Topic: Mean Value Theorem

Question: Which is the correct statement of the Mean Value Theorem?

Answer choices:

A If f is continuous and differentiable on the open interval (a, b), then there exists a number c in (a, b) such that

$$f'(c) = \frac{f(b) - f(a)}{b - a}$$

B If f is continuous on the closed interval $[a, b]$, then there exists a number c in $[a, b]$ such that

$$f'(c) = \frac{f(b) - f(a)}{b - a}$$

C If f is continuous on the closed interval $[a, b]$ and differentiable on the open interval (a, b), then there exists a number c in $[a, b]$ such that

$$f'(c) = \frac{f(b) - f(a)}{b - a}$$

D If f is continuous on the closed interval $[a, b]$ and differentiable on the open interval (a, b), then there exists a number c in (a, b) such that

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$$f'(c) = \frac{f(b) - f(a)}{b - a}$$

Solution: D

The Mean Value Theorem states:

> If f is continuous on the closed interval $[a, b]$ and differentiable on the open interval (a, b), then there exists a number c in (a, b) such that
>
> $$f'(c) = \frac{f(b) - f(a)}{b - a}$$

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Topic: Mean Value Theorem

Question: Which statement is true?

Answer choices:

A The Mean Value Theorem applies to functions that are continuous and differentiable on a given interval (a, b) and states that there will be a point c in the interval such that $f(b) - f(a) = f'(c)(a - b)$.

B The Mean Value Theorem applies to functions that are discontinuous and differentiable on a given interval $[a, b]$ and states that there will be a point c in the interval such that $f(b) - f(a) = f'(c)(b - a)$.

C The Mean Value Theorem applies to functions that are continuous on a given interval $[a, b]$ and differentiable on a given interval (a, b) and states that there will be a point c in the interval such that $f(b) - f(a) = f'(c)(b - a)$.

D The Mean Value Theorem applies to functions that are discontinuous and differentiable on a given interval $[a, b]$ and states that there will be a point c in the interval such that $f(b) - f(a) = f'(c)(a - b)$.

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Solution: C

The Mean Value Theorem applies to functions that are continuous on a given interval $[a, b]$ and differentiable on a given interval (a, b) and states that there will be a point c in the interval such that

$$f(b) - f(a) = f'(c)(b - a)$$

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Topic: Mean Value Theorem

Question: Two police officers are sitting separately along a highway, 3 miles apart. A car passes the first officer at 60 mph, and passes the second officer two minutes later at 58 mph. Can the officers prove that the car was speeding (going faster than 65 mph) at some point between them?

Answer choices:

A Yes, they can prove the car was speeding

B No, they can't prove the car was speeding

C It's impossible to say one way or the other

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Solution: A

The officers can use the Mean Value Theorem to prove that the car was traveling faster than the 65 mph speed limit at some point between them.

Let time $t = 0$ and position $s = 0$ when the car passes the first officer, and let $t = 2/60 = 1/30$ hr (after converting minutes to hours) and $s(1/30) = 3$ miles. Then the average speed of the car over the 3 miles (or 2 minutes) is

$$v_{avg} = \frac{s\left(\frac{1}{30}\right) - s(0)}{\frac{1}{30} - 0}$$

$$v_{avg} = \frac{3 - 0}{\frac{1}{30}}$$

$$v_{avg} = 3 \cdot \frac{30}{1}$$

$$v_{avg} = 90 \text{ mph}$$

By the Mean Value Theorem, the car must have been traveling at 90 mph at some point along the 3-mile stretch.

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