AP Calculus AB FRQ Practice · Unit 2

Derivatives From a Table · numberbender.com

Name: _____ Date: _____ Score: / 9

What this question practices

- Estimating a derivative with a difference quotient
- The product rule
- The quotient rule
- Recognizing the limit definition of the derivative

No calculator is allowed for this question. Show all your work, and justify your answers. Suggested time: 15 minutes.

The functions f and g are differentiable for all real numbers. The table gives selected values of f, g and their derivatives.

x	f(x)	f'(x)	g(x)	g'(x)
1	4	2	3	−1
2	7	4	5	2
3	12	6	2	−3

(a) Use the data in the table to estimate f'(2.5). Show the computation that leads to your answer.

(b) Let h be the function defined below. Find h'(2).

$$h(x) = f(x)\,g(x)$$

(c) Let k be the function defined below. Find k'(3).

$$k(x) = \frac{f(x)}{g(x)}$$

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(d) The limit below is the derivative of a function p at a point. Identify p and the point, and find the value of the limit.

$$\lim_{h \to 0} \frac{(2+h)^4 - 16}{h}$$

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This question is worth 9 points, scored the way AP Calculus readers score free-response questions. Compare your work with the model solution, then award yourself points using the scoring notes.

(a) Use the data in the table to estimate f'(2.5). Show the computation that leads to your answer.

$$f'(2.5) \approx \frac{f(3) - f(2)}{3 - 2} = \frac{12 - 7}{1} = 5$$

→ Use the average rate of change of f over the interval [2, 3], which contains 2.5.

Scoring. 1 point for a difference quotient using x = 2 and x = 3, with the value 5.

(b) Let h be the function defined below. Find h'(2).

$$h(x) = f(x)\,g(x)$$

$$h'(2) = f'(2)g(2) + f(2)g'(2) = 4(5) + 7(2) = 34$$

→ Apply the product rule, then read the values at x = 2 from the table.

Scoring. 2 points: 1 point for the product rule, 1 point for the answer 34.

(c) Let k be the function defined below. Find k'(3).

$$k(x) = \frac{f(x)}{g(x)}$$

$$k'(3) = \frac{f'(3)g(3) - f(3)g'(3)}{(g(3))^2} = \frac{6(2) - 12(-3)}{2^2} = \frac{48}{4} = 12$$

→ Apply the quotient rule, being careful with the subtraction order and the sign of g'(3).

Scoring. 3 points: 1 point for the quotient rule, 1 point for correct substitution, 1 point for the answer 12.

(d) The limit below is the derivative of a function p at a point. Identify p and the point, and find the value of the limit.

$$\lim_{h \to 0} \frac{(2+h)^4 - 16}{h}$$

$$p(x) = x^4, \quad x = 2: \quad p'(x) = 4x^3, \quad p'(2) = 4(8) = 32$$

→ Compare with the definition of the derivative: the limit of (p(2 + h) − p(2)) / h as h approaches 0, where p(2) = 16.

Scoring. 3 points: 1 point for $p(x) = x^4$, 1 point for the point x = 2, 1 point for the value 32.

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