① $f(x) = x^2 - x$ $\qquad f'(3)$

$$f'(3) = \lim_{x \to 3} \frac{(x^2 - x) - (3^2 - 3)}{x - 3}$$

$$= \lim_{x \to 3} \frac{x^2 - x - 6}{x - 3}$$

$$= \lim_{x \to 3} \frac{\cancel{(x-3)}(x+2)}{\cancel{x-3}} = 5$$

② $f(x) = \sqrt{x+7}$

$f'(2)$

$$f'(2) = \lim_{x \to 2} \frac{\sqrt{x+7} - \sqrt{2+7}}{x - 2}$$

$$= \lim_{x \to 2} \frac{\sqrt{x+7} - 3}{x - 2} \cdot \frac{\sqrt{x+7} + 3}{\sqrt{x+7} + 3}$$

$$= \lim_{x \to 2} \frac{\overset{\overset{1}{\cancel{x-2}}}{\cancel{(x+7)-9}}}{\cancel{(x-2)}\left(\sqrt{x+7}+3\right)} = \frac{1}{6}$$

③ $f(x) = x^2$ $\quad (h = \Delta x)$

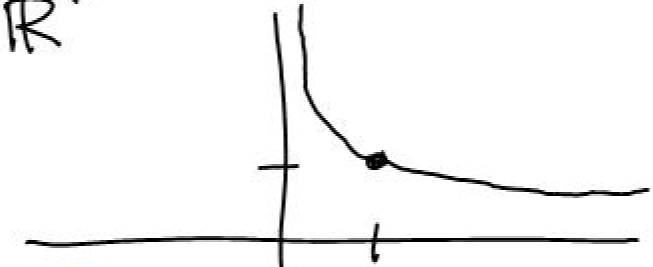
$$\qquad\qquad f(x+h) \quad - \quad f(x)$$

$$f'(x) = \lim_{h \to 0} \frac{(x+h)^2 - x^2}{h}$$

$$= \lim_{h \to 0} \frac{\cancel{x^2} + 2xh + h^2 - \cancel{x^2}}{h}$$

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

④ $f(x) = \frac{1}{\sqrt{x}}$ D: $\mathbb{R}^+$



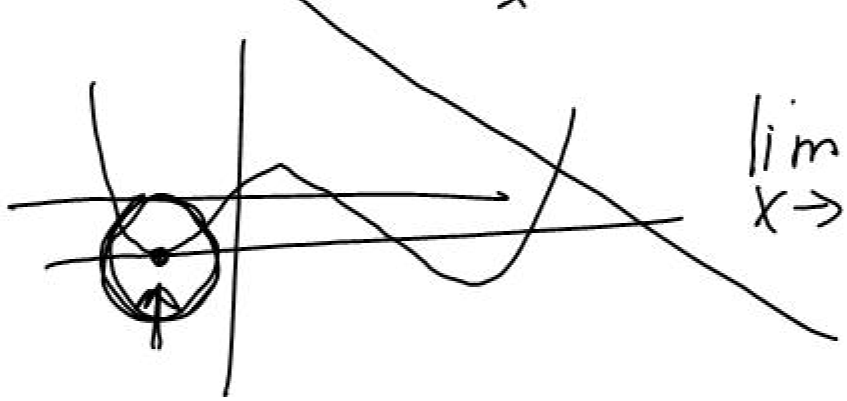
$$f'(x) = \lim_{h\to 0} \frac{\frac{1\sqrt{x}}{\sqrt{x}\sqrt{x+h}} - \frac{1\sqrt{x+h}}{\sqrt{x}\sqrt{x+h}}}{\cancel{\frac{h}{1}}} \cdot \frac{1}{h}$$

$$= \lim_{h\to 0} \frac{(\sqrt{x} - \sqrt{x+h})}{h\sqrt{x}\sqrt{x+h}} \cdot \frac{(\sqrt{x} + \sqrt{x+h})}{\sqrt{x} + \sqrt{x+h}}$$

$$= \lim_{h\to 0} \frac{\cancel{x} - \cancel{x} - \overset{-1}{\cancel{h}}}{\cancel{h}\sqrt{x}\sqrt{x+\cancel{h}}\cdot(\sqrt{x} + \sqrt{x+\cancel{h}})}$$

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

$$\lim_{x\to\infty} f'(x) = \lim_{x\to\infty} \frac{-1}{2x\sqrt{x}} = 0$$



$$\lim_{x\to 0^+} f'(x) =$$

#4

$x(t)$ = position function

t: independent var.

x: dependent var.

$m = \frac{\Delta y}{\Delta x}$

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(3) $r'(\theta) = \frac{dr}{d\theta}$

$r(\theta + h) \quad - \quad r(\theta)$

$$= \lim_{h \to 0} \frac{\left(\sqrt{3(\theta+h)-5} - \sqrt{3\theta-5}\right)}{h} \cdot \frac{\left(\sqrt{3(\theta+h)-5} + \sqrt{3\theta-5}\right)}{\sqrt{3(\theta+h)-5} + \sqrt{3\theta-5}}$$

$\cancel{3\theta} + 3\cancel{h} - \cancel{5} \cancel{-3\theta} + \cancel{5}$

$$= \lim_{h \to 0} \frac{3(\theta+h)-5 - 3\theta + 5}{\cancel{h}\left(\sqrt{3(\theta+\cancel{h})-5} + \sqrt{3\theta-5}\right)} = \frac{3}{2\sqrt{3\theta-5}}$$

6 $y'(t) = \frac{dy}{dt}$

$$= \lim_{h\to 0} \frac{\left(3\overbrace{(t+h)^2}^{t^2+2th+h^2} - 2(t+h) + 1\right) - \left(3t^2 - 2t + 1\right)}{h}$$

$$= \lim_{h\to 0} \frac{\cancel{3t^2} + 6th + 3h^2 - \cancel{2t} - 2h + \cancel{1} - \cancel{3t^2} + \cancel{2t} - \cancel{1}}{h}$$

$$= \lim_{h\to 0} \frac{\cancel{h}(6t+3h-2)}{\cancel{h}} = 6t-2$$

$$y'(-2) = \left.\frac{dy}{dt}\right|_{t=-2} = 6(-2) - 2 = -14$$

$$\boxed{\text{HW \# 1, 2, 4, 5, 7}}$$