

Your Name

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Your Signature

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Student ID #

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Quiz Section

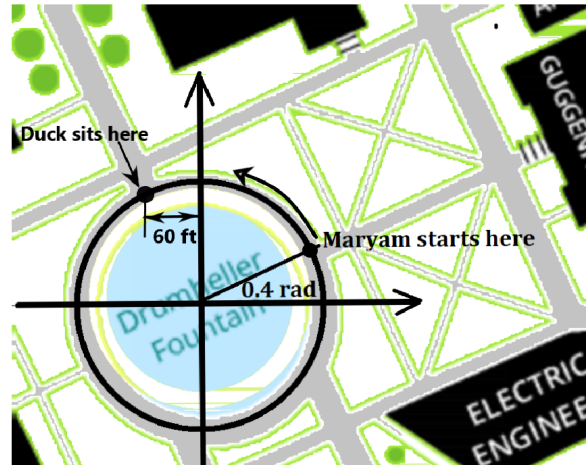
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## INSTRUCTIONS:

- Turn off and stow away all cell phones and any other electronic devices.
- This exam is closed book. You may use one  $8.5'' \times 11''$  sheet of handwritten notes (both sides OK). Do not share notes.
- You can use only a Texas Instruments TI-30X IIS calculator. No other models are allowed.
- Unless otherwise specified, in order to receive credit, you must **show your work**. If you do not indicate the way in which you solved a problem, or if the work shown is incorrect or incomplete, you may get partial or no credit for it, even if your answer is correct.
- Place a box around your answer to each question. Unless otherwise instructed, you may round your final answers to 2 decimal digits.
- If you need more room, you can use the backs of the pages but clearly indicate that you have done so. Otherwise the grader may miss the work you wrote elsewhere.
- This exam has 7 pages, in addition to this cover sheet. Make sure you have a complete exam.
- Read each question carefully and think about it for a moment before you answer it. Good luck!

Question	Points	Score
1	14	
2	16	
3	14	
4	16	
5	14	
6	16	
7	10	
<b>Total</b>	<b>100</b>	

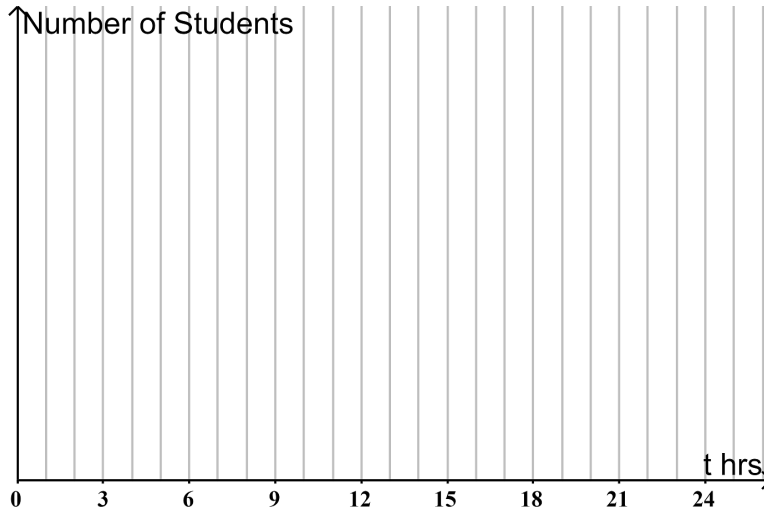
1. Maryam gets out of the Math 120 final in Guggenheim and, to celebrate, she starts running counterclockwise on the path around the Drumheller fountain, which has a circumference of 660 feet. It takes her 55 seconds to run a full victory lap (one time around the fountain), at constant speed.
- (a) (8 points) Impose a coordinate system with origin at the center of the fountain. Maryam's starting position is as indicated. Compute her  $(x,y)$ -coordinates after 38 seconds of running.



- (b) (6 points) When does Maryam first pass the sitting duck, at the position indicated in the picture?

2. (16 points) You are computing a sinusoidal model  $S(t)$  for the number of Math 120 students who are studying at  $t$  hrs past midnight on March 15. Your data indicates that the highest number of students studying on that day was 80, first occurring at 9am. The lowest number of students studying was 2, first occurring at 3am.

(a) Write down the function  $S(t)$ , in standard sinusoidal form, that models the number of students studying on March 15, at  $t$  hours past midnight. Also, sketch its graph.



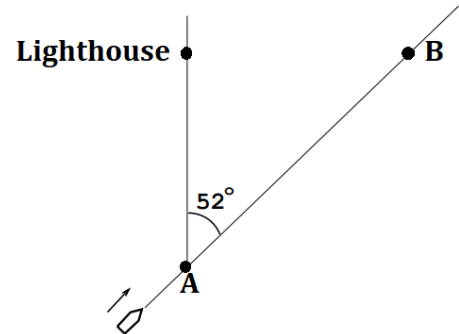
$$S(t) =$$

(b) Find all times on March 15 when exactly 50 students were studying, according to this model.

3. Joe is a farmer and he knows that the number of pumpkins he'll sell is a linear function of the price per pumpkin. From previous years he knows that when he charges \$2 per pumpkin, he sells 2500 pumpkins. If he charges \$3 per pumpkin, he will sell 2000 pumpkins. Joe is trying to determine the price he should charge per pumpkin, to maximize his revenue (the total amount of money he gets for his pumpkins).
- (a) (6 points) Find the **linear** function  $y = n(x)$  that computes the number of pumpkins sold, as a function of the price per pumpkin,  $x$ .
- (b) (8 points) What is the maximum possible revenue Joe can get from the sale of the pumpkins? What price should he charge per pumpkin, and how many pumpkins will Joe sell to get that maximal revenue?

4. A ship sails in a straight line at constant speed in a northeasterly direction, as shown. At midnight the ship is at Point A, which is 20 miles due south of a lighthouse. At 3 AM, the ship gets to Point B, which is due east of the same lighthouse. The angle between the ship's path and the due north direction is  $52^\circ$ , as shown. (Switch your calculator to degrees. Round all values to 2 decimal digits.)

(a) (5 points) What is the ship's speed?

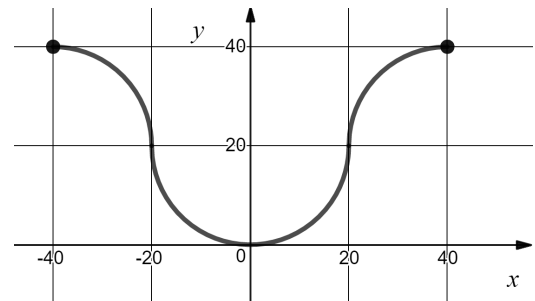


(b) (5 points) What is the closest distance between the ship and the lighthouse?

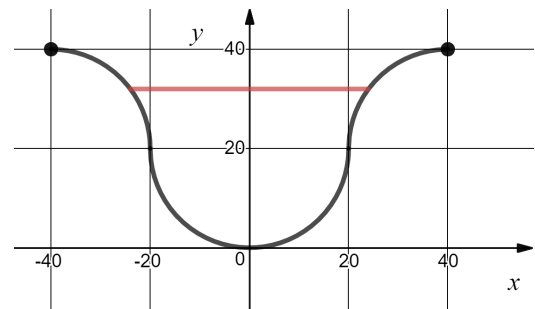
(c) (6 points) Write the distance between the ship and the lighthouse as a function of  $t$ , where  $t$  is the number of hours past midnight.

5. The vertical cross-section through a certain canal looks like in the picture below. It consists of two quarter circles and a half circle. All dimensions are in feet.

(a) (6 points) Write down the multi-part function  $y = f(x)$  corresponding to this canal, in the shown coordinate system. Make sure to include domains for each part.



(b) (8 points) Compute the horizontal width across this canal at a height of 32 feet above the  $x$ -axis.



6. On this entire page, let:  $f(x) = x^2 - 4x$ , and  $g(x) = 3^x$ .

(a) (4 points) Find the range of  $f$ .

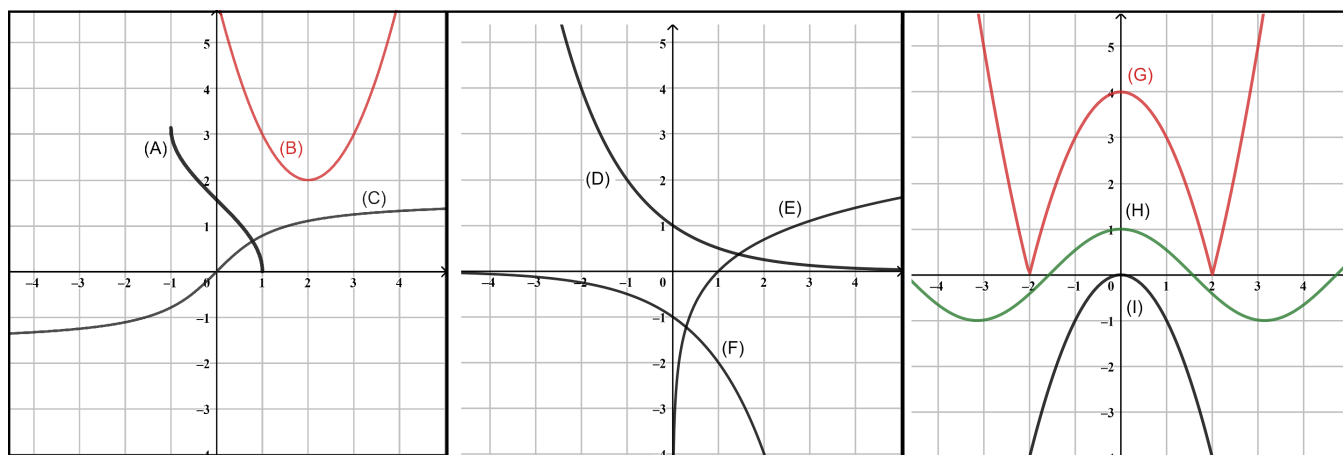
(b) (6 points) Compute and simplify the following function compositions, as expressions in  $x$ .

- $f(x + 3) =$

- $f(g(2x)) =$

(c) (6 points) Solve for  $x$  the equation  $g(f(x)) = 5$ . Show all steps.

7. (10 points) Consider the following graphs labeled (A)-(I):



For each of the functions listed below, circle ONE letter (A)-(I) for its corresponding graph above. If none of the graphs above match the function, then circle "None". Some graphs may match none of the functions. No need to justify or show any work.

- (a)  $y = 3x + 7$  has graph: (A), (B), (C), (D), (E), (F), (G), (H), (I), or None of above
- (b)  $y = (x - 2)^2 + 2$  has graph: (A), (B), (C), (D), (E), (F), (G), (H), (I), or None of above
- (c)  $y = \sqrt{x}$  has graph: (A), (B), (C), (D), (E), (F), (G), (H), (I), or None of above
- (d)  $y = |x^2 - 4|$  has graph: (A), (B), (C), (D), (E), (F), (G), (H), (I), or None of above
- (e)  $y = 2^{-x}$  has graph: (A), (B), (C), (D), (E), (F), (G), (H), (I), or None of above
- (f)  $y = -2^x$  has graph: (A), (B), (C), (D), (E), (F), (G), (H), (I), or None of above
- (g)  $y = \ln(x)$  has graph: (A), (B), (C), (D), (E), (F), (G), (H), (I), or None of above
- (h)  $y = \cos(x)$  has graph: (A), (B), (C), (D), (E), (F), (G), (H), (I), or None of above
- (i)  $y = \cos^{-1}(x) = \arccos(x)$  has graph: (A), (B), (C), (D), (E), (F), (G), (H), (I), or None of above
- (j)  $y = \tan^{-1}(x) = \arctan(x)$  has graph: (A), (B), (C), (D), (E), (F), (G), (H), (I), or None of above