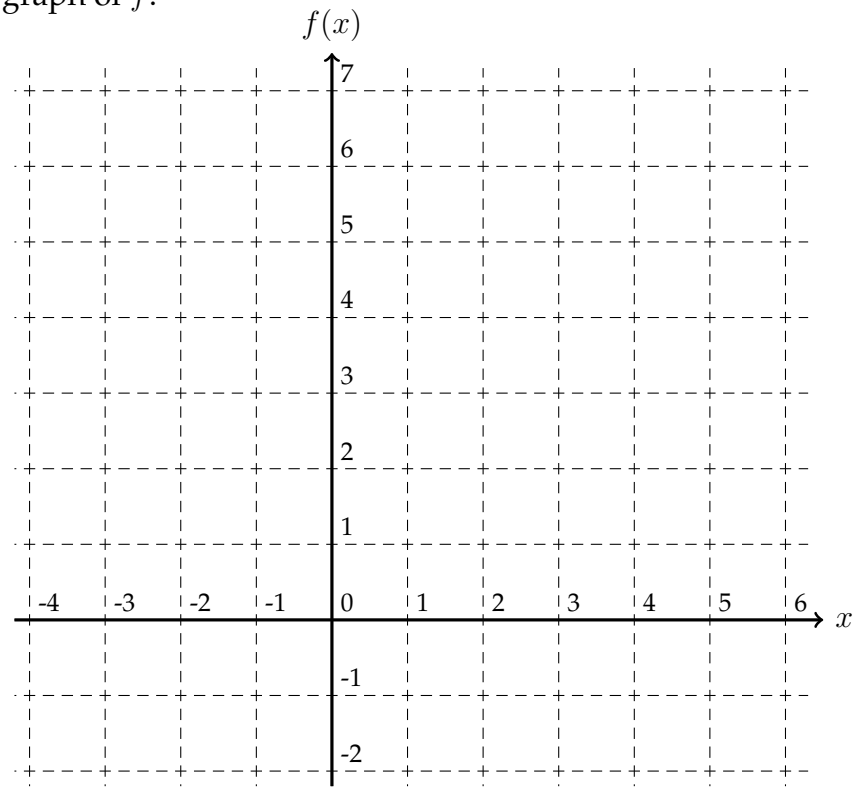
   Over the next 24 hours (starting now), for how long will the temperature be above 78° F?

Total: _____ hours

7. **[5 points per part]** For this problem, consider the following function:

$$f(x) = \begin{cases} 1 - x & \text{if } -4 < x \leq 1 \\ 2 + \sqrt{25 - (x-1)^2} & \text{if } 1 < x \leq 6 \end{cases}$$

(a) Sketch the graph of f:



(b) Find all values a such that $f(a) = a$.

$a =$ _____ (list all possibilities)

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.