

Math 120 - Autumn 2004
Final Exam
December 11, 2004

Name (print full name): _____

Section: _____

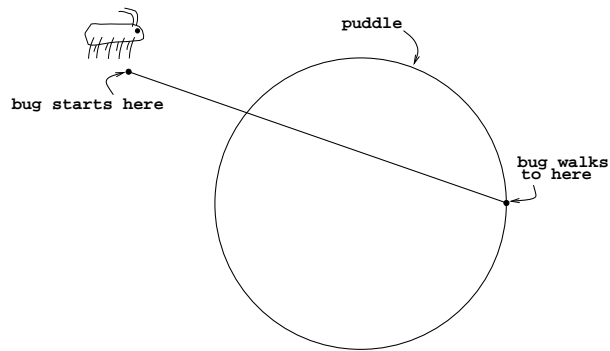
Student ID Number: _____

Signature: _____

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8	10	
Total	80	

- Complete all questions.
- You may use a calculator during this examination. Other electronic devices are not allowed, and should be turned off for the duration of the exam.
- If you use a trial-and-error or guess-and-check method, or read a numerical solution from a graph on your calculator when an algebraic method is available, you will not receive full credit.
- You may use one hand-written 8.5 by 11 inch page of notes.
- Show all work for full credit.
- You have 170 minutes to complete the exam.

1. A bug starts 30 cm west and 18 cm north of the center of a circular puddle. The puddle has a diameter of 40 cm. The bug travels in a straight line towards the easternmost point of the puddle, as in the figure below.



- (a) Find the location of the point where the bug first enters the puddle.

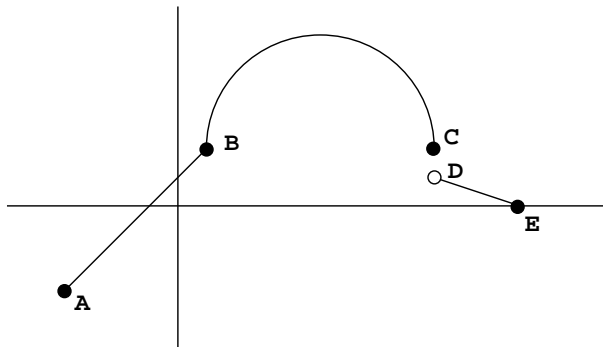
- (b) Assume the bug travels at a speed of 0.8 cm per second when moving through the puddle. How long is the bug in the puddle?

2. You have inherited an orange grove. The more orange trees there are in the grove, the fewer oranges each produces. When there are 30 trees, each tree produces 84 kg of oranges. If you have 90 trees, each tree produces 74 kg of oranges. Assume that the amount of oranges each tree produces is a linear function of the number of trees.

(a) Let x be the number of trees grown in the grove. In terms of x , what is the total number of kg of oranges produced in the grove?

(b) What is the maximum number of kg of oranges that can be produced in the grove?

3. The graph of a function $y = g(x)$ is given below. Between the points A and B , it is a line segment, between B and C it is a semicircle, and between D and E it is a line segment. The coordinates for the labeled points are $A = (-4, -3)$, $B = (1, 2)$, $C = (5, 2)$, $D = (5, 1)$ and $E = (8, 0)$.



(a) Find the multipart formula for $g(x)$.

(b) What is the range of $g(x)$?

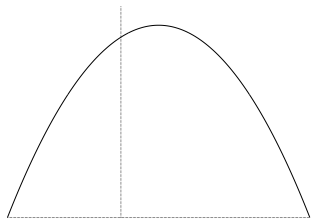
4. Let $f(t)$ be the following function:

$$f(t) = \begin{cases} 1 - t & \text{if } t \leq 1, \\ t^2 & \text{if } t > 1. \end{cases}$$

(a) Find the multipart rule for $g(t) = tf\left(\frac{1}{3}(t-2)\right)$.

(b) Using $f(t)$ from part (a), find the multipart rule for $h(t) = g(t) - f(t)$.

5. A soccer ball is on the ground and has coordinates $(-3, 0)$. The soccer ball is then kicked, and its height $h(x)$ above the ground is given by $h(x) = -\frac{5}{4}(x + 3)(x - 5)$. The ground is flat.



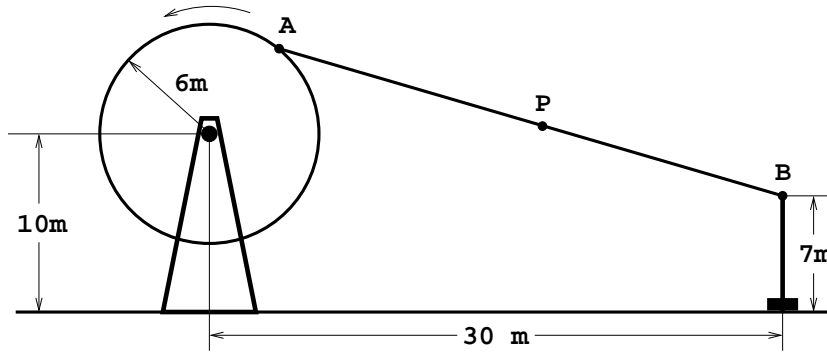
- (a) Find the domain where $h(x)$ is one to one and the ball goes from its highest point to where it lands.

- (b) Find the inverse of $h(x)$ on this domain.

6. You have just designed a carnival ride, The Stretcho, a diagram of which is shown below. It consists of a large vertical circular wheel, a tower and a bungee-like cord. The rider is attached to the cord at the point marked P in the figure. As the wheel turns, P is always precisely half way between points A and B.

The wheel turns at a rate of 75 rpm in a counter-clockwise direction.

Assume that at the start of the ride (i.e., $t=0$) the point A is at its highest point.



Write parametric equations describing the motion of point P.

7. Steve is monitoring the temperature of a hive of bees. He started monitoring it at midnight. The temperature increased until 12:15 AM, when it reached a maximum of 110° F. Steve then fell asleep and woke up at 6 AM, when the temperature was at its minimum of 85° for the third time since midnight.

Assuming the temperature of the hive is a sinusoidal function of time.

- (a) Give the function for the temperature of the hive t hours after midnight.

- (b) What percentage of the time is the hive's temperature above 90° ?

8. The population of Fargo increases by 8% every 12 years. The population of Grafo triples every 134 years. Both cities had the same population in the year 2000; their population was 100,000. In what year will Grafo have twice the population of Fargo?