

Math 151, Algebra 1, Bonus Questions

Chapter 6

Name _____

Q1. A biologist is researching a newly discovered species of bacteria. At time $t = 0$, he puts 100 bacteria into what he has determined to be a favorable growth medium. Six hours later, he measures 450 bacteria. Assuming exponential growth, what is the growth constant k for the bacteria?

Q2. Carbon-14 has a half-life of 5730 years. You are presented with a document which purports to contain the recollections of a Mycenaean soldier during the Trojan War. The city of Troy was finally destroyed in about 1250 B.C., or about 3250 years ago. Carbon-dating evaluates the ratio of radioactive carbon-14 to stable carbon-12. Given the amount of carbon-12 contained a measured sample cut from the document, there would have been about 1.3×10^{-12} grams of carbon-14 in the sample when the parchment was new, assuming the proposed age is correct. According to your equipment, there remains 1.0×10^{-12} grams. Is there a possibility that this is a genuine document? Or is this instead a recent forgery? Justify your conclusions.

Q3. A certain type of bacterium, given a favorable growth medium, doubles in population every 6.5 hours. Given that there were approximately 100 bacteria to start with, how many bacteria will there be in a day and a half?

Q4. Radio isotopes of different elements have different half-lives. Magnesium-27 has a half-life of 9.45 minutes. What is the decay constant for Magnesium-27?

Q5. The number of people, N , in hundreds, at a local community college who have heard the rumor 'Carl is afraid of Virginia Wolf' can be modeled using the logistic equation

$$N(t) = \frac{84}{1 + 2799e^{-2t}}$$

where $t \geq 0$ is the number of days after April 1, 1990.

1) Graph $N(t)$.

2) What is $N(0)$?

3) $\lim_{t \rightarrow \infty} N(t) = ?$

4) How long until 314,159 people have heard the rumor?

Q6. An oil is heated to 60°C. It cools to 50°C after six minutes. Find the time taken by the oil to cool from 50°C to 40°C. The surrounding temperature is 25°C.

Q7. Robin heats a pot of water to 70°C. He waits for 10 minutes. How much would be the temperature if $k = 0.056$ per minute and surrounding temperature is 27°C?

Newton's Law of Cooling : $T(t) = T_a + (T_o - T_a)e^{-kt}$