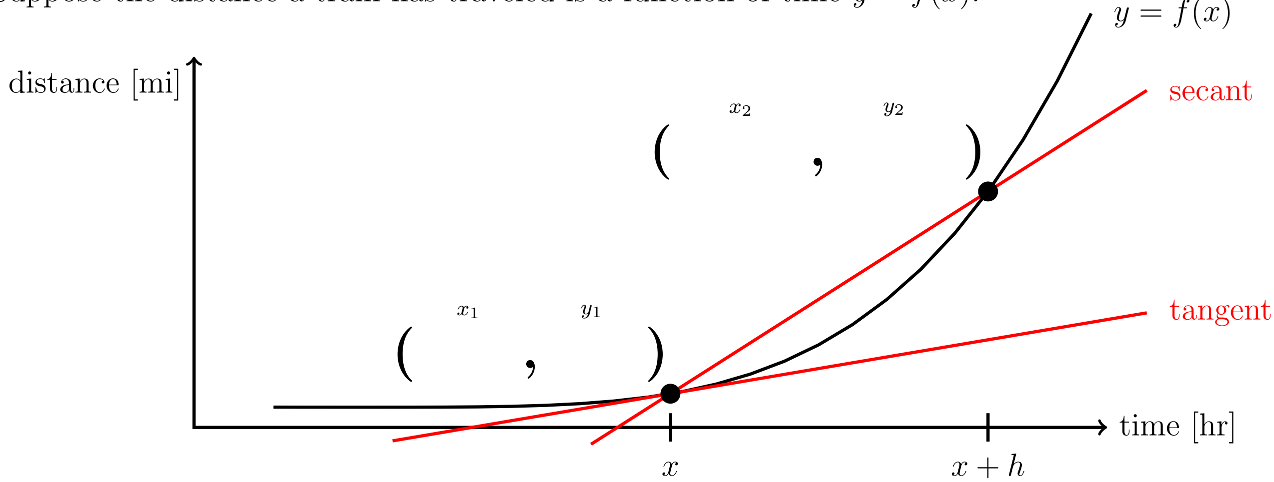
1. **Definition.** The Limit Definition of Derivative

Suppose the distance a train has traveled is a function of time $y = f(x)$.



average velocity over $[x, x+h]$ $=$ average rate of change over $[x, x+h]$ $=$ slope of secant between $x, x+h$ $=$ $\frac{\Delta y}{\Delta x}$ $=$ $\frac{y_2 - y_1}{x_2 - x_1}$ $=$ $\boxed{\qquad\qquad}$ $=$ definition of difference quotient

velocity at x $=$ rate of change at x $=$ slope of tangent at x $=$ $\boxed{\lim_{h \to} \qquad\qquad}$ $=$ definition of derivative $f'(x)$

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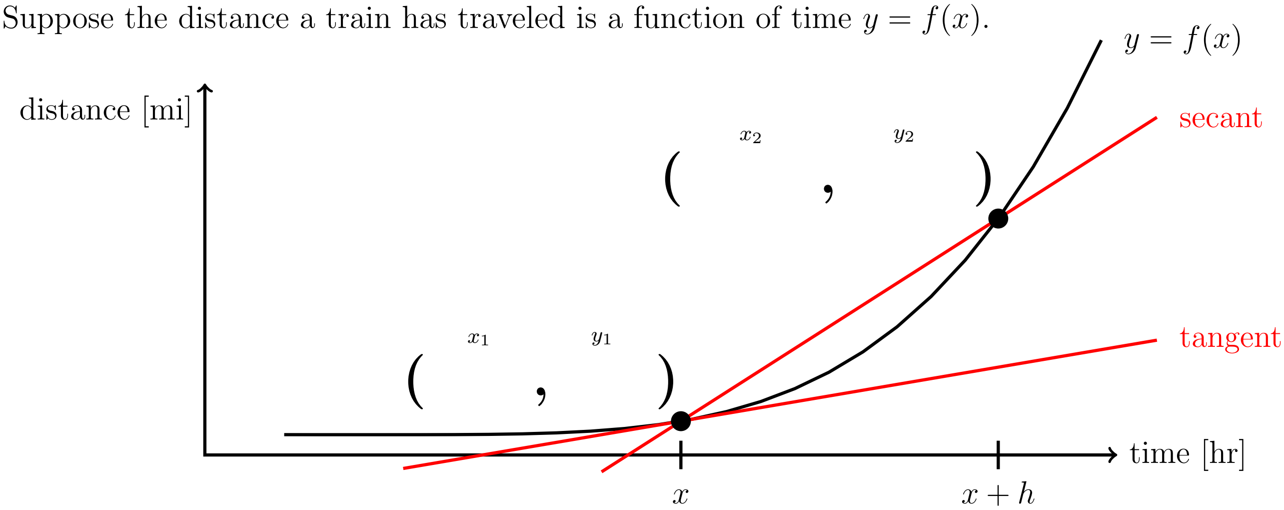

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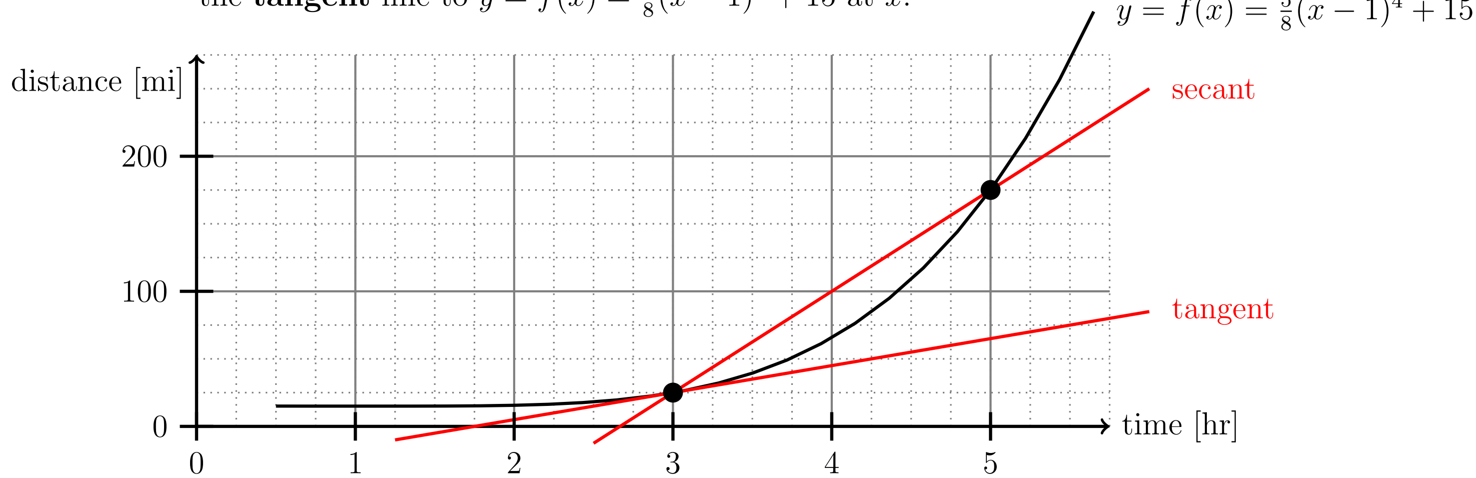
2. **Example.** Use the definition of difference quotient to find the slope of the **secant** line through $y = f(x) = \frac{5}{8}(x-1)^4 + 15$ between x and $x + h$.
Hint: $f(x+h) = \frac{5}{8}((x-1)+h)^4+15$
$= \frac{5}{8}(x-1)^4+4(x-1)^3h+6(x-1)^2h^2+4(x-1)h^3+4h^4+15$

3. **Exercise.** Use the definition of derivative to find the slope of the **tangent** line to $y = f(x) = \frac{5}{8}(x-1)^4 + 15$ at x.



4. **Exercise.** Use the **diagram** to estimate the slope of the **secant** line to $y = f(x) = \frac{5}{8}(x-1)^4 + 15$ **between 3 and 5**.

5. **Exercise.** Use your answer to Exercise 2 above to estimate the slope of the **tangent** line to $y = f(x) = \frac{5}{8}(x-1)^4 + 15$ **at 3**.

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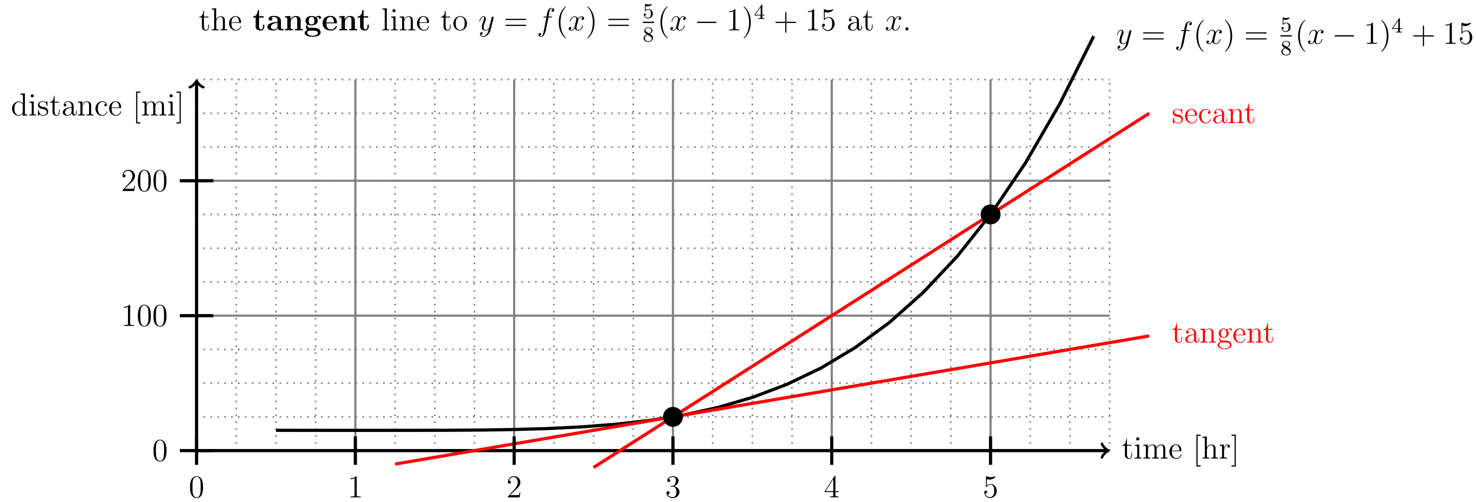

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