2.1 # 18, 36, 46, 52, 72, 74

15, 19, 33, 35, 45, 53, 71,

15) $f(x) = 6 - 2x$, $(2, 2)$

$y = mx + b$

$$f'(x) = \lim_{\Delta x \to 0} \frac{f(x + \Delta x) - f(x)}{\Delta x}$$

$$= \lim_{\Delta x \to 0} \frac{[6 - 2(x + \Delta x)] - [6 - 2x]}{\Delta x}$$

$$= \lim_{\Delta x \to 0} \frac{\cancel{6} - \cancel{2x} - 2\Delta x - \cancel{6} + \cancel{2x}}{\Delta x}$$

$$= \lim_{\Delta x \to 0} \frac{-2\Delta x}{\Delta x}$$

$$= \lim_{\Delta x \to 0} -2 \quad , \quad \Delta x \neq 0$$

$$= -2$$

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19) $f(x) = x^2 - 1$, $(2, 3)$ ☆

$$f'(x) = \lim_{\Delta x \to 0} \frac{f(x + \Delta x) - f(x)}{\Delta x}$$

$$= \lim_{\Delta x \to 0} \frac{[(x + \Delta x)^2 - 1] - (x^2 - 1)}{\Delta x}$$

$$= \lim_{\Delta x \to 0} \frac{\cancel{x^2} + 2x\Delta x + (\Delta x)^2 \cancel{-1} \cancel{-x^2} \cancel{+1}}{\Delta x}$$

$$= \lim_{\Delta x \to 0} \frac{2x\cancel{\Delta x} + (\Delta x)^{\cancel{2}}}{\cancel{\Delta x}}$$

$$= \lim_{\Delta x \to 0} (2x)$$

$$= 2x$$

At $x = 2$

$$f'(2) = 2(2)$$

$$= 4$$

33. $h(t) = \sqrt{t-1}$

$$h'(t) = \lim_{\Delta t \to 0} \frac{h(t+\Delta t) - h(t)}{\Delta t}$$

$$= \lim_{\Delta t \to 0} \frac{\sqrt{(t+\Delta t)-1} - \sqrt{t-1}}{\Delta t} \left(\frac{\sqrt{t+\Delta t-1} + \sqrt{t-1}}{\sqrt{t+\Delta t-1} + \sqrt{t-1}} \right)$$

$$= \lim_{\Delta t \to 0} \left[\frac{(\cancel{t} + \Delta t \cancel{-1}) - (\cancel{t} \cancel{-1})}{\Delta t(\sqrt{t+\Delta t-1} + \sqrt{t-1})} \right]$$

$$= \lim_{\Delta t \to 0} \left[\frac{\cancel{\Delta t}}{\cancel{\Delta t}(\sqrt{t+\Delta t-1} + \sqrt{t-1})} \right]$$

$$= \lim_{\Delta t \to 0} \left[\frac{1}{\sqrt{t+\Delta t-1} + \sqrt{t-1}} \right]$$

$$= \frac{1}{\sqrt{t-1} + \sqrt{t-1}}$$

$$= \frac{1}{2\sqrt{t-1}}$$

35. $f(t) = t^3 - 12t$

$$f'(t) = \lim_{\Delta t \to 0} \frac{f(t+\Delta t) - f(t)}{\Delta t}$$

$$= \lim_{\Delta t \to 0} \frac{[(t+\Delta t)^3 - 12(t+\Delta t)] - (t^3 - 12t)}{\Delta t}$$

$$= \lim_{\Delta t \to 0} \frac{(\cancel{t^3} + 3t^2\Delta t + 3t(\Delta t)^2 + (\Delta t)^3 - \cancel{12t} - 12\Delta t) - (\cancel{t^3} - \cancel{12t})}{\Delta t}$$

$$= \lim_{\Delta t \to 0} \frac{3t^2\cancel{\Delta t} + 3t(\Delta t)^{\cancel{2}} + (\Delta t)^{\cancel{3}\,2} - 12\cancel{\Delta t}}{\cancel{\Delta t}}$$

$$= \lim_{\Delta t \to 0} \left[3t^2 + 3t\,\Delta t + (\Delta t)^2 - 12 \right]$$

$$= 3t^2 - 12$$

45) $f(x) = \frac{1}{x}$, $(1, 1)$

$$f(x) = x^{-1}$$

$$f'(x) = \lim_{\Delta x \to 0} \frac{f(x+\Delta x) - f(x)}{\Delta x}$$

$$= \lim_{\Delta x \to 0} \frac{(x+\Delta x)^{-1} - x^{-1}}{\Delta x}$$

$$= \lim_{\Delta x \to 0} \frac{\frac{1}{x+\Delta x} - \frac{1}{x}}{\Delta x} = \lim_{\Delta x \to 0} \frac{\frac{x}{x(x+\Delta x)} - \frac{x+\Delta x}{x(x+\Delta x)}}{\Delta x}$$

$$= \lim_{\Delta x \to 0} \frac{x-(x+\Delta x)}{x(x+\Delta x)\Delta x} = \lim_{\Delta x \to 0} \frac{-\cancel{\Delta x}}{x\cancel{\Delta x}(x+\Delta x)}$$

$$= \lim_{\Delta x \to 0} \frac{-1}{x(x+\Delta x)} = \frac{-1}{x^2}$$

$$f'(1) = \frac{-1}{(1)^2} = -1$$

$y - y_0 = m(x - x_0)$ $(1, 1)$

$$y - 1 = -1(x - 1)$$

$$y - 1 = -1x + 1$$

$$y = -x + 2$$

71) The slope of $f(x) = x^2$ is different at every point.

$$\lim_{\Delta x \to 0} \frac{(x+\Delta x)^2 - x^2}{\Delta x} = \lim_{\Delta x \to 0} \frac{\cancel{x^2} + 2x\cancel{\Delta x} + (\Delta x)^{\cancel{2}} - \cancel{x^2}}{\cancel{\Delta x}}$$

$$= \lim_{\Delta x \to 0} (2x + \Delta x)$$

$$= 2x$$

x can be any real number

$f'(x) = 2x$

So the slope is different at every point.