$$\lim_{x\to 0}\frac{\sin x}{x}\left(\tfrac{0}{0}\text{ form}\right)=\lim_{x\to 0}\frac{\cos x}{1}=\lim_{x\to 0}\cos x=\cos 0=1$$

$$\frac{\sin 0}{0}=\frac{0}{0}$$

L'Hospital's Rule

$$\lim_{x\to a}\frac{f(x)}{g(x)}\quad\left[\frac{f(a)}{g(a)}\text{ is either }\frac{0}{0}\text{ or }\frac{\infty}{\infty}\right]$$

$$\| \quad \lim_{x\to a}\frac{f'(x)}{g'(x)}$$

$$\lim_{x\to 0^+}\frac{\cot x}{\ln x}\left(\tfrac{\infty}{\infty}\text{ form}\right)\qquad \frac{\cot 0}{\ln 0}=\frac{\infty}{\infty}$$

$$=\lim_{x\to 0^+}\frac{-\csc^2 x}{\frac{1}{x}}$$

$$\boxed{\lim_{x\to 0}\frac{\sin x}{x}=1 \quad \lim_{x\to 0}\frac{1-\cos x}{x}=0}$$

$$=\lim_{x\to 0^+}\frac{-x}{\sin^2 x}\qquad \frac{0}{0}$$

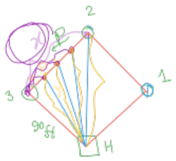
$$=\lim_{x\to 0^+}\frac{-x}{1-\cos^2 x}\qquad \boxed{\frac{0}{0}\ /\ \frac{\infty}{\infty}}$$

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

$$=\lim_{x\to 0^+}\frac{1}{\frac{1-\cos x}{x}}\cdot\frac{-1}{1+\cos x}$$

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

$$=\infty\left(-\frac{1}{2}\right)=\infty$$



$$x^2+90^2=y^2$$

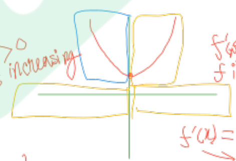
$$\frac{d}{dt}(x^2+90^2)=\frac{d}{dt}(y^2)$$

$$\Rightarrow 2x\frac{dx}{dt}+0=2y\frac{dy}{dt}$$

$$\Rightarrow \boxed{\frac{dy}{dt}=\frac{x}{y}\frac{dx}{dt}}=\frac{-20}{\sqrt{8500}}\,30\ \text{ft/s}=\boxed{-6.51\ \text{ft/s}}$$

$x=20$ ft $\quad y=\sqrt{x^2+90^2}=\sqrt{20^2+90^2}=\sqrt{8500}$

$$\left.\frac{dx}{dt}\right|_{x=20}=-30\ \text{ft/s}$$



$f'(x)>0$, f is increasing

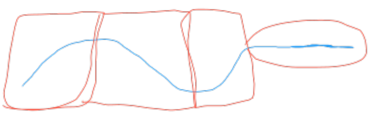
$f'(x)<0$, f is decreasing

$f'(x)=0$

Increasing $f(x)=x^2+2$ decreasing

$x=2,\ f(2)=6$
$x=3,\ f(3)=11$
$x=4,\ f(4)=18$

$x=-4,\ f(-4)=18$
$x=-3,\ f(-3)=11$
$x=-1,\ f(-1)=3$



$\boxed{f(x)=5+12x-x^3}$ $\quad D_f=(-\infty,+\infty)$

$f'(x)=\frac{d}{dx}(\ )=12-3x^2$
$=3(4-x^2)$
$=\boxed{3(2+x)(2-x)}$

We set, $f'(x)=0$

$\Rightarrow 3(2+x)(2-x)=0\Rightarrow x=2,-2$

Intervals	sign of $f'(x) = 3(2+x)(2-x)$	Conclusion
$-\infty<x<-2$	$(+)(-)(+)=(-)$	f is decreasing
$-2<x<2$	$(+)(+)(+)=(+)$	f is increasing
$2<x<\infty$	$(+)(+)(-)=(-)$	f is decreasing

$f''(x)=-6x$ $\quad D_f=(-\infty,\infty)$

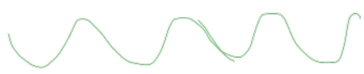
We set $f''(x)=0$

$\Rightarrow -6x=0$

$\Rightarrow x=0$

Interval	Sign of $f''(x)=-6x$	Conclusion
$-\infty<x<0$	$(-)(-)=(+)$	f is concave up
$0<x<\infty$	$(-)(+)=(-)$	f is concave down

x = 0 is a point of inflection.



Concavity:

$f''(x)=0$
$\to$ inflection point.