1. (1)

$$\left(\frac{x^2+1}{x^2-1}+\frac{x^2}{x+2}\right)'$$

$$=\frac{2x(x^2-1)-(x^2+1)\cdot 2x}{(x^2-1)^2}+\frac{2x\cdot(x+2)-x^2}{(x+2)^2}$$

(2)

$$\left(\frac{x\tan x}{1+\cos x}\right)'$$

$$=\frac{(x\tan x)'\cdot(1+\cos x)-x\tan x\cdot(-\sin x)}{(1+\cos x)^2}$$

$$=\frac{(\tan x+x\sec^2 x)(1+\cos x)+x\tan x\sin x}{(1+\cos x)^2}$$

(3)

$$\frac{d}{dt}\left(\frac{t+\sin t}{t^2\cos t}\right)$$

$$=\frac{(1+\cos t)\,t^2\cos t-(t+\sin t)(2t\cos t-t^2\sin t)}{t^4\cos^2 t}$$

(4) $(x^2\cos x+x^3)'$

$$=2x\cos x-x^2\sin x+3x^2$$

$$(x^2\cos x + x^3)''$$

$$= 2\cos x - 4x\sin x - x^2\cos x + 6x$$

(5) $(x^5 + \sin x)^{(29)}$

$29 = 28 + 1$

$$= (x^5)^{(29)} + (\sin x)^{(29)}$$

$$= \cos x$$

2. $$f'(3) = \lim_{h\to 0} \frac{f(3+h) - f(3)}{h}$$

$$\underset{h=1}{\approx} \frac{f(4) - f(3)}{h} = \frac{23 - 13}{1} = 10$$

Alternatively, take $h = -1$

$$f'(3) \approx \frac{f(2) - f(3)}{-1} = \frac{6 - 13}{-1} = 7$$

3. $$\underbrace{f(a+h)}_{\sqrt{3.999}} \approx \underbrace{f(a)}_{\sqrt{4}} + f'(a)h \quad \text{for small } h$$

$f(x) = \sqrt{x}$ $\qquad a = 4$ $\qquad h = -0.001$

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

$$f(3.999) \approx f(4) + f'(4)\cdot(-0.001)$$

$$= 2 + \frac{1}{2\cdot\sqrt{4}}\cdot(-0.001)$$

$$= 1.99975$$

4. $s(t) = \frac{1}{t+1} + \frac{t}{4} + k \,, \quad t \geq 0$

(1) $s(0)=0 \qquad \frac{1}{0+1} + \frac{0}{4} + k = 0 \Rightarrow k = -1$

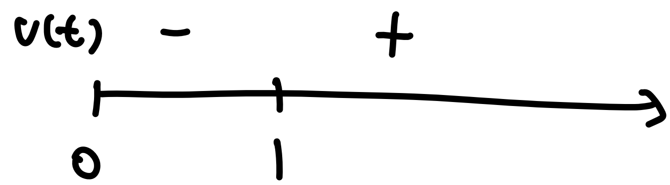
(2) $v(t) = \frac{0\cdot(t+1) - 1\cdot 1}{(t+1)^2} + \frac{1}{4} = -\frac{1}{(t+1)^2} + \frac{1}{4}$

$$a(t) = -\frac{0\cdot(t+1) - 1\cdot(2t+2)}{(t+1)^4} = \frac{2t+2}{(t+1)^4} = \frac{2}{(t+1)^3}$$

(3) $v(t)=0 \Rightarrow -\frac{1}{(t+1)^2} + \frac{1}{4} = 0$

$$\Rightarrow t = 1 \text{ or } \cancel{-3}$$

(4) $v(t) > 0$



$\Rightarrow (1, \infty)$