

AP Calculus AB

Topic: Velocity and Other Rates of Change

Instructions

Solve the following problems. Show all work and include proper mathematical justifications. Use appropriate differentiation techniques wherever necessary.

Practice Problems

- 1. A ball is thrown vertically upward with a velocity of 20 m/s. Its height after t seconds is given by $s(t) = 20t 5t^2$. Find:
 - (a) The velocity of the ball at any time t.
 - (b) The time when the ball reaches its highest point.
 - (c) The maximum height reached by the ball.
- 2. A particle moves along a straight line such that its position at time t is given by $s(t) = t^3 6t^2 + 9t + 2$ (in meters). Determine:
 - (a) The velocity of the particle at time t.
 - (b) The acceleration of the particle at time t.
 - (c) The times when the particle is at rest.
- 3. The radius of a circular ripple in a pond increases at a rate of 2 cm/s. Find the rate at which the area of the circle is increasing when the radius is 5 cm.
- 4. A car's position is modeled by the function $s(t) = 4t^3 3t^2 + 2t$ (in meters) where t is the time in seconds. Compute:

- (a) The velocity of the car at t = 2 seconds.
- (b) The acceleration of the car at t = 2 seconds.
- 5. A population of bacteria grows according to the formula $P(t) = 500e^{0.02t}$, where t is measured in hours. Determine:
 - (a) The rate of change of the population at t = 5 hours.
 - (b) The time at which the population is growing fastest.

Multiple Choice Questions

1. If the position of a particle is given by $s(t) = t^2 + 3t$, what is its velocity at t = 2?

- a. 5 m/s
- b. 7 m/s
- c. 10 m/s
- d. 12 m/s
- 2. A ball is dropped from a height of 80 m and its height after t seconds is given by $s(t) = 80 5t^2$. What is its velocity after t = 3 seconds?
 - a. -30 m/s
 - b. -25 m/s
 - c. -15 m/s
 - d. -45 m/s
- 3. The radius of a circle increases at a constant rate of 3 cm/s. What is the rate of change of the area when the radius is 10 cm?
 - a. $30\pi \text{ cm}^2/\text{s}$
 - b. $60\pi \text{ cm}^2/\text{s}$
 - c. $90\pi \text{ cm}^2/\text{s}$
 - d. $120\pi \text{ cm}^2/\text{s}$
- 4. The acceleration of a particle is given by a(t) = 6t 4. If its initial velocity is 3 m/s, what is its velocity at t = 2 seconds?
 - a. 5 m/s
 - b. 7 m/s
 - c. 9 m/s
 - d. 11 m/s

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