Title : Growth and Decay

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Part 1:

A. An example of growth and decay is the population of a city. If a city grows, it means more people are moving in, possibly because of job opportunities, immigration, or high birth rates. In such cases, the city may need to provide more housing, schools, and healthcare facilities to cater to the increasing number of people. Conversely, if the population declines, it means people are leaving the city, possibly due to factors like an aging population, low birth rates, or job losses. As a result, resources like housing and public services may become less in demand or may be closed down. Whether a city grows or decays, it can significantly affect the local economy, infrastructure, and quality of life of its inhabitants. Growth and decay problems are mathematical problems that aim to understand how quantities change over time. These problems require finding the rate of change of a quantity as it either increases or decreases. They can be used to model various real-world scenarios, such as population growth, radioactive decay, and asset depreciation. The main objective of growth and decay problems is to anticipate how a quantity will change over time and use this information to make informed decisions or to optimize a process or system.

B. The growth and decay problem involves analyzing the change in a quantity over time, where the rate of change is influenced by the current quantity. Differential equations are commonly used to model these types of problems. For exponential growth, the rate of change is directly proportional to the quantity and can be expressed as $\frac{dy}{dt} = ky$, where k is a constant growth rate. The solution to this equation is y(t) = y(0)e^{kt}, where y(0) is the initial quantity at time t=0. Exponential decay is similar, but with a negative rate of change proportional to the quantity, and the solution is $y(t) = y(0)e^{-kt}$. These equations are often applied in fields such as population growth and radioactive decay to describe the behavior of the quantity over time.

To solve these differential equations, we can use separation of variables or integrating factor methods. Separation of variables involves isolating the variables on opposite sides of the equation and integrating both sides. Integrating factor involves multiplying both sides by a function that makes the left side the derivative of a product rule.

The solution to the differential equation is given by:

$$y = Ce^{kt}$$

where C is the constant of integration that is determined by the initial conditions of the problem (such as the initial quantity at time t=0).

In the context of growth and decay problems, the variable y represents the quantity being modeled, t represents time, and k represents the rate of growth or decay. The constant C represents the initial quantity of the function at time t=0.

Part 2 :

Examples explaining Growth and Decay are below with extensive explanations;

- https://mathinsight.org/exponential_growth_decay_differential_equation_refresher
- https://staffordhs.ss8.sharpschool.com/common/pages/UserFile.aspx?fileId=43305076
- https://wethestudy.com/mathematics/growth-and-decay-applications-of-differential-equations/
- https://amsi.org.au/ESA_Senior_Years/PDF/GrowthDecay3e.pdf
- https://amsi.org.au/ESA_Senior_Years/SeniorTopic3/3e/3e_2content_1.html
- https://flexbooks.ck12.org/cbook/ck-12-calculus-concepts/section/7.5/primary/lesson/exponential-growth-and-decay-calc/

- https://resources.saylor.org/wwwresources/archived/site/wp-content/uploads/2011/06/MA221-2.1.1.pdf

Pair Posts :

- https://openlab.citytech.cuny.edu/https-openlabcitytechcunyedu-poiriermat2680spring2023/2023/03/03/project-1-pt-1-growth-decay-ch-4-1-q5/ (Danny and John)
- https://openlab.citytech.cuny.edu/https-openlabcitytechcunyedu-poiriermat2680spring2023/2023/02/28/project-1-pt-1-growth-decay-ch-4-1-q13/ (Shadman and Evan)
- https://openlab.citytech.cuny.edu/https-openlabcitytechcunyedu-poiriermat2680spring2023/2023/02/27/project-1-section-4-1-problem-1/ (Opemipo and Oscar)
- https://openlab.citytech.cuny.edu/https-openlabcitytechcunyedu-poiriermat2680spring2023/2023/02/27/project-1-section-4-1-problem-3-by-kunal-and-maharin/ (Kunal and Maharin)
- https://openlab.citytech.cuny.edu/https-openlabcitytechcunyedu-poiriermat2680spring2023/2023/02/26/project-1-section-4-1-problem-11/ (Jason Truong)
- https://openlab.citytech.cuny.edu/https-openlabcitytechcunyedu-poiriermat2680spring2023/2023/02/26/project-1-2/ (Luijen Payano and Ken Mei)
- https://openlab.citytech.cuny.edu/https-openlabcitytechcunyedu-poiriermat2680spring2023/2023/03/05/project-part-1/ (Ebtida Ahmed)

Part 3 :

Question : A candymaker makes 400 pounds of candy per week, while his large family eats the candy at a rate equal to Q.t /=20 pounds per week, where Q.t / is the amount of candy present at time t. (a) Find Q.t / for t > 0 if the candymaker has 150 pounds of candy at t D 0.