

AP Calculus BC

Topic: Slope Fields and Euler's Method

Instructions

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

Practice Problems

- 1. **Drawing Slope Fields:** Sketch the slope field for the following differential equations at the given points:
 - i. $\frac{dy}{dx} = x + y$, for $-2 \le x \le 2$ and $-2 \le y \le 2$.
 - ii. $\frac{dy}{dx} = x y$, for $-2 \le x \le 2$ and $-2 \le y \le 2$.
 - iii. $\frac{dy}{dx} = y^2 x$, for $-1 \le x \le 1$ and $-1 \le y \le 1$.
- 2. Analyzing Slope Fields: Match the following differential equations to their slope fields:
 - i. $\frac{dy}{dx} = x + y$
 - ii. $\frac{dy}{dx} = y x$
 - iii. $\frac{dy}{dx} = x^2 y^2$
 - iv. $\frac{dy}{dx} = x^2 + y^2$

Explain your reasoning for each match.

- 3. Using Euler's Method: Use Euler's method to approximate the value of y at x = 1 for the differential equation $\frac{dy}{dx} = x + y$ with initial condition y(0) = 1 using:
 - i. A step size of h = 0.5.

- ii. A step size of h = 0.25.
- 4. Initial Value Problems: Solve the following initial value problems:
 - i. $\frac{dy}{dx} = 2x + 3$, with y(0) = 5.
 - ii. $\frac{dy}{dx} = \sin(x)$, with y(0) = 2.
- 5. **Interpreting Slope Fields:** The slope field for a differential equation is shown below. Which of the following differential equations is most likely represented by this slope field? (Include the graph of the slope field here and provide multiple options for the equations.)

Multiple Choice Questions

- 1. Which of the following is the solution to the differential equation $\frac{dy}{dx} = x + 1$ with the initial condition y(0) = 2?
 - a. $y = x^{2} + 2x + 2$ b. $y = \frac{x^{2}}{2} + x + 2$ c. $y = x^{2} + 2$ d. $y = x^{2} + x + 2$
- 2. Using Euler's method with h = 0.1, what is the approximate value of y(0.3) for the differential equation $\frac{dy}{dx} = 2x + y$ with y(0) = 1?
 - a. 1.12
 - b. 1.13
 - c. 1.14
 - d. 1.15
- 3. Which of the following differential equations has a slope field where the slopes are horizontal along the line y = 1?
 - a. $\frac{dy}{dx} = y 1$ b. $\frac{dy}{dx} = x - 1$ c. $\frac{dy}{dx} = x + y$ d. $\frac{dy}{dx} = y + 1$

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