

Precalculus

Homework Lecture 16

- 1 day after the start of hypothetical experiment a population of fruit flies was measured to have 110 individuals. 3 days after the start there were 190 flies. Write down an exponential growth law that fits this data. According to the model, how many fruit were there at the start of the experiment? After 5 days? The answer key has not been proofread, use with caution.

$$\text{answer: } P(t) = be^{at} \quad \frac{1}{1} = b \quad \frac{190}{110} = e^{3a} \quad \ln \left(\frac{190}{110} \right) = 3a \quad a \approx 0.2773, b \approx 84.1 \quad P(0) \approx 84.1, P(5) \approx 328.8$$

2. In a hypothetical experiment, the number of E. Coli bacteria cells is modeled with a logistic curve $E(t) = \frac{2.8 \times 10^{11}}{1 + (3.5 \times 10^9)e^{-1.2t}}$, where t measures time in hours since the start of the experiment.

- According to the model, approximately how many cells were there at the start of the experiment?
- According to the model, how many hours are needed for the number of cells to be approximately 10^{10} ?

The answer key has not been proofread, use with caution.

$$\text{answer: about } 80 \text{ cells at the start; about } 15.6 \text{ hours needed for } 10^{10} \text{ cells.}$$

3. The Richter magnitude M_L of an earthquake is determined from the logarithm of the amplitude A of waves recorded by seismographs (with adjustment to compensate for the distance between the measuring station and the estimated epicenter of the earthquake). The formula is

$$M_L = \log_{10} A - J_0(\delta),$$

where $J_0(\delta)$ depends on the distance δ from the epicenter. Compare the amplitudes A_1 and A_2 of the seismographic waves of two hypothetical earthquakes of magnitudes 5 and 7.2 with the same epicenter.

$$\text{answer: the stronger earthquake has seism. amplitude about } 10^{2.2} \approx 158.5 \text{ times larger}$$