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4.

$0 \times$

$4 - \left(2\sin^2 x + 2\sin x \right) \geq 0$

$\boxed{\sin x = 1}$

5. LHL $= \lim_{x \to 0^-} \frac{x \ln 2}{\ln(1+x)} = \ln 2$

$\lim_{x \to 0} f(x) = 0$

$\ln\left(1 + 2\sqrt{x} + e^{x^2} - 1\right)$

$\left(\frac{2\sqrt{x}}{\sqrt{x}} + \frac{(e^{x^2} - 1)}{x^2} \times x^{3/2} \right)$

RHL $= \lim_{x \to 0^+} \left(\frac{\tan \sqrt{x}}{\sqrt{x}} \right)$

$= 2$

$\left(x - \sqrt{3} \right)\left(x + \left(f(x) - 2 + \sqrt{3} \right) \right) = 0 \quad \forall x \in R$

$x = \sqrt{3}$

$x \neq \sqrt{3}$

$f(x) = 2 - \sqrt{3} - x$,

$\lim_{x \to \sqrt{3}} f(x) = 2 - 2\sqrt{3} = f(\sqrt{3})$

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$n = 4$ or 5 $\leftarrow$ $(0, n\pi)$

$\sin^2 x - \sin x - 1 = 0$

$\sin x = \frac{1-\sqrt{5}}{2}$

11.

$a - 1 = 0$

$x = -1 \Rightarrow$ RHL $= -3$, $f(-1) = -3$

$\boxed{3x \in I}$

$\frac{\cos x - \cos bx}{x^2} = \frac{\cos x - 1}{x^2} + \frac{1 - \cos bx}{(bx)^2} b^2$

$4 = \frac{1}{2}(b^2 - 1)$

$x = 1$

LHL $= 2$

$f(1) = 3$

$\left[\frac{3x}{3}\right] + \left[\frac{3x+1}{3}\right] + \left[\frac{3x+2}{3}\right]$

$= [3x]$

Limit

- Standard results
- series
- sandwich

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6. $$\lim_{x \to 0} \frac{\left(e^{2x} - 1 - (k-1)x\right)}{\left(\frac{e^{2x}-1}{2x}\right)(2x)^2}$$

$$\boxed{k-1 = 2}$$

$$= 1$$

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Differentiability in $[a, b]$

- $\alpha \in (a, b)$ $\quad$ LHD = RHD = finite.
- $x = a$, RHD = finite
- $x = b$, LHD = finite

$x \in [a, b)$

* $\alpha \in (a, b)$
LHD = RHD = finite

* $x = a$,
RHD = finite.

Differentiability in (a, b)

* $\alpha \in (a, b)$, LHD = RHD = finite

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Relation b/w Cont. & Differentiability

At $x=a$

Differentiable $\Rightarrow$ Continuous

Continuous $\not\Rightarrow$ Differentiable

Non differentiable $\not\Rightarrow$ Discontinuous

DisContinuous $\Rightarrow$ Non differentiable

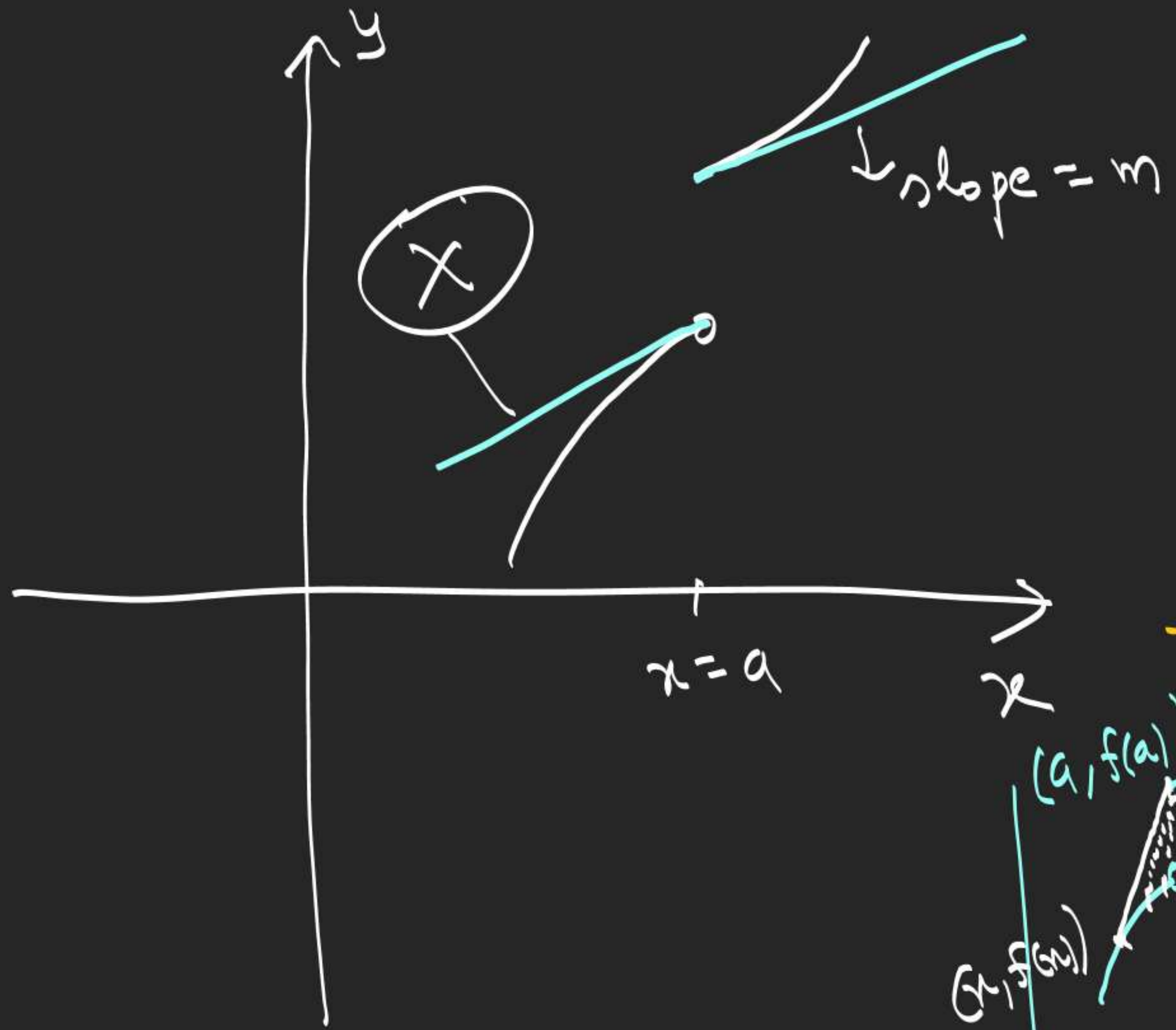
Note $\rightarrow$

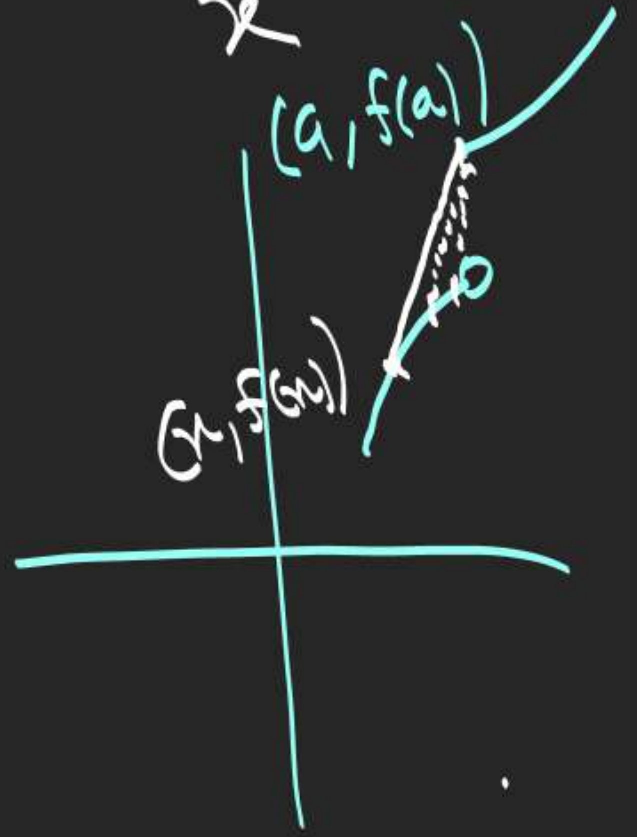
$$\lim_{x\to a}\left(\frac{f(x)-f(a)}{x-a}\right) = l$$

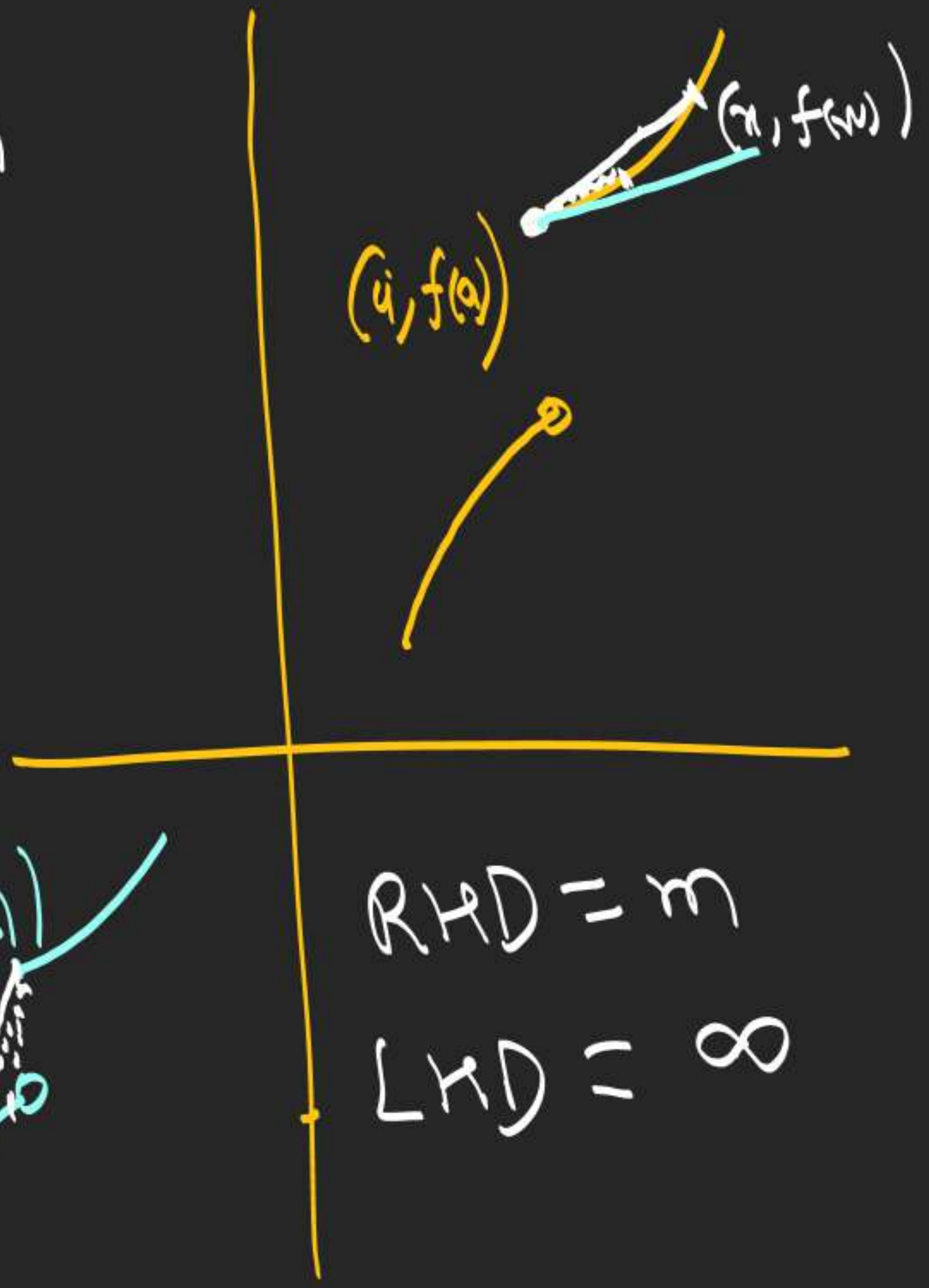
$$\lim_{x\to a}\left(f(x)-f(a)\right) = \lim_{x\to a}\left(\frac{f(x)-f(a)}{(x-a)}(x-a)\right) = 0$$

$$\lim_{x\to 2} f(x) = 5$$

$$\lim_{x\to 2}\left(f(x)-5\right) = 0$$







RHD = m

LHD = ∞

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Theorems over Differentiability

At $x = a$.   D → Diff, ND → Non diff.

f	g	$f+g$	$f-g$	fg	$\frac{f}{g}$
D	D	D	D	D	D, $g(a) \neq 0$
D	ND	ND	ND	–	–
ND	D	ND	ND	–	–
ND	ND	–	–	–	–

$$\left(\frac{f}{g}\right)' = \frac{gf' - fg'}{g^2}$$

$$\left(\frac{f}{g}\right)'(a) = \lim_{x \to a} \left(\frac{\frac{f(x)}{g(x)} - \frac{f(a)}{g(a)}}{x-a} \right)$$

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$$\lim_{x\to a}\left(\frac{\frac{f(x)}{g(x)}-\frac{f(a)}{g(a)}}{x-a}\right)=\lim_{x\to a}\left(\frac{f(x)g(a)-f(a)g(x)}{g(x)g(a)(x-a)}\right)$$

$$=\lim_{x\to a}\left(\frac{f(x)g(a)-f(a)g(a)+f(a)g(a)-f(a)g(x)}{g(x)g(a)(x-a)}\right)$$

$$=\lim_{x\to a}\left(\left(g(a)\left(\frac{f(x)-f(a)}{x-a}\right)-f(a)\left(\frac{g(x)-g(a)}{x-a}\right)\right)\frac{1}{g(x)g(a)}\right)$$

$$=\frac{g(a)f'(a)-f(a)g'(a)}{g^2(a)}$$

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$f \to D, \quad g \to N \cdot D$

Ex-II

$\boxed{Q \quad 1-10}$

P.T. $\quad f+g \to ND$

Let $f+g \to D$.

$$g(x) = \underbrace{(f+g)(x)}_{D} - \underbrace{f(x)}_{D}$$

$\Rightarrow g(x)$ is Diff.

Contradiction