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AP Calculus AB FRQ #1

Differentiation

The twice-differentiable function f is defined for all real numbers and satisfies the following conditions:

$f(0) = 2, \quad f'(0) = -4, \quad \text{and } f''(0) = 3.$

(a) The function g is given by $g(x) = e^{ax} + f(x)$ for all real numbers, where a is a constant. Find $g'(0)$ and $g''(0)$ in terms of a. Show all work.

$g(x) = e^{ax} + f(x)$

$g'(x) = e^{ax} \cdot \frac{d}{dx} ax + f'(x)$

$= ae^{ax} + f'(x)$

$g'(0) = ae^{0} + f'(0)$

$\boxed{= a - 4}$

$g''(x) = ae^{ax} \cdot a + f''(x)$

$= a^2 e^{ax} + f''(x)$

$g''(0) = a^2 e^0 + f''(0)$

$\boxed{= a^2 + 3}$

(b) The function h is given by $h(x) = \cos(kx) \cdot f(x)$ for all real numbers and k constant. Find $h'(x)$ and write an equation for the line tangent to the graph of h at $x=0$.

$h(x) = \cos(kx) \cdot f(x)$

$h'(x) = f(x) \cdot \frac{d}{dx} \cos(kx) + \cos(kx) \cdot f'(x)$

$= -\sin(kx) \cdot f(x) \cdot k + \cos(kx) \cdot f'(x)$

$h'(0) = -\sin(0) \cdot f(0) \cdot k + \cos(0) \cdot f'(0)$

$= 0 + 1 \cdot -4 = -4$

$h(0) = \cos(0) \cdot f(0) = 2$

$y - 2 = -4x$