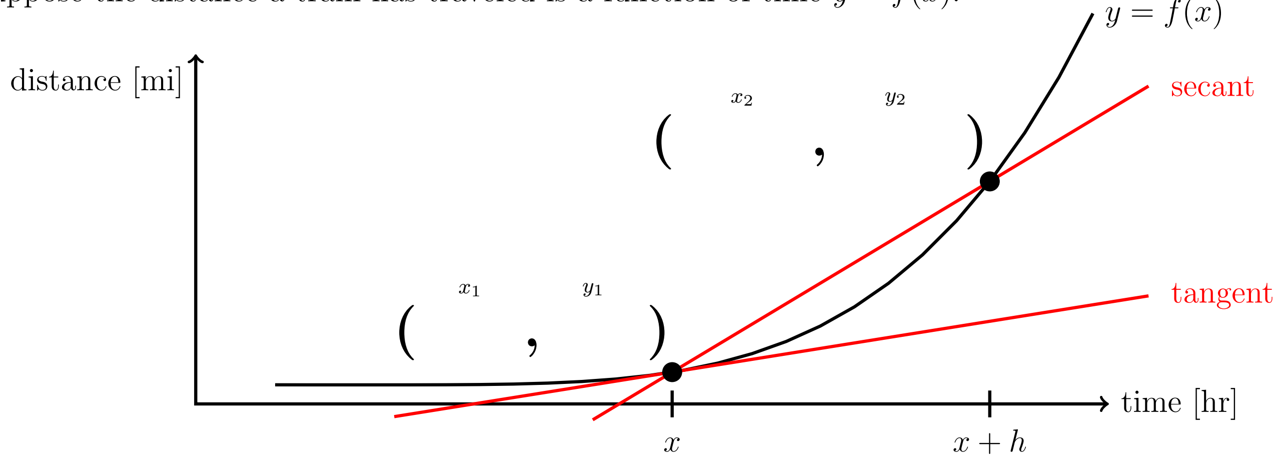
1. **Definition.** The Limit Definition of Derivative

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 $x, x+h$ $=$ $\frac{\Delta y}{\Delta x}$ $=$ $\frac{y_2 - y_1}{x_2 - x_1}$ $=$ $\boxed{\quad\quad\quad\quad}$ $=$ definition of difference quotient

velocity at x $=$ rate of change at x $=$ slope of tangent at x $=$ $\boxed{\lim_{h \to} \quad\quad\quad\quad}$ $=$ definition of derivative written y' or $\frac{dy}{dx}$ or $f'(x)$ or $\frac{d}{dx} f(x)$

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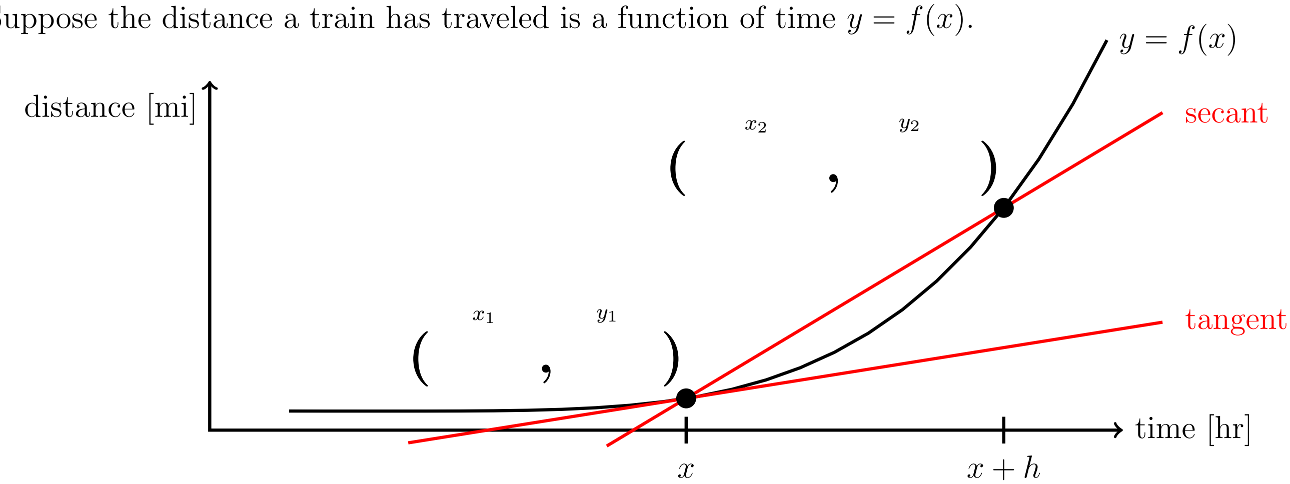

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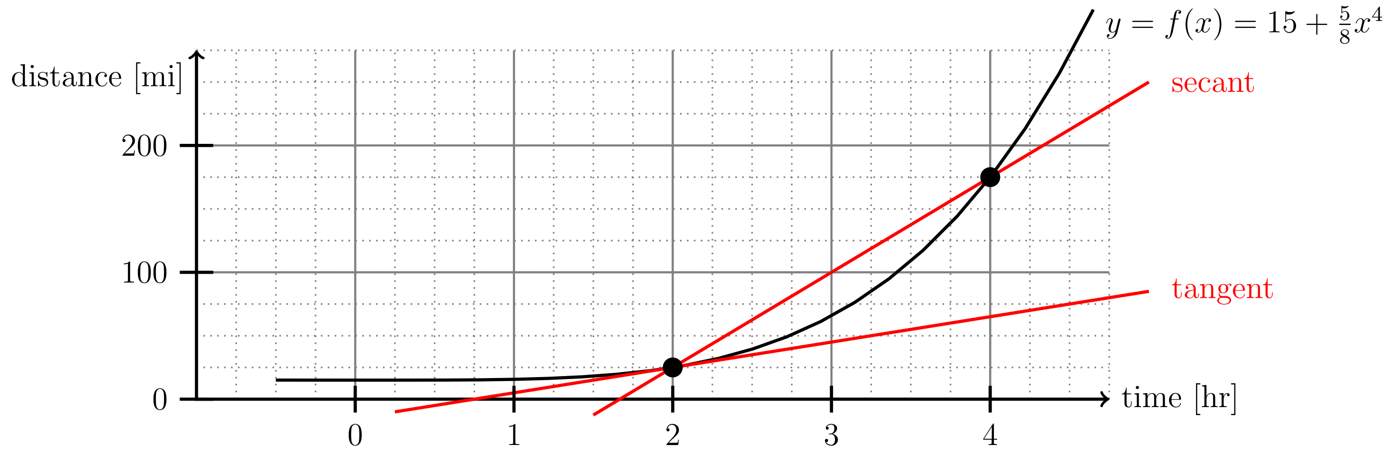
2. **EXAMPLE.** Use the definition of difference quotient to find the slope of the **secant** line through $y = f(x) = 15 + \frac{5}{8}x^4$ between x and $x + h$.
Hint: $f(x+h) \quad = \quad 15 + \frac{5}{8}x^4 + \frac{20}{8}x^3h + \frac{30}{8}x^2h^2 + \frac{20}{8}xh^3 + \frac{5}{8}h^4$

3. **Exercise.** Use the definition of derivative and your answer to **Example 2** to find the slope of the **tangent** line to $y = f(x) = 15 + \frac{5}{8}x^4$ at x.



4. **Exercise.** Use the **diagram** to estimate the slope of the **secant** through $y = 15 + \frac{5}{8}x^4$ **between 2 and 4**.
5. **Exercise.** Use the **diagram** to estimate the slope of the **tangent** line to $y = f(x) = 15 + \frac{5}{8}x^4$ **at 2**.
6. **Exercise.** Use your answer to **Exercise 3** to confirm your answer to **Exercise 5**.

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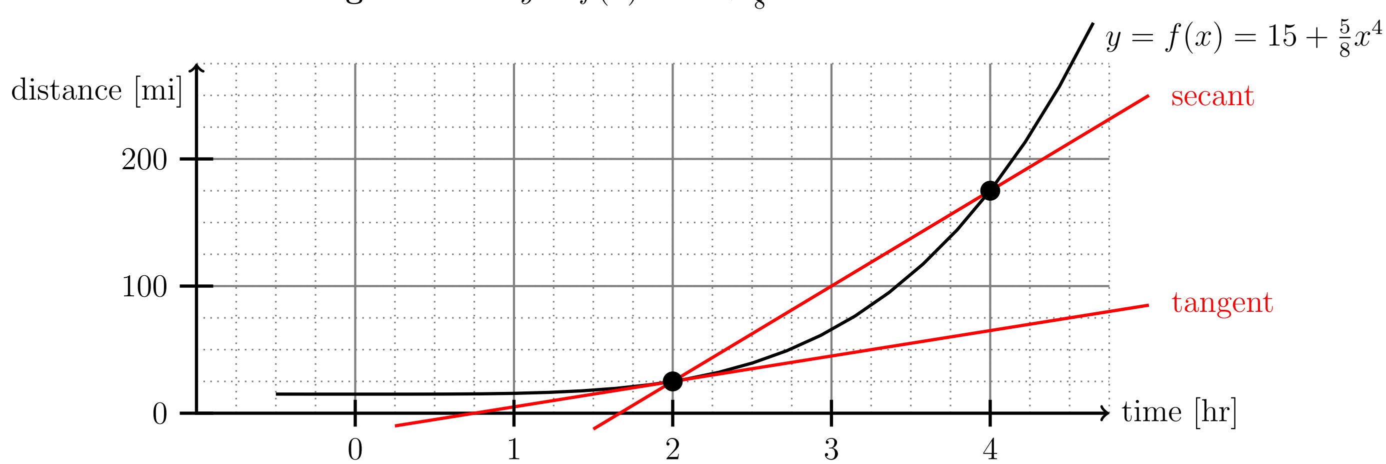

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