

HW 22

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Due 11/28/21

1. I got the word problem question wrong

"I have trouble with 'word problems' and had no clue how to translate from verbal English to mathematics"

The population of a certain bacteria increases at a rate that equals a third of the reciprocal of its current value to the fourth power. If at time $t=1$, its value is 4, what is its value at $t=3$?

$$\frac{dx}{dt} = \frac{-1}{3x^4} \rightarrow x^4 dx = \frac{1}{3} dt \rightarrow 4x^3 = \frac{1}{3}t + C$$

$$x = \left(\frac{1}{12}t + C\right)^{1/3} \quad \text{At } t=1 \quad 4 = \left(\frac{1}{12} + C\right)^{1/3} \quad C = \frac{767}{12}$$

$$x = \left(\frac{1}{12}t + \frac{767}{12}\right)^{1/3} \quad \text{at } t=3, \quad x = \left(\frac{770}{12}\right)^{1/3} \approx 4.003$$

The population of a certain bacteria decrease at a rate that equals 3 times the square of its current value. If at $t=1$, its value is 12, what is the value at $t=5$?

$$\frac{dx}{dt} = 3x^2 \rightarrow \frac{dx}{x^2} = 3dt \rightarrow \frac{-1}{x} = 3t + C \rightarrow \frac{-1}{3t + C} = x$$

$$\text{at } t=1, \quad \frac{-1}{-3+C} = 12 \quad C = \frac{-37}{12}$$

$$\text{at } t=5, \quad \frac{-1}{27 - \frac{37}{12}} = \frac{-12}{287}, \quad \text{dead.}$$

$$\#15 \quad \frac{x^{(n-1)}}{10+x^{(n-1)}} = x^{(n)}$$

FP's

$$x = f(x)$$

$$f(x) = \frac{x}{10+x}$$

$$x = \frac{x}{10+x}$$

$$10x + x^2 = x$$

$$x^2 + 9x = 0$$

$$x = 0, -9$$

STFP's $|f'(x)| < 1$

$$f'(x) = \frac{10}{(10+x)^2}$$

$$f'(0) = \left| \frac{1}{10} \right| < 1 \quad \checkmark$$

$$f'(-9) = 1 < 1 \quad \times$$

$x(0) = 0$ is a stable fixed point