Part 3: AP Questions on the Difference Quotient

If \( f \) is a differentiable function, then \( f'(a) \) is given by which of the following?

I. \( \lim_{h \to 0} \frac{f(a + h) - f(a)}{h} \)

II. \( \lim_{x \to a} \frac{f(x) - f(a)}{x - a} \)

III. \( \lim_{x \to a} \frac{f(x + h) - f(x)}{h} \)

(A) I only \hspace{1cm} (B) II only \hspace{1cm} (C) I and II only \hspace{1cm} (D) I and III only \hspace{1cm} (E) I, II, and III

If \( f(x) = e^x \), which of the following is equal to \( f''(e) \)?

(A) \( \lim_{h \to 0} \frac{e^{x+h}}{h} \)

(B) \( \lim_{h \to 0} \frac{e^{x+h} - e^e}{h} \)

(C) \( \lim_{h \to 0} \frac{e^{x+h} - e}{h} \)

(D) \( \lim_{h \to 0} \frac{e^{x+h} - 1}{h} \)

(E) \( \lim_{h \to 0} \frac{e^{x+h} - e^e}{h} \)

\( \lim_{h \to 0} \frac{\ln(e + h) - 1}{h} \) is

(A) \( f''(e) \), where \( f(x) = \ln x \)

(B) \( f'(e) \), where \( f(x) = \frac{\ln x}{x} \)

(C) \( f'(1) \), where \( f(x) = \ln x \)

(D) \( f'(1) \), where \( f(x) = \ln(x + e) \)

(E) \( f'(0) \), where \( f(x) = \ln x \)
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6. Sketch the graph of a function that has a positive derivative for \(x<2\) and a negative derivative for \(x>2\) and that has \(f'(2)=0\).

7. Sketch the graph of a function that has a positive derivative for \(x<-1\) and a negative derivative for \(x>-1\) and that is not differentiable at 1.

8. Given the graph of \(f(x)\) Sketch \(f'(x)\).

9. Based on the graph fill in the blank with < or >. \[\frac{f(3)-f(1)}{3-1} \, f'(1)\]