A Modular Presentation System for the Calculus Sequence

3.3 Rates of Change in the Natural and Social Sciences

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Physics: Velocity

EXAMPLE: An object moves along a straight line so that after t minutes, its distance from its starting point is $D(t) = 10t + \frac{5}{t+1} - 5$ meters.

(a) At what velocity is the object moving at the end of 4 minutes?

(b) How far does the object actually travel during the fifth minute?

Chemistry: Orientation Polarization

EXAMPLE: According to Debye's formula in physical chemistry, the orientation polarization P of a gas satisfies $P = \frac{4}{3}\pi N\left(\frac{\mu^2}{3kT}\right)$ where μ, k, and N are positive constants and T is the temperature of the gas. Find the rate of change of P with respect to T.

Biology: Drug Dosage

EXAMPLE: One biological model suggests that the human body's reaction to a dose of medicine can be measured by a function of the form $F = \frac{1}{3}(KM^2 - M^3)$ where K is a positive constant and M is the amount of medicine absorbed in the blood. The derivative $S = \frac{dF}{dM}$ can be thought of as a measure of the sensitivity of the body to the medicine.

(a) Find the sensitivity S.

(b) Find $\frac{dS}{dM} = \frac{d^2F}{dM^2}$ and give an interpretation of the second derivative.

Economics: Online Banking

EXAMPLE: In a study prepared in 2000, the percent of households using online banking was projected to be $f(t) = 1.5e^{0.78t}$, $0 \leq t \leq 4$, where t is measured in years, with $t = 0$ corresponding to the beginning of 2000.

(a) What is the projected percent of households using online banking at the beginning of 2003?

(b) How fast will the projected percent of households using online banking be changing at the beginning of 2003?

(c) How fast will the rate of the projected percent of households using online banking be changing at the beginning of 2003?