

Check limit & differentiability

Q.1)  $f(x) = \begin{cases} x^2 + 2x + 1 & x < 2 \\ \sin(x-2) + 1 & x \geq 2 \end{cases}$

Q.2)  $f(x) = \begin{cases} x^2 + 2x + 1 & x < 2 \\ \sin(x-2) + 1 & x \geq 2 \end{cases}$

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Draw the graph of following functions.

①  $y = \sin |x|$

②  $y = |\log |x||$

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⑤  $y = \sin |x|$

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Q.9)  $y = \sin |x|$

Q.10)  $y = |\log |x||$

Q.1)  $y = |x-1| - 5$

Q.2)  $y = \max\{\sin x, \cos x\}$  in  $(0, 2\pi)$

Q.3)  $y = |x-1| - 5$

Q.4)  $y = \max\{\sin x, \cos x\}$  in  $(0, 2\pi)$

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# Theorems on Differentiability:

① If  $f(x)$  and  $g(x)$  are differentiable at  $x=a$   
 then  $f(x) \pm g(x)$ ,  $f(x)g(x)$ ,  $\frac{f(x)}{g(x)}$  ( $g(a) \neq 0$ )  
 will also be differentiable at  $x=a$ .  
 eg  $f(x) = \sin x + e^x$  at  $x=4$   
 At  $x=0$  \*

② If  $f(x)$  is not differentiable at  $x=a$  and  $g(x)$  is differentiable at  $x=a$  then

★ (i)  $f(x) \pm g(x)$  will be not differentiable

(ii)  $f(x) \cdot g(x)$  is  $\frac{f(x)}{g(x)}$  ( $g(a) \neq 0$ ) may or may not be differentiable.

★ ③ If both  $f(x)$  and  $g(x)$  are not differentiable at  $x=a$  then  
 $f(x) \pm g(x)$ ,  $f(x)g(x)$  and  $\frac{f(x)}{g(x)}$  may or may not be differentiable.

Differentiability in an interval:

(i) A function  $f(x)$  defined on an  $(a, b)$  is said to be differentiable or derivable in open interval  $(a, b)$  if it is differentiable in each & every point in  $(a, b)$ .

(ii) A function is said to be differentiable in  $[a, b]$  if it is differentiable in  $(a, b)$  and  $\lim_{h \rightarrow 0} \frac{f(a+h)-f(a)}{h}$  exists.  $\lim_{h \rightarrow 0} \frac{f(b-h)-f(b)}{-h}$  exists. Both

Note: |x|

① All polynomial, exponential, logarithmic & trigonometric (inverse trig not included) functions are differentiable in their domain.

② Derivability should be checked at following points for

(i) All the points where continuity needs to be checked.

(ii) All critical points of the functions (maxima, minima, inf, ex),  $\sin x$  etc.  
 $|x|$ ,  $\sqrt{x}$ ,  $\ln x$

Ex ① Find no. of points of non-differentiability in  $(1, 3)$  for  $f(x) = [x]$   
 $f(x) = [x^2]$   
 $f(x) = [x^3]$

②  $f(x) = [x-1] + \tan x$   
 Discuss the limits and deriv of  $f(x)$