$f(x) = \#$ of bacteria at end of day x

$x = \#$ of end of days

Homework 7.4

FRQ 1: Calculator Permitted

$x =$ **Day Number**	1	2	3	4	5	6	7
$f(x) =$ **Bacteria Population**	125	160	190	220	265	300	345

The table above shows the number of bacterial organisms present in a culture dish at the end of various days of an experiment. The data in the table can be represented as an exponential function.

a. If the function, $f(x) = a \cdot b^{c(x-h)} + k$, is an exponential function that models the data in the table, what can be assumed about the values of a and c? Explain your reasoning based only on information given at this point.

+1 All y-values of $f(x) > 125$ $\therefore$ $f(x)$ is above the HA $\therefore$ $a > 0$

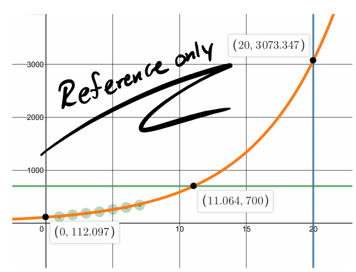
+1 $\lim_{x \to \infty} f(x) = \infty$ $\therefore$ $c > 0$ $\therefore$ $f(x)$ is exponential growth +1

b. Using the regression capabilities of a graphing utility, find the function, $f(x)$, and use it to find the value of $f(20)$. In the context of the scenario and using correct units of measure, explain what this value represents.

+1 $f(x) = 112.097(1.180)^x$

$f(20) = 112.097(1.180)^{20} \approx 3070.677$ +1

+1 At the end of day 20 of an experiment, there are 3070.677 bacteria in the culture dish.



c. What was the initial population of the bacteria in the culture dish? Show and justify your work.

+1 The initial population would be at the beginning of day 1, when $x = 0$

+1 $f(0) = 112.097(1.180)^0 = 112.097$ bacteria

d. When the bacteria in the culture dish reaches a population of 700, an antibiotic will be applied to kill the bacteria. On what day will the antibiotic need to be applied? Show and explain the analysis that leads to your answer

$f(x) = 112.097(1.180)^x$

+1/2 $700 = 112.097(1.180)^x$

CALC $\boxed{Y_1 = 112.097(1.180)^x \quad Y_2 = 700}$

+1/2 $x = 11.067$

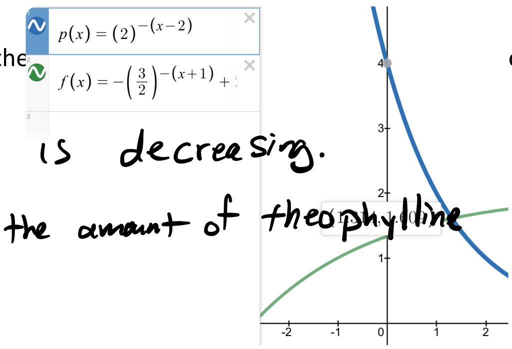
The antibiotic will need to be applied on day 12 since $f(x)$ represents the number of bacteria at the end of x days. +1

FRQ 2: Calculator Permitted

	Time (hours)	0	1	3	5	7	9
$t =$	**Time (hours)**	0	1	3	5	7	9
$f(t) =$	**Concentration (mg/liter)**	12.0	10.0	7.0	5.0	3.5	2.5

The table above shows the concentration of theophylline, a common asthma drug, in the blood stream as a function of time after the injection of a 300 mg initial dose. The concentration reflects the amount of theophylline in milligrams per liter of blood present in the body.

a. Does the data in the table show a growth or decay in the e blood? Explain your reasoning.



+1 The amount of theophylline is decreasing.

+1 ∴ The data shows decay in the amount of theophylline

b. Using the regression capabilities of a graphing calculator, find a function in the form $f(t) = a \cdot b^t$, which would represent the data in the table, where $f(t)$ represents the concentration of theophylline and t represents the number of hours. Based on the values of a and b, explain why this function is the type of function you claimed it was in part a.

+1 $f(t) = 11.914(0.840)^t$

$a > 0$ ∴ there is no vertical reflection

Since $0 < b < 1$, we can reciprocate $\frac{1000}{840}$ and change the sign of the exponent,

giving us $f(t) = 11.914\left(\frac{1000}{840}\right)^{-t}$ +1

∴ $f(t)$ will have a horizontal reflection, thus $f(t)$ an exponential decay.

c. Find the value of $f(15)$ and state, using correct units of measure, what this value represents in the context of this problem.

+1 $f(15) = 11.914(0.840)^{15} \approx 0.871$

+1 After 15 hours, the concentration level of theophylle in the blood will be 0.871 mg/liter.

d. Will the theophylline ever be completely out of the system of the person who takes it? Explain your reasoning based on the graph of $f(t)$.

Graphically, $f(t)$ has a horizontal asymptote at $y=0$.

+1 The right end behavior is $\lim_{t \to \infty} f(t) = 0$.

∴ the graph of $f(t)$ never reaches 0. +1

+1 ∴ No, the theophylline will never be completely out of the system.