③ ⓐ f is increasing when f' is positive $(-3,-1) \cup (5,\infty)$

ⓑ $(-\infty,-3) \cup (-1,5)$

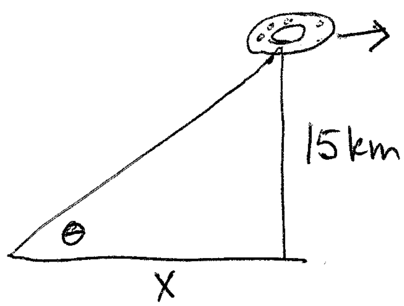
ⓒ positive

ⓓ $-3, 5$

ⓔ when f' is decreasing: $(-2,3)$

ⓕ $f'(0) = -2$.

④



$\cot\theta = \frac{x}{15}$

$-\csc^2\theta \frac{d\theta}{dt} = \frac{dx}{dt}\left(\frac{1}{15}\right)$

$\frac{dx}{dt} = -15\csc^2\theta\left(\frac{d\theta}{dt}\right)$

$= -15\csc^2\left(\frac{\pi}{3}\right)(-0.1)$

$= \boxed{2}$

⑤ $x' = 4t-1 \quad y' = 2t+1 \quad \frac{dy}{dx} = \frac{2t+1}{4t-1}$ tangent line: $y-(t^2+t+1) = \left(\frac{2t+1}{4t-1}\right)(x-(2t^2-t))$

$(1,0)$ is on this tangent line if $0-(t^2+t+1) = \left(\frac{2t+1}{4t-1}\right)(1-2t^2+t)$

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

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

$\boxed{t=0 \text{ or } t=-2}$

$\boxed{P=(0,1) \text{ or } P=(10,3)}$

(b) $t = -2$

1 (a) $\frac{0}{0}$ ⇝ use L'Hôpital. $\lim_{x\to 0} \frac{\pi \sec^2(\pi x)}{\frac{1}{1+x}} = \frac{\pi}{1} = \boxed{\pi}$

(b) ∞^0 ⇝ need to do some work.

$\tan x^{\cos x} = \frac{\sin x^{\cos x}}{\cos x^{\cos x}}$ at $\frac{\pi}{2}$, $(\sin x)^{\cos x} = 1^0 = 1$. What is $\cos x^{\cos x}$?

take ln: $\lim_{x\to\frac{\pi}{2}^-} \ln\left(\cos x^{\cos x}\right) = \lim_{x\to\frac{\pi}{2}^-} \cos x \ln(\cos x) =$

$(0)\cdot(-\infty)$ needs work.

$= \lim_{x\to\frac{\pi}{2}^-} \frac{\ln(\cos x)}{\sec x} = \lim_{x\to\frac{\pi}{2}^-} \frac{\frac{1}{\cos x}(-\sin x)}{\sec x \tan x} = \frac{-\sin x}{\cos x \sec x \tan x} = \frac{-\sin x \cos^2 x}{\cos x \sin x}$

$\frac{\infty}{\infty}$, use L'Hôpital

$= -\cos x = 0.$

take exp to undo the ln: $\lim_{x\to\pi/2^-} \cos x^{\cos x} = e^0 = 1.$

so $\lim \frac{\sin x^{\cos x}}{\cos x^{\cos x}} = \frac{1}{1} = \boxed{1}$

(c) $\lim_{x\to\infty} \frac{\sqrt{100x^2+1} - x}{x-1} \overset{\text{Rationalize}}{=} \lim_{x\to\infty} \frac{99x^2+1}{(x-1)(\sqrt{100x^2+1}+x)} \frac{\cdot 1/x^2}{\cdot 1/x^2}$

$\lim_{x\to\infty} (99x^2+1)\left(\frac{1}{x^2}\right) = \lim_{x\to\infty} 99 + \frac{1}{x^2} = 99$

$\lim_{x\to\infty} (x-1)(\sqrt{100x^2+1}+x)\left(\frac{1}{x^2}\right) = \lim_{x\to\infty}\left(\frac{x-1}{x}\right)\left(\frac{\sqrt{100x^2+1}+x}{x}\right) \overset{\lim}{=} \left(1-\frac{1}{x}\right)\left(\sqrt{100+\frac{1}{x^2}}+1\right)$

$= (1)(\sqrt{100}+1) = 11.$

so the answer is $\frac{99}{11} = \boxed{9.}$

7 (a) $f'(x) = \left(\frac{1}{2\sqrt{1+3\ln(\ln(x)+1)}}\right)\left(\frac{3}{\ln(x)+1}\right)\left(\frac{1}{x}\right)$. $f'(1) = \left(\frac{1}{2}\right)(3)(1) = \boxed{\frac{3}{2}}$

$L = f'(1)(x-1) + f(1) = \boxed{\frac{3}{2}(x-1)+1}$

(b) $\frac{3}{2}(0.02)+1 = \boxed{1.03}$