**Houston Area Calculus Teachers: September 30, 2017**

Quote for the day: *The useless men are those who never change in the years.*

 J.M. Barrie

All of this material is inspired by or parallel to items that are available in the secure documents section of AP Central. I have included problem references so that you can easily locate my source material. Remember that the secure documents are not to be distributed electronically or removed from your classroom.

2016 BC77

Let *f* be a function that is continuous on the closed interval with and What additional information would be needed to conclude that the following statements are true?

*i*) has at least one solution in the interval (4,6).

*ii*) *f* is strictly increasing in the interval

*iii*) has at least one solution in the interval

*iv*)

*v)*

2016 BC86 Note: See similar idea on 2017 AB FR 1

The position of a particle moving along the *y*-axis is given by a twice-differentiable function If and , then describe the movement of the particle for

*i*)

*ii*)

2016 BC91

The number of people in a community who have been exposed to a virus at time *t* is modeled by the function *P* , the solution to a differential equation. On the first day of the month, 40 of the community’s 600 people have been exposed to the virus. Also, on the first day, *P* is increasing at a rate of 50 people per day. Which of the following could be the differential equation?

A)

B)

C)

D)

2016 BCFR4

Find the value of the real number *k* > 1 such that .

2016 AB7

For which of the following pairs of functions *f*  and *g* is infinite?

*i*) and

*ii*) and

*iii*) and

*iv)* and

2016 AB14

If is a solution to the differential equation with the initial condition which of the following is true?

A)

B)

C)

D) 1 +

2016 AB15

A differentiable function gives the rate of evaporation of water, in gallons per hour, from a swimming pool, where *t* is measured in hours since 12 noon. Express each of the following using correct mathematical notation:

*i*) The total volume of water, in gallons, that evaporated from the swimming pool during the first 5 hours after 12 noon.

*ii)* The total volume of water, in gallons, that evaporated from the swimming pool between 2 P.M and 7 P.M.

*iii)* The net change in the rate of evaporation, in gallons per hour, from the swimming pool between 2 P.M and 7 P.M.

*iv)* The average rate of evaporation, in gallons per hour, from the swimming pool between 2 P.M and 7 P.M.

*v)* The average rate of change in the rate of evaporation, in gallons per hour per hour, from the swimming pool between 2 P.M and 7 P.M.

***Note to teachers: You can do something similar with 2016 AB88 and 2017 AB 79***

2016 AB22

A particle moves along the *x*-axis so that at time *t* > 0, the acceleration of the particle is . The position of the particle is 8 when *t* = 0, and the position of the particle is 12 when *t* = 1. What is the velocity of the particle at time *t* = 0?

2016 AB84

A home uses fuel oil at the rate of liters per day, where *t* is the number of days from the beginning of the heating season. Using correct units, interpret each of the following in the context of this problem.

*i*)

*ii)*

*iii)*

*iv)*

*v)*

2017 AB 17

A particle moves along the *y*-axis so that at time *t* > 0 its velocity is given by

What is the first time *t* at whichthe acceleration of the particle is zero?

2017 AB 20 Note: Only 24% of students answered this correctly.

Write three limit statements about that will help explain the behavior of the graph of the function at

2017 AB 26 Note: Only 30% answered this correctly. Could relative growth rates have lead them astray?

# 2017 AB 29 Note: Only 30% answered this correctly. “There's an old saying in Tennessee — I know it's in Texas, probably in Tennessee — that says, fool me once, shame on — shame on you. Fool me — you can't get fooled again.” George W. Bush

# Identify all asymptotes for the graph of the function

# 2017 AB 30 Note: Only 21% of students answered this correctly. How long has it been since YOU did a problem like this?

# For a certain continuous function *f* , the left Riemann sum approximation of with *n* subintervals of equal length is for all *n.* What is the value of

2016 AB 86

 **

The graph of the function *f,* which has a domain of [-2, 6], is shown in the figure above. The graph consists of a semi-circle and a segment with slope 2. Let *k* be a positive number such that What is the value of *k*?

2017 AB 13



Shown above is a slope field for which of the following differential equations?

A)

B)

C)

D)

2017 AB 14 Note: this was the most commonly missed item on the exam with only 18% of students answering correctly.

The population of bacteria in a culture is given by a differentiable function *y,* where is measured in thousands and *t* is measured in days. The population of bacteria increases according to the equation where *k* is a constant. At time the population is 45 thousand bacteria and is increasing at a rate of 15 thousand per day. Find an expression for

2017 AB 22 Note: This was also a commonly missed item with only 39% of students answering correctly.

Find the solution to the differential equation with the initial condition

2017 AB 76

Let *f* be a twice-differentiable function for all real numbers *x*. What information would need to be added to each of the following to guarantee that *f* has a relative maximum at

*i) ii)* changes signs at

2017 AB 78

The continuous function *f* is positive and has domain . If the asymptotes of the graph of *f* are and write two limit statements that apply to this function.

2017 AB 88 Note: Only 27% of the BC students answered this correctly.

The function *f* is concave down on the interval [2,6] and nowhere else. The second derivative of *f,*  is continuous for all real numbers. Explain why each of the following cannot be a table of values for

A)

|  |  |
| --- | --- |
| *x* |  |
| 0 | 1 |
| 2 | -1 |
| 4 | -2 |
| 6 | -1 |
| 8 | 2 |

B)

|  |  |
| --- | --- |
| *x* |  |
| 0 | -1 |
| 2 | 0 |
| 4 | 2 |
| 6 | 0 |
| 8 | -1 |

C)

|  |  |
| --- | --- |
| *x* |  |
| 0 | 1 |
| 2 | 0 |
| 4 | -1 |
| 6 | 0 |
| 8 | -3 |

2017 AB 89 Note: Only 37% of students answered this correctly.

Let *f* be a continuous function for all real numbers. Let *h* be the function

. If the average rate of change of *h* on the interval is 8, write at least four correct mathematical statements involving either or