Math 1B: Discussion 4/9/19

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Question 1 (Review of Implicit Differentiation)

Find $\frac{dy}{dx}$ for

$$x^2 + xy^2 + ye^{2x} = 2$$

Question 2 (Orthogonal Trajectories)

Find the orthogonal trajectories for the following families of curves.

$$x^2 - y^2 = C$$

$$e^x + y^2 = C$$

$$x^3 + 3x + \ln(1 + y^2) = C$$

Question 3

A gazelle population grows logistically. The carrying capacity of the population is 1000 gazelles and there are 200 gazelles initially. After 5 years, there are 300 gazelles. Find the amount of time it takes for the gazelle population to reach 75% of its carrying capacity. Then, write a differential equation that models the gazelle population.

Question 4

A bacteria population is modeled by the differential equation

$$\frac{dP}{dt} = \frac{P}{4}\left(1 - \frac{P}{5000}\right)$$

where t is time in hours, and $P(t)$ is the number of bacteria at time t where $t = 0$ is the current time. Find the general solution to this differential equation. Suppose we know that at time $t = 5$ hours, there are 2000 bacteria. At what time will there be 4000 bacteria?