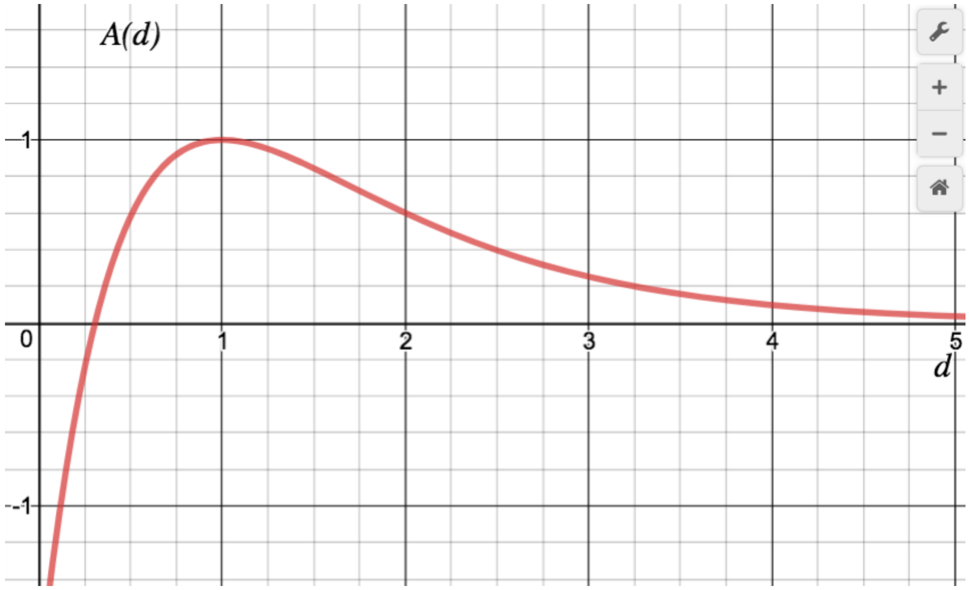
Math 145 - Calculus I Name________________________

Changing Relationships - Day 2 [1]



The graph of $A(d)$ above represents the amount of affection A between a couple as a function of their "distance" d. Depending on the context, distance could mean physical distance, time spent together, or emotional closeness, and large values of d indicate more distance between the partners.

1. What can you say about the values and behavior of A for large values of d, say $d > 3$? Describe why this makes sense in terms of a romantic relationship.

2. At what point does the function $A(d)$ have a maximum? List both coordinates of the point.

3. What happens if d is less than the value from question 2.? Describe how this could make sense in terms of a romantic relationship.

[1]This example is based on the Morse potential in chemistry, which models the interaction between atoms in a diatomic molecule.

4. What do you think is meant by a negative value of A?

5. Estimate $A(2)$ and $A(3)$ from the graph.

6. Use the values from 5. to calculate the average rate of change of A over the interval $[2, 3]$.

7. What does the sign of your answer in 6. say about the change of affection over the interval?

8. Okay, so here's some new information. The function graphed above has the formula

$$A(d) = 1 - (1 - e^{1-d})^2.$$

   Use this equation to calculate the average rate of change over the interval $[2, 3]$.

   (Your answer should be similar to 6. above. Is it?)

9. Use the equation to calculate the average rate of change over the interval $[0.5, 1]$.

10. Use the equation to calculate the average rate of change over the interval $[0.9, 1]$.

11. Calculate the average rate of change of A over intervals for which the lower limit gets closer and closer to $d = 1$ as shown in the table below (you already have the first two answers!). *(Hint: Keep enough decimal places in your calculations or your values may not reveal what we are after in the next question!)*

Interval	average rate of change of A
$[0.5, 1]$	
$[0.9, 1]$	
$[0.95, 1]$	
$[0.99, 1]$	
$[0.995, 1]$	

12. Since the intervals in the previous question are shrinking towards $d = 1$, the calculations are approximating the *instantaneous rate of change* at $d = 1$. Based on your results in the previous part, what's your guess for the value of that instantaneous rate of change?