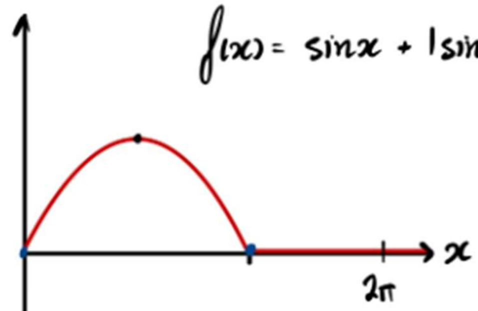
1) $f(x) = \sin x + |\sin x|$



for $0 < x < \pi$, $f(x) = 2\sin x$ since $\sin x + \sin x$ where $|\sin x| > 0$.

$$\frac{d}{dx}(2\sin x) = 2\cos x$$

- $f'(x) = 2\cos x,\ 0 < x < \pi$
- $f'(x) =$ undefined when $x = 0,\ x = \pi,\ x = 2\pi$
- $f'(x) = 0,\ \pi < x \leq 2\pi$

2) $f(x) = \sin x + \cos x$

$A\sin(x+\alpha) = A\sin x\cos\alpha + A\cos x\sin\alpha$

comparing coefficients of $\sin x$ and $\cos x$;

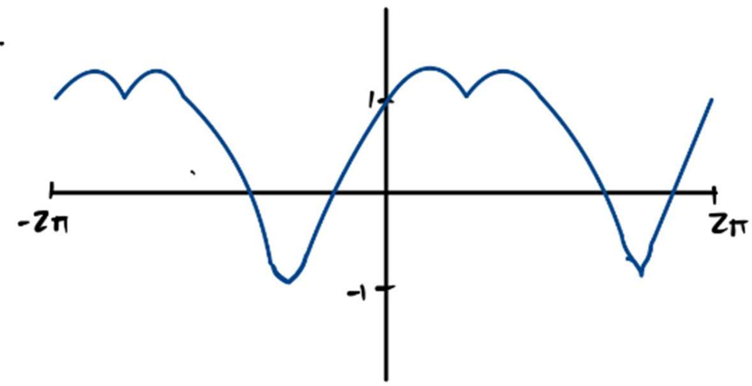
$A\cos\alpha = 1$ and $A\sin\alpha = 1$

$A\sin\alpha = A\cos\alpha \rightarrow \frac{\sin\alpha}{\cos\alpha} = 1 \rightarrow \alpha = \tan^{-1}(1) \therefore \frac{\pi}{4}^{c}$

$A\cos(\pi/4) = 1 \rightarrow A = 1/\cos(\pi/4) \therefore A = \frac{1}{1/\sqrt{2}} = \sqrt{2}$

$\therefore \sin x + \cos x = \underline{\sqrt{2}\sin(x + \pi/4)}$

3.



where $\cos x > 0$ is $-2\pi \le x < -3/2\,\pi$, $-\frac{\pi}{2} < x < \frac{\pi}{2}$, $\frac{3}{2}\pi < x < 2\pi$

* for $-2\pi \le x \le 2\pi$

when $\cos x > 0$ $f(x)$: $\sqrt{2}\sin(x + \pi/4)$

$\hookrightarrow f'(x) = \sqrt{2}\cos(x + \pi/4)$ ①

when $\cos x < 0$ $f(x)$: $\sin x - \cos x$

$\hookrightarrow f'(x) = \cos x + \sin x$ ②

$\therefore$ $f'(x) = \sqrt{2}\cos(x + \pi/4)$ when $-2\pi \le x < -3/2\,\pi$, $-\frac{\pi}{2} < x < \frac{\pi}{2}$, $\frac{3}{2}\pi < x < 2\pi$

$f'(x) = \sin x - \cos x$ when $-\frac{3}{2}\pi < x < -\frac{\pi}{2}$, $\frac{\pi}{2} < x < 3/2\,\pi$

$f'(x) =$ undefined at $x = -\frac{3}{2}\pi, -\frac{\pi}{2}, \frac{\pi}{2}, 3/2\,\pi$