

Math 120 A - Spring 2015
Final Exam
June 6, 2015

Name: _____

Student ID no. : _____

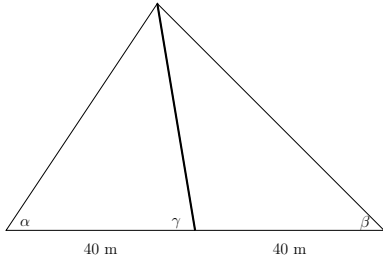
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Section: _____

1	13	
2	14	
3	16	
4	16	
5	14	
6	13	
7	14	
Total	100	

- This exam consists of SEVEN problems on EIGHT pages, including this cover sheet.
- Show all work for full credit.
- You may use a scientific calculator during this exam. Graphing calculators are not permitted. Also, other electronic devices are not allowed, and should be turned off and put away for the duration of the exam.
- Unless you are asked for an exact answer, round off your final answers to two decimal digits.
- If you use a trial-and-error or guess-and-check method when a more rigorous method is available, you will not receive full credit.
- If you write on the back of the page, please indicate that you have done so!
- You may use one hand-written double-sided 8.5" by 11" page of notes.
- You have 170 minutes to complete the exam.

1. [13 points] Tom is standing 40 m to the left of the bottom of a leaning tower. He measures the angle α (see figure) to be equal to 16° , then he moves right and when he stands 40 m to the right of the bottom of the tower he measures the angle β (see figure) to be 9° . Find the length of the tower and the angle γ of inclination (see figure). (Hint: draw the height of the tower)



2. [14 points] Mary checked the concentration of glucose in her blood several times during the day today and found out that it peaked at 125 mg/dl at 2pm and it was at its lowest level of 65 mg/dl at 8 am. Mary feels sluggish when her blood glucose is below 85 mg/dl. Assume that the concentration of glucose in Mary's blood is modeled by a sinusoidal function. For how long did Mary feel sluggish today, in the time interval between 6 am and 11 pm ?

3. **[16 points]** Tom is riding a ferris wheel. The radius of the wheel is 48 m and the center of the wheel is 50 m from the ground. The ride lasts 10 minutes and consists of 3 complete revolutions. The wheel rotates counterclockwise. It takes Tom 2 minutes to reach the top of the wheel from the position where he boards the wheel.
- (a) Find Tom's angular velocity.

 - (b) Find Tom's coordinates at time t , with respect to a coordinate system having the origin on the ground, directly below the center of the wheel.

 - (c) Find the coordinates of P, Tom's position at time $t=3$ min.

 - (d) 3 minutes into his ride Tom drops his camera. The camera's path to the ground is the line tangent to the wheel at P (Tom's position at time $t=3$ min). Where does the camera hit the ground? (Your answer should be of the form x meters left/right of the center of the wheel).

4. [16 points] Given the function $f(x) = \frac{2x-3}{x+5}$

(a) Find vertical and horizontal asymptotes:

Vertical asymptote is :

Horizontal asymptote is:

(b) Sketch a graph of $f(x)$. Your graph should clearly show the asymptotes, and the x and y intercepts.

(c) Find a formula for the inverse of f , and give the domain and range of the inverse.

Domain of f^{-1} is

Range of f^{-1} is

5. [14 points] The population of city A was 800,000 in 2000 and 500,000 in 2014. Assume it decreased exponentially from 2000 to 2014. Due to economic boom after 2014 the population is expected to increase exponentially: it is expected to double every 180 years.

(a) Write a formula for the multipart function $P(t)$ that gives the population of city A t years after 2000.

(b) What is city A expected population in 2050 ?

(c) When, in the 21st century (that is $0 \leq t \leq 100$) is the population of city A equal to 600,000 ?

6. [13 points]

- (a) Write the equation of the line perpendicular to $2x + 3y - 1 = 0$ and through $P(2, 3)$.
- (b) Write the equation of the lower semicircle centered at $C(1, 2)$ with radius 3.
- (c) Given $f(x) = x^2 - x + 1$ simplify $\frac{f(x+h)-f(x)}{h}$ to an expression such that plugging in $h = 0$ would be allowed.
- (d) Given $f(x) = \sqrt{x^2 - x + 1}$ write an expression for the curve obtained by shifting the graph of $f(x)$ upwards 2 units and then moving it to the left three units.

7. **[14 points]** At time $t = 0$ a boat leaves the harbor towards an island that is situated 30 mi East and 40 mi North of the harbor. The boat travels in a straight line at a speed of 60 mph. Half an hour later, that is at time $t = 0.5$ a second boat leaves the island and travels straight South at a speed of 60 mph. When will be the two boats closest together and how close will they get ?