

DIGITLE – BC CALCULUS

Puzzle 207 – Logistic Growth



Directions: The first 5 problems have single digit or letter answers. The 6th problem has a 3-digit answer (counting leading zeros if present). You have a choice: solve the easier single-character answer problems or tackle the more difficult 3-digit answer and the multiple choice.

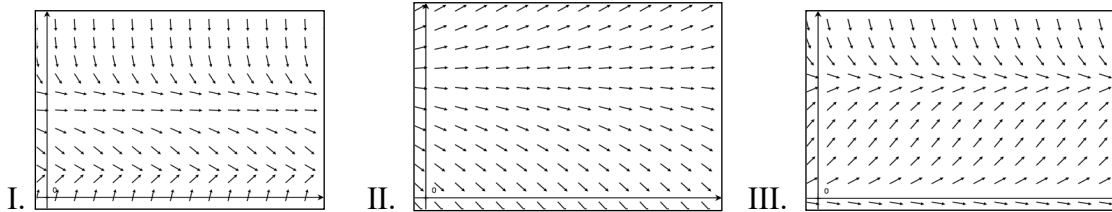
Single Digit or Letter Answers:

1) The population $P(t)$ measured in thousands of a rare species satisfies the differential equation

$$\frac{dP}{dt} = P \left(0.032 - \frac{P}{250} \right), \text{ where the initial population is } 1000 \text{ and } t \text{ is measured in months. If } \lim_{t \rightarrow \infty} P(t) = 100k$$

where k is an integer, find k .

2) Which of the following slope field could model logistic growth?

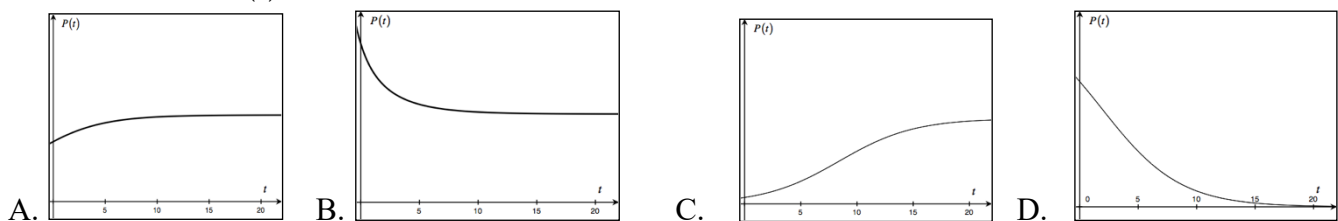


- A) I only B) II only C) III only D) I and III only

3) A population is modeled by a function P that satisfies the differential equation $\frac{dP}{dt} = P \left(12 - \frac{P}{3} \right)$. If $P(0) = 2$, for what value of P is the population growing the fastest?

4) The population of bald eagles in an Alaskan preserve changes according to the differential equation

$$\frac{dP}{dt} = 0.4P - 0.0002P^2 \text{ where } P \text{ is the number of eagles at time } t \text{ in years. If } P(0) = 2500, \text{ what is the shape of the graph of } P(t)?$$



5) The population of sting rays P in a restricted area changes according to the logistic equation

$$\frac{dP}{dt} = k(P - 55)(200 - P). \text{ If } \lim_{t \rightarrow \infty} P(t) = 100k \text{ where } k \text{ is an integer, find the largest possible value of } k.$$

Three Digit Answer:

6) In a small town, 40 people have had a virus on March 1. The rate of growth of the number of people P having had the virus is given by $\frac{dP}{dt} = 0.0004S(1700 - S)$ where t is measured in days. How fast is the virus spreading in people per day at the time when it is spreading the quickest?