## Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**CALCULUS BC**

**SECTION I, Part A**

**Time – 55 Minutes**

**Number of Questions – 28**

**A CALCULATOR MAY NOT BE USED ON THIS PART OF THE EXAMINATION**

**Directions: Solve each of the following problems, using the available space for scratch work. After examining the form of the choices, decide which is the best of the choices given and fill in the corresponding oval on the answer sheet. No credit will be given for anything written in the test book. Do not spend too much time on any one problem.**

**In this test:**

**(1) Unless otherwise specified, the domain of a function is assumed to be the set of all real numbers**

**for which is a real number.**

**(2) The inverse of a trigonometric function may be indicated using the inverse function notation**

**or with the prefix “arc” (e.g., ).**

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

1. If ,

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. A particle moves along the -axis with velocity given by for time . If the particle

is at position at time , what is the position of the particle at time ?

6. If and , then

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

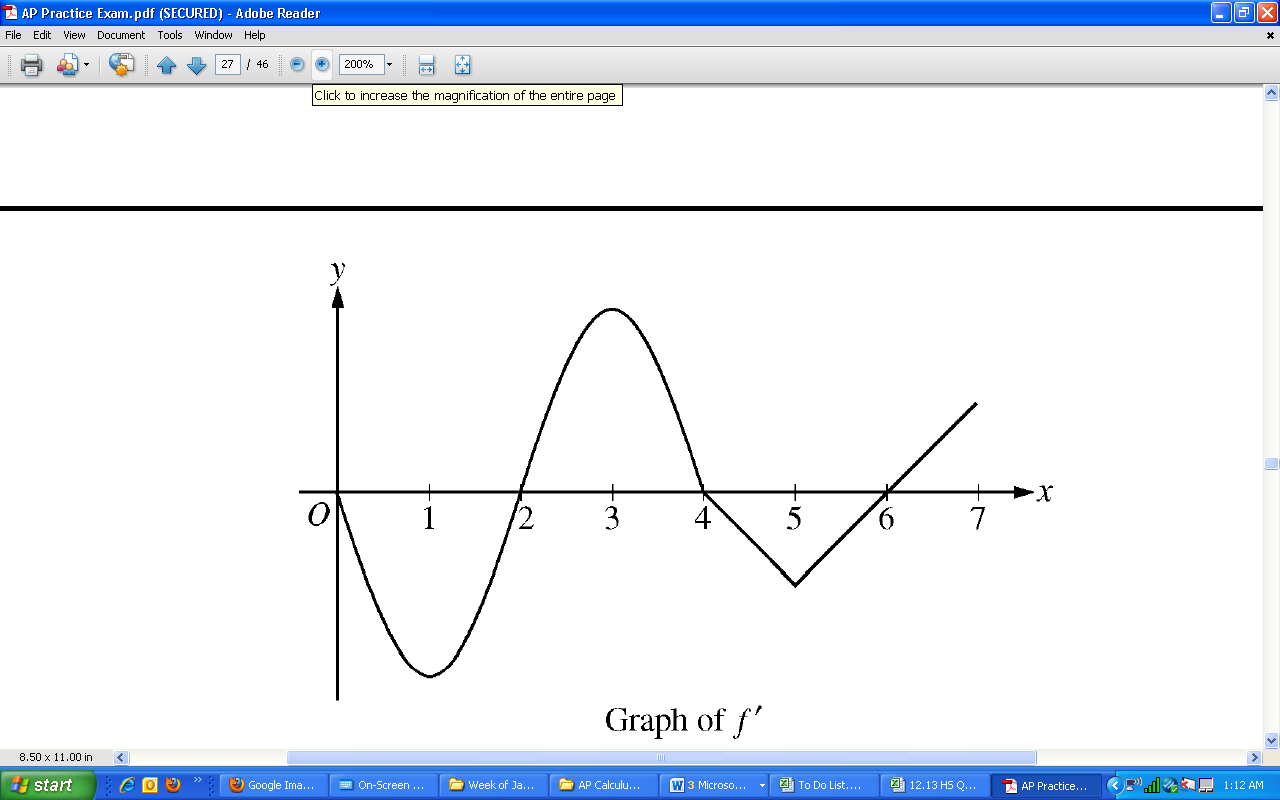
1. Which of the following expressions represents the length of the curve for from to ?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

5. If , then



\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_



6. The graph of , the derivative of the function , is shown above. On which of the following

intervals is both concave up and decreasing?

1. only
2. only
3. only
4. and
5. and

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

7. Let be the region enclosed by the curve and the lines and . Find the volume of the solid whose base is the region and whose cross sections perpendicular to the -axis are semi-circles.



If , what is the maximum value of the product ?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_



\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_



11. The region enclosed by the graph of , the line , and the line is rotated about the -axis. Which of the following integrals represents the volume of the resulting solid?

(A)

(B)

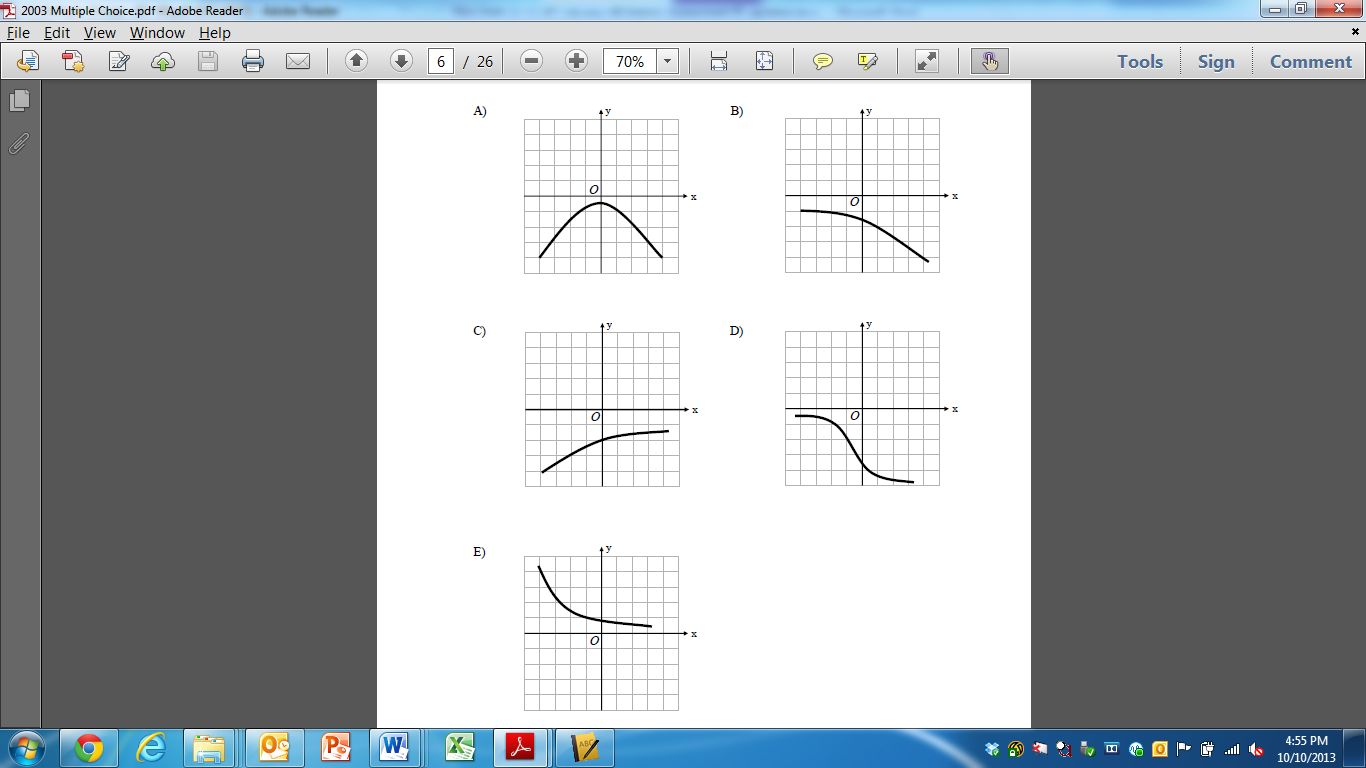
(C)

(B)

(E)

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

12. The function has the property that , , and are for all real values . Which of the following could be the graph of ?



\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

13. The region enclosed by the graph of and the lines and is

rotated about the -axis. Which of the following gives the volume of the generated solid?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

14.

5. The limit does not exist.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

15. The function has a relative minimum at



\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

16. The radius of a sphere is decreasing at a rate of centimeters per second. At the instant when the radius

of the sphere is centimeters, what is the rate of change, in square centimeters per second, of the surface

area of the sphere?

(A)

(B)

(C)

(D)

(E)

17. The function is continuous on the closed interval and twice differentiable on the open interval . If and for all on the open interval , which of the following could be a table of values for ?

(A) (B) (C) (D) (E)

|  |  |
| --- | --- |
|  |  |
| 6 | 10.5 |
| 7 | 15.5 |
| 8 | 17.5 |

|  |  |
| --- | --- |
|  |  |
| 6 | 12 |
| 7 | 10 |
| 8 | 8 |

|  |  |
| --- | --- |
|  |  |
| 6 | 15 |
| 7 | 9.5 |
| 8 | 6.5 |

|  |  |
| --- | --- |
|  |  |
| 6 | 4 |
| 7 | 7 |
| 8 | 14 |

|  |  |
| --- | --- |
|  |  |
| 6 | 7 |
| 7 | 4 |
| 8 | 0 |

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_



|  |  |  |
| --- | --- | --- |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

19. The table above gives selected values for a differentiable and increasing function and its derivative. If is the inverse function of , what is the value of ?



\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

20. For values of very close to , which of the following functions best approximates

?



\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_



\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

22. The area of the region enclosed between the curves and is exactly:

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

23. If the substitution is used, which of the following is equivalent to ?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_



\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

25. The function is defined by . What points on the graph of have the property that

the line tangent to at has slope ?

1. only
2. only
3. only
4. and
5. There are no such points.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

26. Let be the function given by . What is the value of that satisfies the conclusion of the Mean Value Theorem of differential calculus on the closed interval ?



\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

28. For , if , then is



\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**END OF PART A OF SECTION I**

IF YOU FINISH BEFORE TIME IS CALLED, YOU MAY CHECK YOUR WORK ON THIS PART ONLY.

DO NOT GO ON TO PART B UNTIL YOU ARE TOLD TO DO SO.

**SECTION I, Part B**

**Time – 50 Minutes**

**Number of Questions – 17**

**A CALCULATOR IS REQUIRED FOR SOME QUESTIONS**

**ON THIS PART OF THE EXAMINATION.**

**Directions: Solve each of the following problems, using the available space for scratch work. After examining the form of the choices, decide which is the best of the choices given and fill in the corresponding oval on the answer sheet. No credit will be given for anything written in the test book. Do not spend too much time on any one problem.**

**BE SURE YOU ARE USING PART B OF THE ANSWER SHEET   
TO RECORD YOUR ANSWERS TO QUESTIONS NUMBERED 29 – 45.**

**YOU MAY NOT RETURN TO PART A OF THE ANSWER SHEET.**

**In this test:**

1. **The exact numerical value of the correct answer does not always appear among the answer choices given. When this happens, select from among the choices the number that best approximates the exact numerical value.**

**(2) Unless otherwise specified, the domain of a function is assumed to be the set of all real**

**numbers for which is a real number.**

**(3) The inverse of a trigonometric function may be indicated using the inverse function notation or with the prefix “arc” (e.g., ).**

29. What is the average value of the function on the closed interval ?



\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

30. For time , the position of a particle traveling along a line is given by a differentiable function . If is increasing for and is decreasing for , which of the following is the total distance the particle travels for ?



\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ­ |  |  |  |  |
|  |  |  |  |  |

31. The polynomial function has selected values of its first derivative given in the table above. Which

of the following statements must be true?

1. is decreasing on the interval .
2. is increasing on the interval .
3. has a local maximum at .
4. has a local minimum on the interval .
5. has an inflection point on the interval .

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

32. Suppose the graph of a function is both increasing and concave up on the interval . Then, using

the same number of subdivisions, and with and denoting, respectively, the left, right, midpoint, and trapezoidal sums, it follows that:

5. It cannot be determined from the information given.

33. The function is continuous for and differentiable for . If and , which of the following statements could be false?

1. There exists , where , such that .
2. There exists , where , such that .
3. There exists , where , such that .
4. There exists , where , such that .
5. There exists , where , such that for all on the closed interval

.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_



\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

35. Let be the function given by for At which of the following values of does attain a relative maximum?

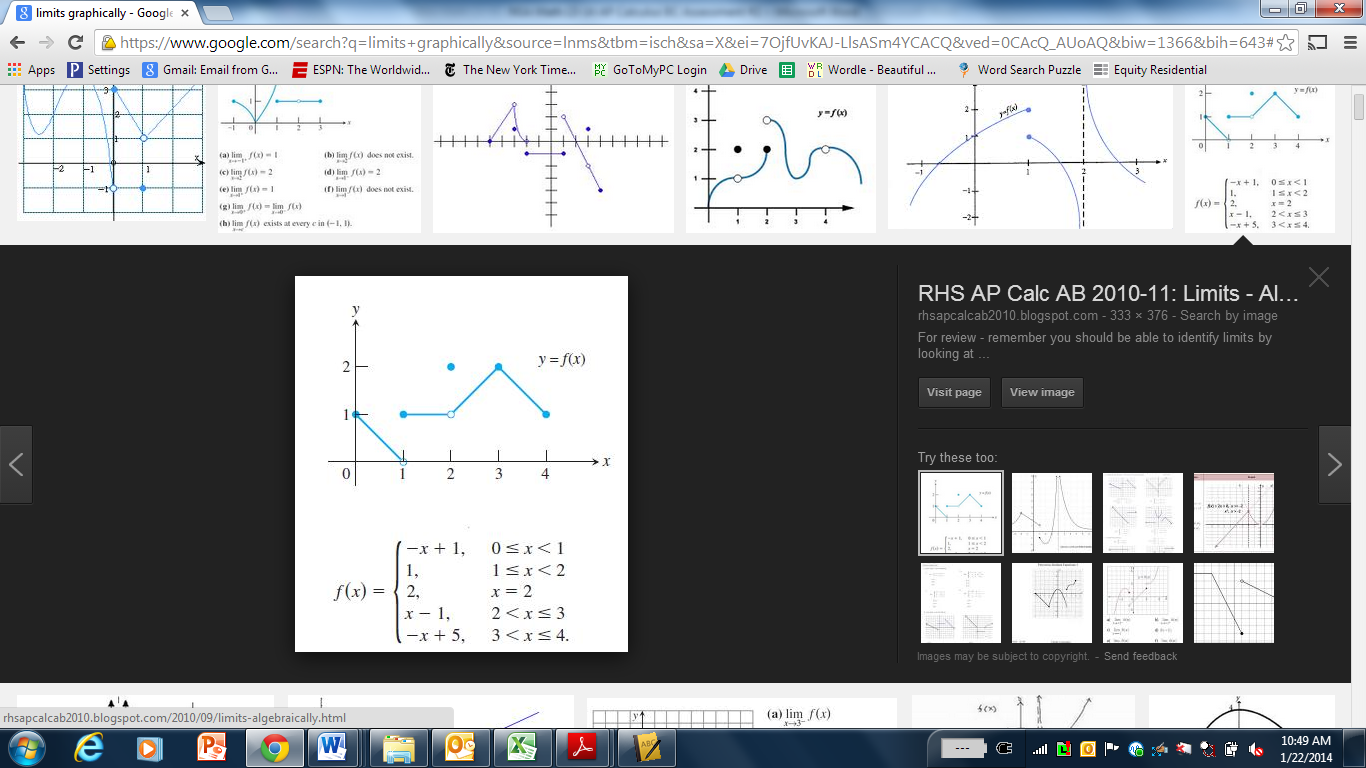
1. and
2. and
3. only

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

36. If and , then



\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_



37. The graph of a function is shown above. For which of the following values of does ?

1. only
2. only
3. and only
4. and
5. There are no values of on .

38. When the region bounded by the -axis, , and is rotated around the -axis it forms a solid with volume:



**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

39. The slope of the line tangent to the curve at the point is exactly:



\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

40. The substitution of in the integrand of results in:



**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

41. Which of the following statements is always true?

1. If is continuous at , then exists.
2. If , then has a local maximum or minimum at .
3. If , then the graph of has an inflection point at .
4. If is differentiable at , then is continuous at .
5. If is continuous on , then maintains a maximum value on .

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

42. A particle moves along the -axis so that at time its position is given by . What is

the velocity of the particle at the first instance the particle is at the origin?



\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

43. The second derivative of the function is given by . How many points of inflection does have on the interval ?



\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

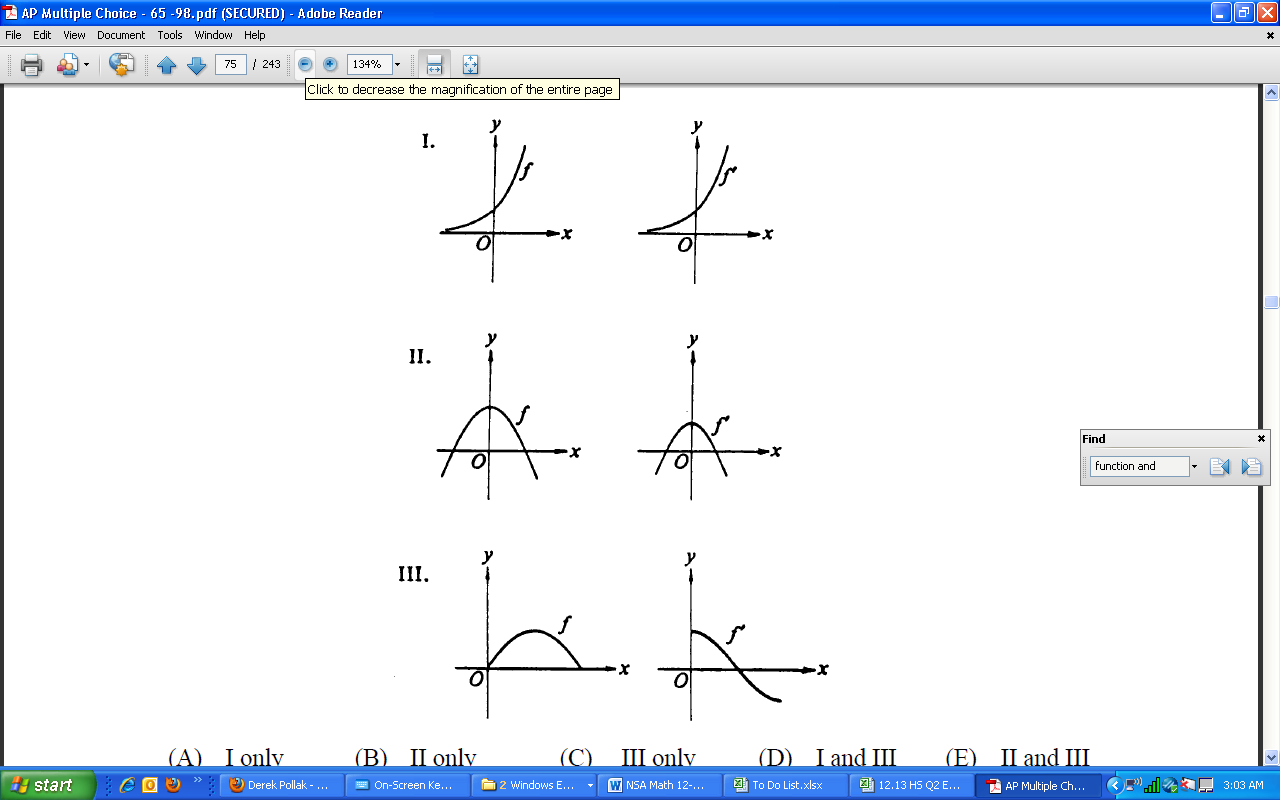
44. Let be the piecewise function defined above. At :

1. is continuous but not differentiable.
2. is differentiable but not continuous.
3. is neither continuous nor differentiable.
4. is both continuous and differentiable.
5. None of the above.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

45. Which of the following pairs of graphs could represent the graph of a function and the graph of its

derivative?



(A) I only

(B) II only

(C) III only

(D) I and III

(E) II and III

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**END OF SECTION I**

IF YOU FINISH BEFORE TIME IS CALLED, YOU MAY CHECK YOUR WORK ON PART B ONLY.

DO NOT GO ON TO SETION II UNTIL YOU ARE TOLD TO DO SO.

**SECTION II, Part A**

**Time – 30 Minutes**

**Number of Questions – 2**

**A GRAPHING CALCULATOR IS REQUIRED FOR SOME QUESTIONS ON THIS PART OF THE EXAMINATION.**

**REMEMBER TO SHOW YOUR SETUPS AS DESCRIBED IN THE GENERAL INSTRUCTIONS.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| (days) |  |  |  |  |
| (GL per day) |  |  |  |  |

1. The twice-differentiable function models the volume of water in a reservoir at time , where is measured in gigaliters (GL) and is measured in days. The table above gives values of sampled at various times during the interval days. At time , the reservoir contains 125 gigaliters of water.
2. Estimate . Indicate units of measure.
3. Use the tangent line approximation to at time to predict the volume of the water,

, in gigaliters, in the reservoir at time . Show the computations that lead to your answer.

1. Use a trapezoidal sum, with the three subintervals indicated by the data in the table, to

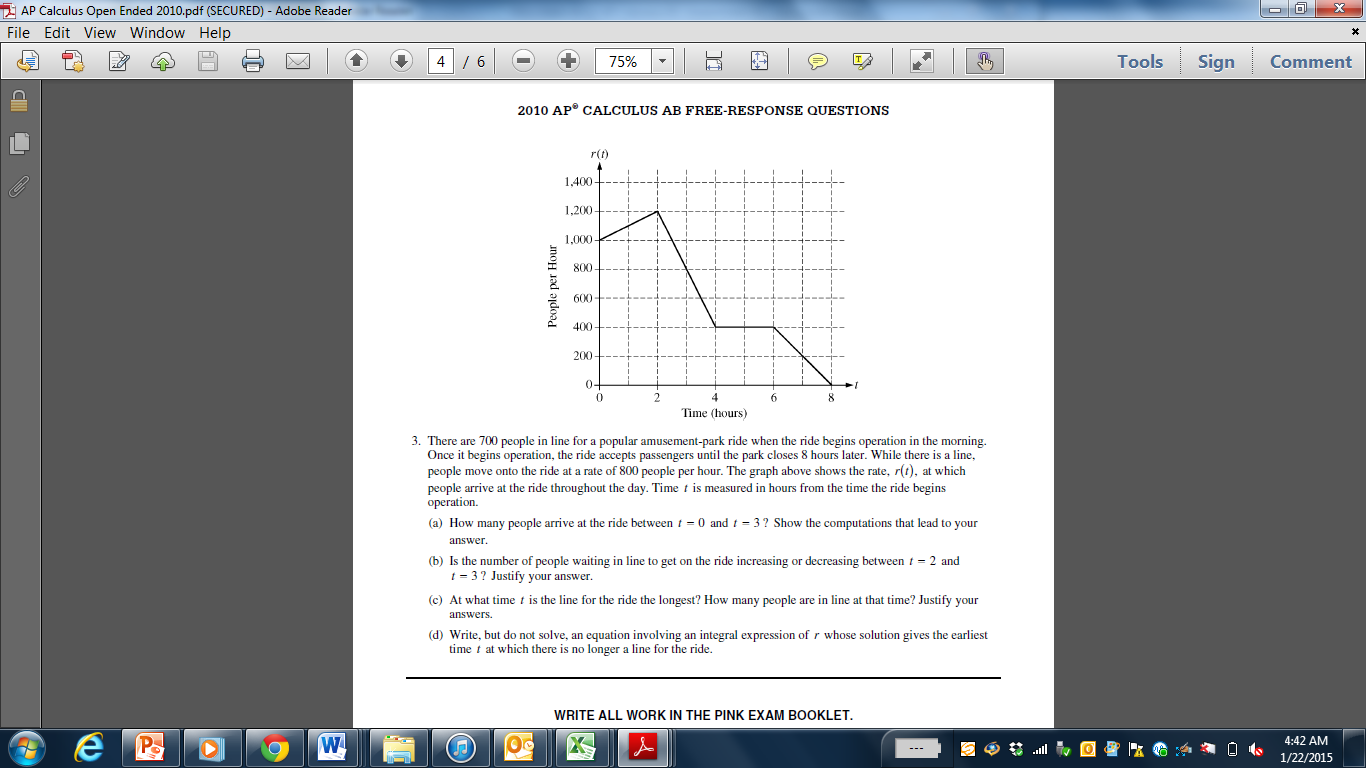
approximate . Use this approximation to estimate the volume of the water , in

gigaliters, in the reservoir at time . Show the computations that lead to your answer.

1. The equation gives the relationship between the area , in square kilometers, of

the surface of the reservoir, and the volume of water , in gigaliters, in the reservoir. Find

the instantaneous rate of change of , in square kilometers per day, with respect to when days.



1. There are people in line for a popular amusement-park ride when the ride begins operation in the morning. Once it begins operation, the ride accepts passengers until the park closes hours later. While there is a line, people onto the ride at a rate of people per hour. The graph above shows the rate, , at which people arrive at the ride throughout the day. Time is measured in hours from the time the ride begins operation.
2. How many people arrive at the ride between and ? Show the computations that lead

to your answer.

1. Is the number of people waiting in line to get on the ride increasing or decreasing between

and ? Justify your answer.

1. At what time is the line for the ride the longest? How many people are in line at that time?

Justify your answers.

1. Write, but do not solve, an equation involving an integral expression of whose solution gives

the earliest time at which there is no longer a line for the ride.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**END OF PART A OF SECTION II**

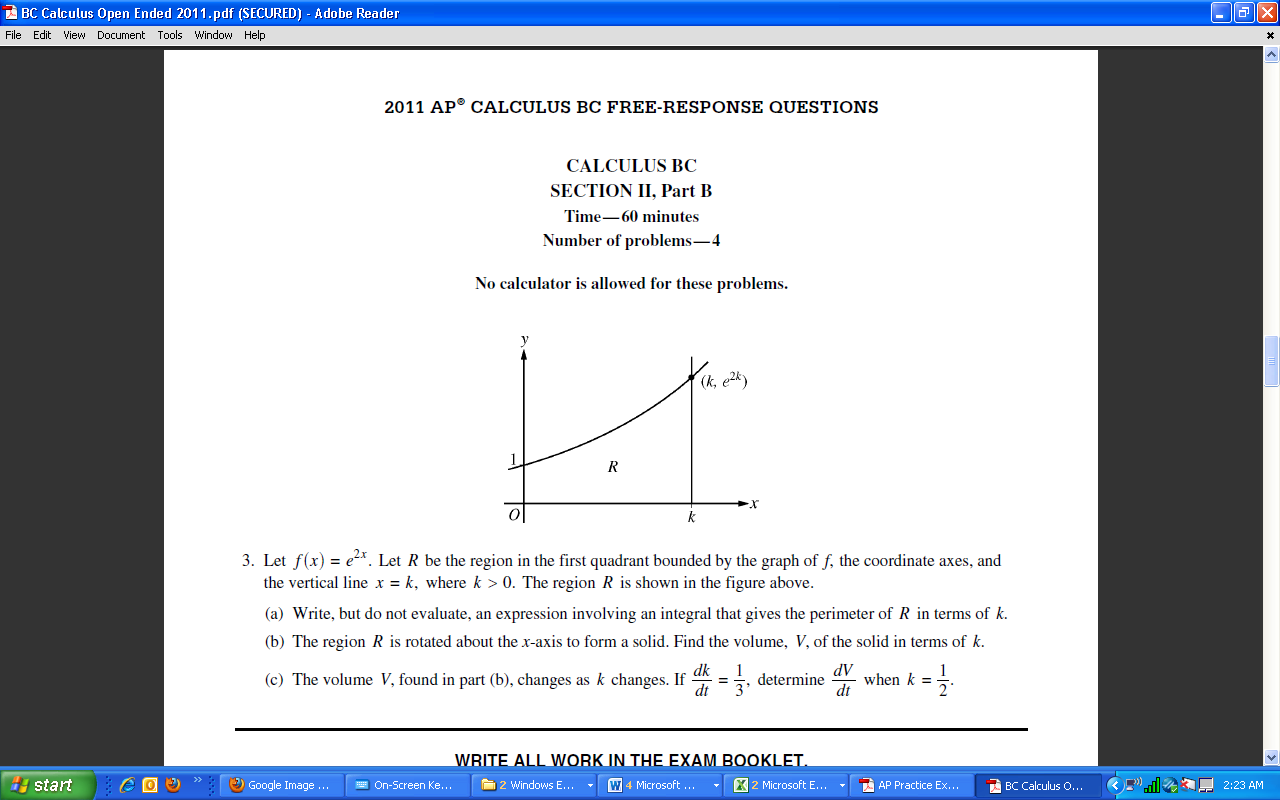
**SECTION II, Part B**

**Time – 60 Minutes**

**Number of Questions – 4**

**A CALCULATOR MAY NOT BE USED ON THIS PART OF THE EXAMINATION.**

**REMEMBER TO SHOW YOUR SETUPS AS DESCRIBED IN THE GENERAL INSTRUCTIONS.**



1. Let . Let be the region in the first quadrant bounded by the graph of , the coordinate axes, and the vertical line where . The region is shown in the figure above.
2. Find the area of region in terms of .
3. The region is rotated about the -axis to form a solid. Find the volume, , of the solid in terms

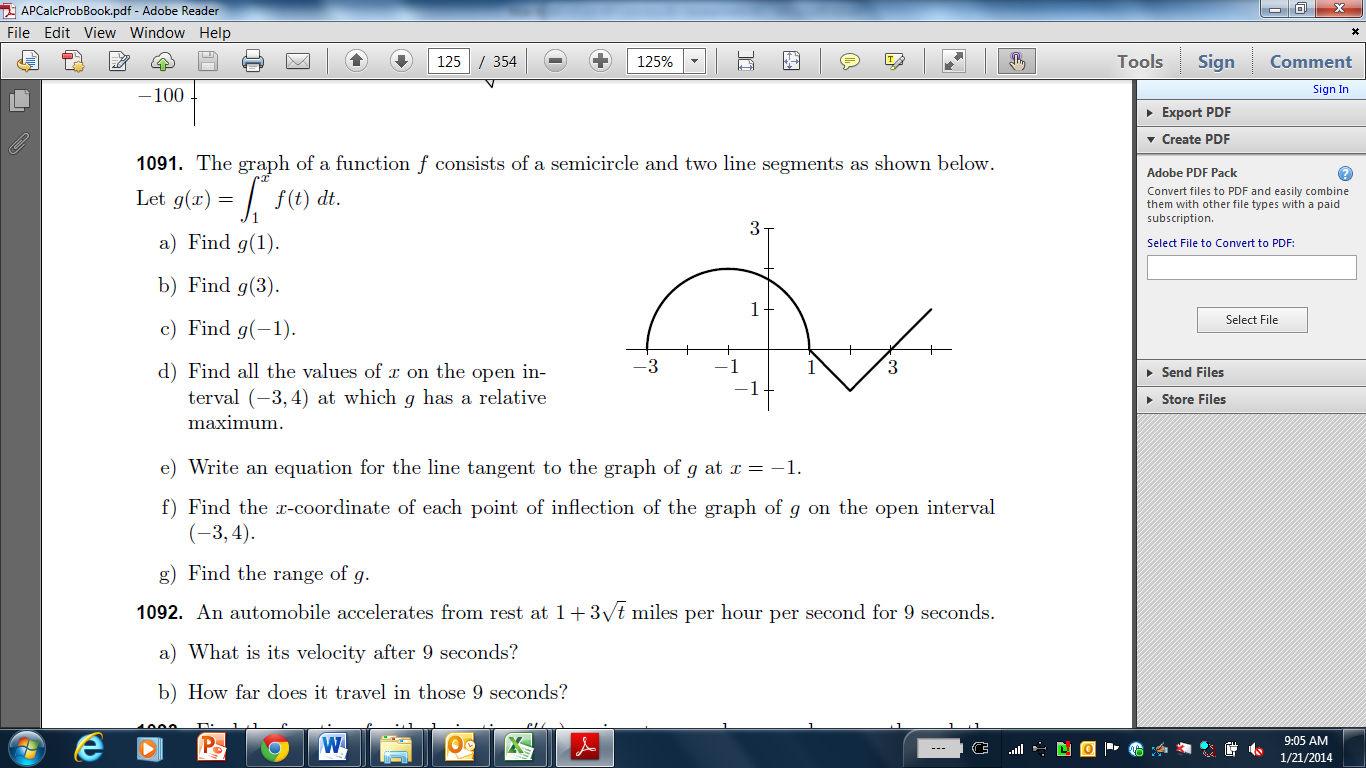
of .

1. The volume , found in part (b), changes as changes. If , determine when .

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Consider the function given by for all real numbers .
2. Find the equation of the line tangent to at .
3. On what interval(s), if any, is decreasing? Justify your answer.
4. At what of does attain its absolute maximum? Justify your answer.
5. Find an antiderivative of .

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_



Graph of

1. Let be the continuous function defined on , whose graph, consisting of a semicircle centered at and two line segments, is given above. Let be the function given by .
2. Find and , or state that the value does not exist.
3. For , find all values of for which the graph of has a point of inflection. Explain

your reasoning.

1. Find the interval(s) on which is both increasing and concave down.
2. Find the absolute maximum value of on the closed interval .

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. For , a particle moves along the -axis. The velocity of the particle at time is given by . The particle is at position at time .
2. For , when is the particle moving the left?
3. Write, but do not evaluate, an integral expression that gives the total distance traveled by the

particle from time to .

1. Find the acceleration of the particle at time . Is the speed of the particle increasing, decreasing,

or neither at time ? Explain your reasoning.

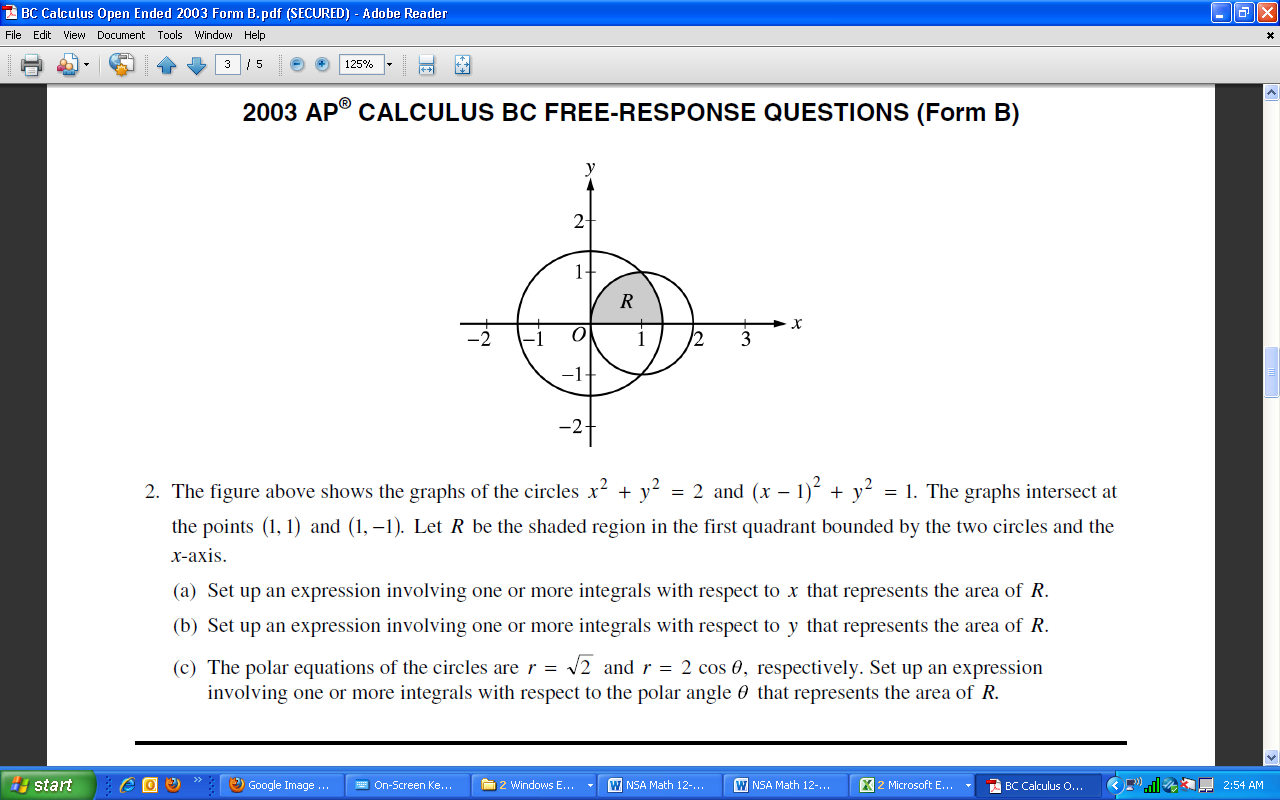
1. Find the position of the particle at time

**END OF SECTION II PART B**

IF YOU FINISH BEFORE TIME IS CALLED, YOU MAY CHECK YOUR WORK ON

PART A OR PART B ON SECTION II ONLY.

**Extra Credit:**



1. The figure above shows the graphs of the circles and . The graphs intersect at the points and . Let be the shaded region in the first quadrant bounded by the two circles and the -axis.

1. Set up an expression involving one or more integrals with respect to that represents the area of

.

1. Set up an expression involving one or more integrals with respect to that represents the area of

.

1. Write, but do not evaluate, one or more integral expressions that could be used to compute the

perimeter of .

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**END OF EXAM**