

Calculus: Limits, Continuity & Derivative Rules



Use the matching sheet ID when checking answers.

Part A: Calculus Computation. Evaluate each limit and derivative problem. Choose the correct mathematical result.

1. Evaluate the limit analytically: $\lim (x \rightarrow 3) [(x^2 - 9) / (x - 3)]$

Answer: C. 6

Factoring the numerator yields $(x - 3)(x + 3) / (x - 3)$. For $x \neq 3$, cancel $(x - 3)$: $\lim (x \rightarrow 3) (x + 3) = 3 + 3 = 6$.

2. Find the derivative $f'(x)$ of the cubic polynomial function: $f(x) = 4x^3 - 5x^2 + 7x - 12$

Answer: A. $f'(x) = 12x^2 - 10x + 7$

Using the Power Rule $d/dx[x^n] = n \cdot x^{(n-1)}$: $d/dx[4x^3] = 12x^2$; $d/dx[-5x^2] = -10x$; $d/dx[7x] = 7$; $d/dx[-12] = 0$. $f'(x) = 12x^2 - 10x + 7$.

3. What is the slope of the tangent line to the curve $y = x^2$ at the specific point where $x = 4$?

Answer: B. $m = 8$

The derivative gives the slope of the tangent line: $y' = d/dx[x^2] = 2x$. Evaluating at $x = 4$ yields $m = 2(4) = 8$.

4. A particle moves along a horizontal line with position $s(t) = 2t^3 - 6t^2 + 10t$ meters. What is its instantaneous velocity $v(t) = s'(t)$ at $t = 2$ seconds?

Answer: A. $v(2) = 10$ m/s

Differentiating $s(t)$ gives $v(t) = s'(t) = 6t^2 - 12t + 10$. Evaluating at $t = 2$: $v(2) = 6(2)^2 - 12(2) + 10 = 24 - 24 + 10 = 10$ m/s.

Part B: Power Rule Differentiation Fluency. Complete each derivative calculation with the correct leading coefficient or power.

1. For $f(x) = 5x^4$, the power rule gives $f'(x) = 5 \cdot 4x^3 = 20x^3$.

2. The derivative of any constant value c (e.g., $d/dx [42]$) is identically equal to 0 because a horizontal line has zero rate of change.

3. For the linear function $f(x) = x$, the derivative is $d/dx [x^1] = 1 \cdot x^0 = 1$.

4. If $f(x) = 3x^2$, then $f'(2) = 6(2) = 12$ represents the instantaneous slope at $x = 2$.