



AP Calculus BC

Topic: Applications from Science and Statistics

Instructions

Solve the following problems. Show all your work clearly and include units in your answers where appropriate.

Practice Problems

1. Applications in Science:

- A container is being filled with water at a rate of $R(t) = 3t^2 + 2t$ liters per minute. How much water is in the container after 5 minutes if it starts empty?
- The velocity of a particle moving along a straight line is given by $v(t) = t^2 - 4t + 3$ m/s. Find the total distance traveled by the particle from $t = 0$ to $t = 3$ seconds.
- The growth rate of a bacterial culture is modeled by $G(t) = e^{0.2t}$, where t is in hours. Find the total growth of the culture over the first 10 hours.

2. Applications in Statistics:

- A probability density function is given by $f(x) = \frac{1}{4}e^{-x/4}$ for $x \geq 0$. Find the mean of the distribution.
- A uniform distribution is defined on the interval $[0, 5]$. Find the variance of the distribution.
- The height of a curve $y = e^{-x}$ is used to model probabilities. Compute the total area under the curve from $x = 0$ to $x = \infty$.

3. Applications Combining Science and Statistics:

- i. The temperature of an object is modeled by $T(t) = 100e^{-0.1t}$ degrees Celsius, where t is in minutes. Find the average temperature of the object over the first 20 minutes.
- ii. A car's fuel consumption rate is modeled by $F(v) = 0.02v^2$ liters per hour, where v is the car's speed in km/h. Compute the total fuel consumed if the car travels at 60 km/h for 5 hours.

Multiple-Choice Questions

- (a) The integral $\int_0^3 (2t^2 + t)dt$ represents:
 - a. The total velocity.
 - b. The total distance.
 - c. The total volume.
 - d. The total displacement.
- (b) The variance of a uniform distribution on $[0, b]$ is given by:
 - a. $\frac{b^2}{12}$
 - b. $\frac{b}{6}$
 - c. $\frac{b^2}{6}$
 - d. $\frac{b}{12}$
- (c) The total area under $y = e^{-x}$ for $x \in [0, \infty)$ is:
 - a. 1
 - b. e
 - c. ∞
 - d. 0

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