FRQ #2

AP Precalculus Name: ______________________________ **CA #1**

Question #1

Mr. Sullivan started collecting garden gnomes several years ago. After 1 year of collecting (t = 1) he had five garden gnomes. After 20 years (t = 20), he had 391 garden gnomes. The number of garden gnomes Mr. Sullivan had collected can be modeled by the piecewise function *G* given by :

$$G(t) = \begin{cases} a + 3\ln x & for\ 1 \leq t \leq 14 \\ b(1.5)^{x-12} + 7 & for\ t > 14 \end{cases}$$

Where *G(t)* is the number of garden gnomes Mr. Sullivan had collected after *t* years.

(A) (i) Use the given data to write two equations that can be used to find the values for constants *a* and *b* in the expression for *G(t)*.

(ii) Find the values for *a* and *b* as decimal approximations.

(B) (i) Use the given data to find the average rate of change in the number of garden gnomes Mr. Sullivan collected per year, from *t* = 15 to *t* = 20.

(ii) Interpret the meaning of your answer from (i) in the context of the problem.

(iii) Consider the values that result from using the average rate of change found in (i) to estimate the number of garden gnomes Mr. Sullivan collected for times *t* = *p* days, where 15 < *p* < 20. Are these estimates less than or greater than the number of gnomes collected predicted by the model *G* for times *t* = *p* days? Explain your reasoning. Your explanation should include characteristics of the average rate of change and a reference to the graph of *G*.

(C) The model *G* is valid for $1 \leq t \leq 30$ years. Explain how the range of values of the function *G* should be limited by the context of the problem.

Question #2

A new phone app, "Flipped Math Fun," was released. On the day of its launch (t = 0), it had 62 thousand downloads. 30 days later (t = 30), it had 132 thousand downloads.

The number of downloads for " Flipped Math Fun" can be modeled by the function *D,* where $D(t) = a \cdot b^t + 12$. $D(t)$ is the number of downloads, in thousands, on day *t* since the launch.

(A)

(i) Use the given data to write two equations that can be used to find the values for constants *a* and *b.*

(ii) Find the values for *a* and *b,* expressing them as decimal approximations.

(B)

(i) Use the given data to find the average rate of change of the number of downloads, in thousands per day, from *t = 0* to *t = 30*. Express your answer as a decimal approximation. Show the computations.

(ii) Use the average rate of change found in (i) to create a linear model, *L(t),* starting from *t=0.* Use this model to estimate the number of downloads, in thousands, on day *t = 20*.

(iii) For the linear estimate *L(20)* found in (ii), it can be shown that *L(20) > D(20).* Explain why, in general, the linear approximation *L(t)* is greater than the exponential model *D(t)* for all *t* in the interval *0 < t < 30.*

(C)

The game's developer reported that a buggy update released on day 30 caused daily downloads to decrease each day after *t = 30.* Explain why the error in the model *D(t)* increases significantly after *t = 30.*

Question 1: A(i): $5 = a + 3\ln 1$; $391 = b(1.5)^{20-12} + 7$; A(ii): a = 5, b = 14.983

B(i): 66.686 games per year, B(ii) The number of gnomes increases on average 66.686 gnomes between years 15 and 20. B(iii) The estimates are the secant line on the interval 15 < d < 20. The graph is concave up on the interval so the estimates are greater than the actual.

C(i): C(1) = 5 and C(30) = 22,150.375 so therefore the range of the function will go from (5, 22,150.375).

Question 2: A(i): $62 = a \cdot b^0 + 12$; $132 = a \cdot b^{30} + 12$; A(ii) a = 50, b = 1.030

B(i): 2.333 thousand downloads per day; B(ii) 108.333 thousand downloads; B(iii) The estimates are the secant line on the interval 0 < d < 30. The graph is concave up on the interval so the estimates are greater than the actual.

C(i): According to the model as *t* increases without bound the model *D(t)* will increase so once the data goes against that by decreasing we know that *D(t)* will only work on the domain (0, 60) for sure.