A. These all mean (basically) the same thing:

1. slope of tangent line
2. slope of curve
3. instantaneous rate of change
4. \( \lim_{{h \to 0}} \frac{f(x+h)-f(x)}{h} \)

B. A normal line is a line perpendicular to tangent line at point of tangency.

C. \( \frac{f(a+h)-f(a)}{h} \) is called a difference quotient.

D. Symmetric difference quotient: \( \frac{f(a+h)-f(a-h)}{2h} \)

Definition of Derivative - \( f'(x) = \lim_{{h \to 0}} \frac{f(x+h)-f(x)}{h} \) (Say “f-prime of x”)

One of the applications of derivative is to find the slope of (the tangent line to) a curve.

Ex - Find the slope of the tangent line to \( y = x^2 - 3x - 1 \) at the point \( x = 0 \) using two different methods.

\[
\begin{align*}
f'(x) &= \lim_{{h \to 0}} \frac{f(a+h)-f(a)}{h} \quad \text{let } a = 0 \\
&= \lim_{{h \to 0}} \frac{f(0+h)-f(0)}{h} = \lim_{{h \to 0}} \frac{f(h)-f(0)}{h} \\
&= \lim_{{h \to 0}} \frac{h^2 - 3h - 1 - (-1)}{h} = \lim_{{h \to 0}} \frac{h^2 - 3h}{h} \\
&= \lim_{{h \to 0}} \frac{h(h-3)}{h} = 0 - 3 = -3 \\
f'(0) &= -3
\end{align*}
\]

Generic for any \( x \):

\[
\begin{align*}
f'(x) &= \lim_{{h \to 0}} \frac{f(x+h)-f(x)}{h} \\
&= \lim_{{h \to 0}} \frac{(x+h)^2 - 3(x+h) - 1 - (x^2 - 3x - 1)}{h} \\
&= \lim_{{h \to 0}} \frac{x^2 + 2xh + h^2 - 3x - 3h - 1 - x^2 + 3x + 1}{h} \\
&= \lim_{{h \to 0}} \frac{2xh + h^2 - 3h}{h} = \lim_{{h \to 0}} \frac{h(2x+3)}{h} \\
&= 2x + 3 \\
f'(x) &= 2x + 3
\end{align*}
\]
Find the derivative of each of the following:

1. \( f(x) = 4x^2 - 3x - 5 \)
2. \( f(x) = \frac{1}{2 - x} \)
3. \( f(x) = \sqrt{x + 3} \)
4. \( f(x) = x^3 + 1 \)