Math 120 **Final Examination** **Autumn 1999**

Your Name

Your Signature

Student ID #

Quiz Section

Professor's Name

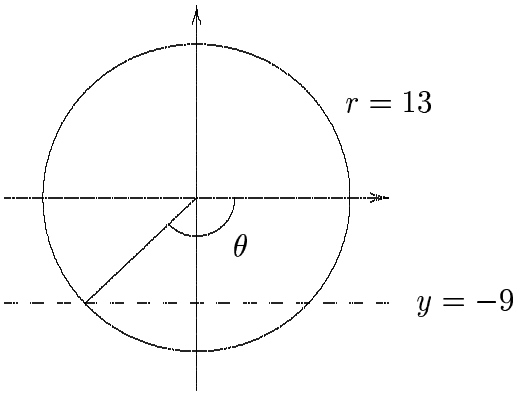
TA's Name

- This exam is closed book. You may use one $8\frac{1}{2} \times 11$ sheet of notes.
- You are not allowed to share notes or calculators.
- In order to receive credit, you must show your work. Be wary of doing computations in your head. Instead, write out your computations on the exam paper.
- **PLACE A BOX AROUND YOUR FINAL ANSWER to each question.**
- If you use a trial and error (or guess and check) method when a more accurate and efficient algebraic method is available, you might not receive full credit.
- If you need more room, use the backs of the pages and indicate to the reader that you have done so.
- Raise your hand if you have a question.

Problem	Total Points	Score
1	15	
2	14	
3	14	
4	14	
5	15	
6	14	
7	14	
Total	100	

1. Solve the following.

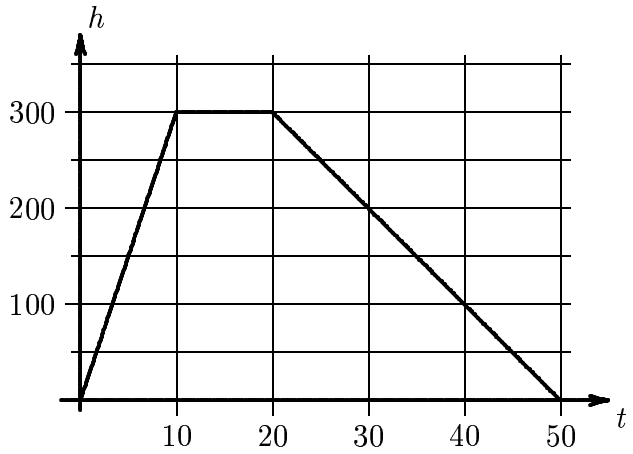
(a) [**5 points**] Find the angle θ.



(b) [**5 points**] Compute and simplify $f(g(x))$ where $f(x) = \dfrac{3-2x}{x-1}$ and $g(x) = \dfrac{x+3}{x+2}$.

(c) [**5 points**] Solve for x if $5^x = 7^{3x^2+\pi x}$.

2. You are hot air ballooning on a warm summer's day. The height h of your balloon above the ground in feet after t minutes is given by the graph to the right.



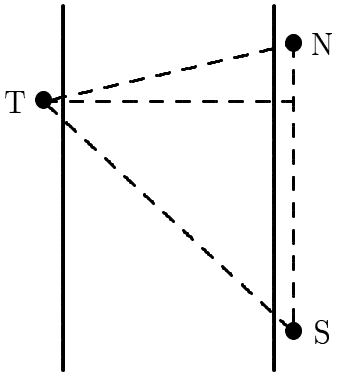
(a) [**2 points**] How long does your balloon gain altitude?

(b) [**2 points**] Your balloon maintains a constant alititude until it springs a leak. When does that happen?

(c) [**6 points**] Find a multipart formula for the height of the balloon on the domain $0 \leq t \leq 60$.

(d) [**4 points**] When is the balloon exactly 220 feet above the ground? (round to 2 decimals)

3. Tafu is standing next to a river and wants to know how wide it is. A jogging path runs along the other side the river. There is a marker every quarter mile on the jogging path and Tafu can see two of them. Using his surveyor's kit Tafu measures the angle with him at vertex, the North marker (N) on one ray, and the South marker (S) on the other ray (see picture). He measures 93°. He also measures angle that the line through him and the North marker makes with the line through him that goes directly across the river. This is 35°.



(a) [**2 points**] Mark the point directly across the river from Tafu and label it Q. Label the distance from N to Q with the variable y. How far is it from Q to S in feet? (Your answer should involve y).

(b) [**8 points**] How wide is the river, to the nearest foot?

(c) [**4 points**] How far from Tafu is the South marker?

4. One day during finals week, Allen eats SMARTIES sugar candies to help him study and take tests. When he wakes up at 7:00 AM, his blood-sugar level is at its lowest of 56 ppm (parts per million). After eating his first roll of SMARTIES, Allen's blood-sugar level rises to a maximum of 140 ppm at 7:32 AM. When his blood-sugar level drops back down to it's lowest level, Allen eats another roll of SMARTIES.

(a) [**5 points**] Determine a sinusoidal function, A(t), where A is Allen's blood sugar level and t is the number of minutes after 7:00 AM.

Due to a different metabolism rate, Bob's blood sugar level is represented by

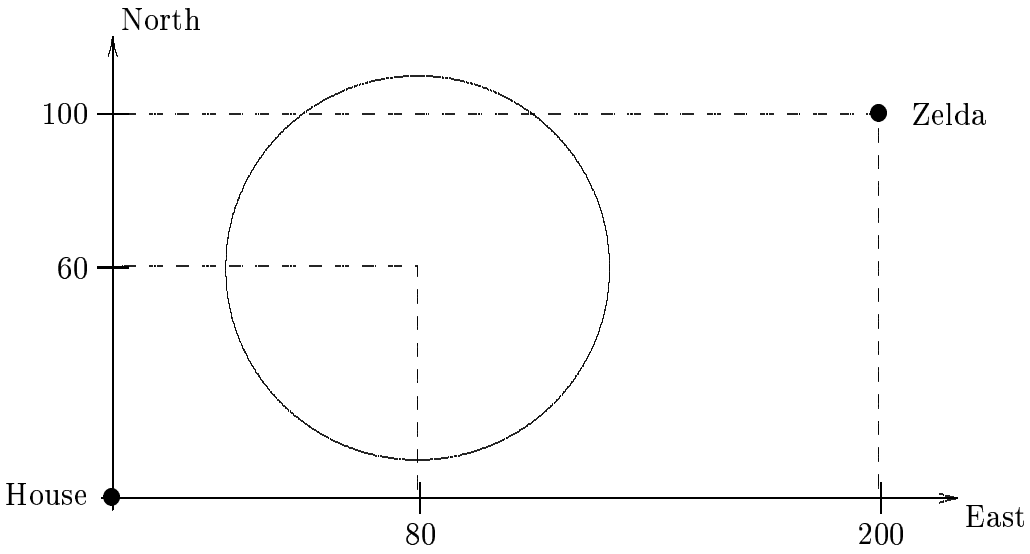
$$B(t) = 56\sin(\frac{\pi}{24}(t-12)) + 97.$$

For parts (b) and (c), use Bob's sugar level. (Note that t is still in minutes).

(b) [**3 points**] Bob has a final that begins at 10:15 AM. What will his blood sugar level (ppm) be at the beginning of the exam? (round to 1 decimal)

(c) [**6 points**] Between 7:00 AM and 11:00 PM that night, for how much time (in minutes) did Bob have a blood sugar level above 80 ppm. (round to 1 decimal)

5. The center of a circular field of radius 50 yards is located 80 yards east and 60 yards north of a farmhouse. Zelda is initially located 200 yards east of the house and 100 yards north and begins walking directly toward the house at 150 yards/min. Impose coordinates with the farmhouse at the origin (see the figure below).



The units on both axes are in yards.

(a) [**3 points**] How long does it take Zelda to reach the house?

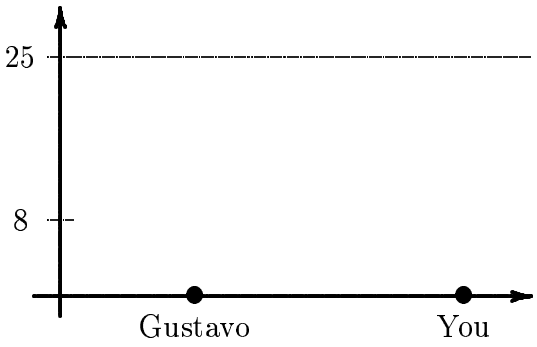
(b) [**4 points**] Find parametric equations which give Zelda's position at all times t during her trip. Specify the domain for each coordinate function.

(Continued on next page)

(c) [**4 points**] Give the x and y coordinates of the point where Zelda first reaches the field.

(d) [**4 points**] How long does Zelda remain inside the field during her trip?

6. You and your friends are playing indoor soccer inside a gymnasium. Let your oppenent's goal be the orgin in a coordinate system. Let the x-axis be the line connecting the goal to your position. The y-coordinate represents height. Your opponent Gustavo on the other team kicks the ball to you. The ball follows the parabola $y = -\frac{1}{20}x^2 + 2x - 15$.



(a) [**5 points**] How far apart are you and Gustavo?

(b) [**4 points**] As soon as Gustavo's kick hits the ground you kick the ball towards the goal. Your kick follows the parabola $y = -\frac{1}{20}x^2 + x + 15$. The ceiling of the gymnasium is 25 feet high. How close to the ceiling does the ball get?

(c) [**5 points**] The goal is 8 feet high. Does your kick go in the goal?

7. A population is made up of two kinds of cells: type A cells and type B cells. The number of type A cells in the population after t days is given by

$$y_A = 1200e^t.$$

The number of type B cells in the population after t days is given by

$$y_B = 900e^{-t}.$$

This problem is about the TOTAL population consisting of both types of cells.

(a) [**3 points**] Write a formula giving the TOTAL population as a function of time t in days.

(b) [**3 points**] How many cells are present after 3 days?

(c) [**8 points**] How many hours does it take until the total population reaches 3000 cells?