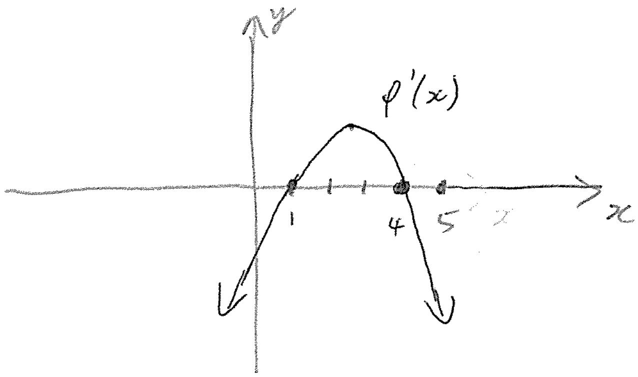
2.4

2) a) $f'(0) \approx -1.5$ b) $f'(1) = 0$ c) $f'(2) \approx 0.8$

d) $f'(3) \approx 0.75$ e) $f'(4) = 0$ f) $f'(5) \approx -0.5$



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18) $g(t) = 3t+5$

$g(t+h) = 3(t+h)+5 = 3t+3h+5$

$$g'(t) = \lim_{h\to 0} \frac{g(t+h)-g(t)}{\boxed{h}} = \lim_{h\to 0} \frac{(3t+3h+5)-(3t+5)}{\boxed{h}}$$

$$= \lim_{h\to 0} \frac{3h}{\boxed{h}} = \lim_{h\to 0} 3 = \underline{\underline{3}}$$

---

20) $f(x) = 1.5x^2 - x + 3.7$

$f(x+h) = 1.5(x+h)^2 - (x+h) + 3.7 = 1.5(x^2+2xh+h^2) - x - h + 3.7$

$= 1.5x^2 + 3xh + 1.5h^2 - x - h + 3.7$

$$f'(x) = \lim_{h\to 0} \frac{f(x+h)-f(x)}{\boxed{h}} = \lim_{h\to 0} \frac{(1.5x^2+3xh+1.5h^2-x-h+3.7)-(1.5x^2-x+3.7)}{\boxed{h}}$$

$$= \lim_{h\to 0} \frac{3xh+1.5h^2-h}{\boxed{h}} = \lim_{h\to 0} \frac{h(3x+1.5h-1)}{\boxed{h}} = \lim_{h\to 0} (3x+1.5h-1)$$

$$= 3x+1.5(0)-1 = \underline{\underline{3x-1}}$$

22) $y = 2x^3 + 7x^2 = y(x)$

$$y(x+h) = 2(x+h)^3 + 7(x+h)^2 = 2(x+h)(x^2+2xh+h^2) + 7(x^2+2xh+h^2)$$
$$= 2(x^3+3x^2h+3xh^2+h^3) + 7x^2 + 14xh + 7h^2$$
$$= 2x^3 + 6x^2h + 6xh^2 + 2h^3 + 7x^2 + 14xh + 7h^2$$

$$y'(x) = \lim_{h\to 0} \frac{y(x+h)-y(x)}{\boxed{h}} = \lim_{h\to 0} \frac{(2x^3+6x^2h+6xh^2+2h^3+7x^2+14xh+7h^2)-(2x^3+7x^2)}{\boxed{h}}$$
$$= \lim_{h\to 0} \frac{6x^2h+6xh^2+2h^3+14xh+7h^2}{\boxed{h}} = \lim_{h\to 0} \frac{h(6x^2+6xh+2h^2+14x+7h)}{\boxed{h}}$$
$$= \lim_{h\to 0} (6x^2+6xh+2h^2+14x+7h) = 6x^2+6x(0)+2(0)^2+14x+7(0) = \underline{\underline{6x^2+14x}}$$

---

24) $N(t) = \frac{1}{t^2}$ $\quad N(t+h) = \frac{1}{(t+h)^2}$

GLCD $= (t^2(t+h)^2)$

$$N'(t) = \lim_{h\to 0} \frac{N(t+h)-N(t)}{\boxed{h}} = \lim_{h\to 0} \frac{\left(\frac{1}{(t+h)^2}\right)-\left(\frac{1}{t^2}\right)}{\boxed{h}}$$
$$= \lim_{h\to 0} \left(\frac{\frac{1}{(t+h)^2}-\frac{1}{t^2}}{\frac{\boxed{h}}{1}}\right)\left(\frac{\frac{t^2(t+h)^2}{1}}{\frac{t^2(t+h)^2}{1}}\right) = \lim_{h\to 0} \frac{1(t^2)-1(t+h)^2}{\boxed{h}\,t^2(t+h)^2}$$
$$= \lim_{h\to 0} \frac{t^2-(t^2+2th+h^2)}{\boxed{h}\,t^2(t+h)^2} = \lim_{h\to 0} \frac{-2th-h^2}{\boxed{h}\,t^2(t+h)^2} =$$
$$= \lim_{h\to 0} \frac{h(-2t-h)}{\boxed{h}\,t^2(t+h)^2} = \lim_{h\to 0} \frac{-2t-h}{t^2(t+h)^2}$$
$$= \frac{-2t-(0)}{t^2(t+(0))^2} = \frac{-2t}{t^2(t)^2} = \frac{-2t}{t^4} = \underline{\underline{\frac{-2}{t^3}}}$$

26) $f(x) = \dfrac{3+x}{1-3x}$

$$1-3x=0$$
$$1=3x$$
$$\tfrac{1}{3}=x$$

domain: $(-\infty, \tfrac{1}{3}) \cup (\tfrac{1}{3}, \infty)$

$$f(x+h) = \frac{3+(x+h)}{1-3(x+h)} = \frac{3+x+h}{1-3x-3h}$$

$$GLCD = (1-3x)(1-3x-3h)$$

$$f'(x) = \lim_{h \to 0} \frac{f(x+h)-f(x)}{\boxed{h}} = \lim_{h \to 0} \frac{\left(\frac{3+x+h}{1-3x-3h}\right) - \left(\frac{3+x}{1-3x}\right)}{\boxed{h}}$$

$$= \lim_{h \to 0} \left(\frac{\frac{3+x+h}{1-3x-3h} - \frac{3+x}{1-3x}}{\frac{\boxed{h}}{1}} \right) \left(\frac{\frac{(1-3x)(1-3x-3h)}{1}}{\frac{(1-3x)(1-3x-3h)}{1}} \right) = \lim_{h \to 0} \frac{(3+x+h)(1-3x)-(3+x)(1-3x-3h)}{\boxed{h}(1-3x)(1-3x-3h)}$$

$$= \lim_{h \to 0} \frac{(3+x+h-9x-3x^2-3xh)-(3-9x-9h+x-3x^2-3xh)}{\boxed{h}(1-3x)(1-3x-3h)} = \lim_{h \to 0} \frac{h-9h}{\boxed{h}(1-3x)(1-3x-3h)}$$

$$= \lim_{h \to 0} \frac{h(1-9)}{\boxed{h}(1-3x)(1-3x-3h)} = \lim_{h \to 0} \frac{1-9}{(1-3x)(1-3x-3h)} = \frac{1-9}{(1-3x)(1-3x-3(0))}$$

$$= \frac{8}{(1-3x)(1-3x)} = \underline{\underline{\frac{8}{(1-3x)^2}}}$$

domain: $(-\infty, \tfrac{1}{3}) \cup (\tfrac{1}{3}, \infty)$

---

28) $f(x) = x + \sqrt{x}$

$$x \geq 0$$
$$0 \leq x$$

domain: $[0, \infty)$

$$f(x+h) = (x+h) + \sqrt{(x+h)} = x+h+\sqrt{x+h}$$

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

$$= \lim_{h \to 0} \frac{h+\sqrt{x+h}-\sqrt{x}}{\boxed{h}} = \lim_{h \to 0} \left\{ \frac{h}{\boxed{h}} + \frac{\sqrt{x+h}-\sqrt{x}}{\boxed{h}} \right\}$$

$$= \lim_{h \to 0} \left\{ 1 + \left(\frac{\sqrt{x+h}-\sqrt{x}}{\boxed{h}} \right) \left(\frac{\sqrt{x+h}+\sqrt{x}}{\sqrt{x+h}+\sqrt{x}} \right) \right\}$$

$\vdots$

28) continued

$$\vdots = \lim_{h\to 0}\left\{1+\frac{(x+h)-(x)}{\boxed{h}\left(\sqrt{x+h}+\sqrt{x}\right)}\right\} = \lim_{h\to 0}\left\{1+\frac{h}{\boxed{h}\left(\sqrt{x+h}+\sqrt{x}\right)}\right\}$$

$$= \lim_{h\to 0}\left\{1+\frac{1}{\sqrt{x+h}+\sqrt{x}}\right\} = 1+\frac{1}{\sqrt{x+(0)}+\sqrt{x}} = 1+\frac{1}{\sqrt{x}+\sqrt{x}} = \underline{\underline{1+\frac{1}{2\sqrt{x}}}}$$

$x > 0$ "because even root appears in denominator" domain: $\underline{(0,\infty)}$

$0 < x$

---

30) $g(t) = \dfrac{1}{\sqrt{t}}$ $\quad t > 0 \quad 0 < t$ $\quad$ domain: $(0,\infty)$

$$g(t+h) = \frac{1}{\sqrt{(t+h)}} = \frac{1}{\sqrt{t+h}}$$

$$g'(t) = \lim_{h\to 0}\frac{g(t+h)-g(t)}{\boxed{h}} = \lim_{h\to 0}\frac{\left(\frac{1}{\sqrt{t+h}}\right)-\left(\frac{1}{\sqrt{t}}\right)}{\boxed{h}}$$

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

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

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

$$= \frac{-1}{\sqrt{t}\,\sqrt{t+(0)}\left(\sqrt{t}+\sqrt{t+(0)}\right)} = \frac{-1}{\sqrt{t}\,\sqrt{t}\left(\sqrt{t}+\sqrt{t}\right)} = \frac{-1}{\sqrt{t}\,\sqrt{t}\left(2\sqrt{t}\right)}$$

$$= \underline{\underline{\frac{-1}{2\left(\sqrt{t}\right)^3}}} \qquad \text{domain: } (0,\infty)$$

38)

a) Increasing: $[0, 1)$, $(3, 5)$

decreasing: $(1, 3)$, $(5, 6]$

b) local max or local min (point of extrema / critical point)

$x = 1$, $x = 3$, $x = 5$

c)