PROBLEM SOLVING

DIFFERENTIAL CALCULUS

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TOPIC OUTLINE

Problem Solving

- **Free-falling Body**
- **Rate of Volume**
- **Rate of Profit**

PROBLEM EXERCISE

EXERCISE

Suppose that a ball is dropped from the upper observation deck of the CN Tower in Toronto, 450 m above the ground.

a. What is the velocity of the ball after 5 seconds?

b. How fast is the ball traveling when it hits the ground?

The distance fallen by a freely falling body is defined by the equation $\boldsymbol{s(t) = 4.9t^2}$.

The CN Tower in Toronto was the tallest free-standing building in the world for 32 years.

EXERCISE

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Solution

EXERCISE

A conical pile of soil is being formed as soil pours from a spout, with the height of the cone always being twice the radius of the base. Determine the rate at which the volume of the cone is changing with respect to its height when the height is 4 feet.

Solution

The volume of the cone is defined by the equation

$$\boldsymbol{V = \frac{1}{3}\pi r^2 h}.$$

EXERCISE

A growing e-commerce company is analyzing its financial performance over time. The company observes that its revenue $R(t)$in dollars after some time t in months is modeled by the equation :

$$\boldsymbol{R(t) = 200t^2 + 500t + 2000}$$

At the same time, the company's expenses grow as it hires more employees and scales its operation, modeled by:

$$\boldsymbol{E(t) = 300t + 1000}$$

Determine the rate of change of the company's profit after 6 months.

Solution

EXERCISE

A semiconductor manufacturing company tracks the output of wafers over time as it optimizes its production line. The number of wafers produced $W(t)$ after some time t in weeks is modeled by :

$$\boldsymbol{W(t) = 50t^2 + 20t + 1000}$$

However, the defective wafers also increases due to wear and tear on the equipment is modeled by:

$$\boldsymbol{D(t) = 30t + 200}$$

Determine the rate of change of net usable wafers after 4 weeks.

Solution

EXERCISE

A rock thrown vertically upward from the surface of the earth at a velocity of 24 m/sec reaches a height of $\boldsymbol{s = 24t - 4.9t^2}$ meters in t seconds. How high would the rock go?

Hint: What happens to the velocity at maximum height?

Solution

LABORATORY