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 CIVIL ENGINEERING
 ENG 282

① Given the function to be as in eq 1

$f(x) = x$

Find min f(x)

$x \rightarrow 3$
 $\frac{df}{dx} = 1$

Solution

$f(x) = x$

$\frac{df}{dx} = 1$

$x \rightarrow 3$

② The model of a system has been developed by an engineer to be as given in equation 2

$f(x) = 5x - 21$

Given that $\delta = 0.1$ and using a step of 0.01, demonstrate in tabular form, that the unit of the model as $x \rightarrow 6$ is equal to 9

Solution

$\delta = 0.01 \quad x = 6$

x	$x + \delta$	$x - \delta$	$f(x)$	$x \rightarrow 9$
0	0	0	6 - 0 = 6	9
1	0.01	6 - 0.01 = 5.99		8.95
2	0.02	6 - 0.02 = 5.98		8.9
3	0.03	6 - 0.03 = 5.97		8.85
4	0.04	6 - 0.04 = 5.96		8.8
5	0.05	6 - 0.05 = 5.95		8.75
6	0.06	6 - 0.06 = 5.94		8.7
7	0.07	6 - 0.07 = 5.93		8.65
8	0.08	6 - 0.08 = 5.92		8.6
9	0.09	6 - 0.09 = 5.91		8.55
10	0.10	6 - 0.10 = 5.9		8.5

n	$n \cdot \delta$	$x + \delta = v$	$f(x) \quad x \rightarrow v$
0	0	$6 + 0 = 6$	9
1	0.01	$6 + 0.01 = 6.01$	9.05
2	0.02	$6 + 0.02 = 6.02$	9.1
3	0.03	$6 + 0.03 = 6.03$	9.15
4	0.04	$6 + 0.04 = 6.04$	9.2
5	0.05	$6 + 0.05 = 6.05$	9.25
6	0.06	$6 + 0.06 = 6.06$	9.3
7	0.07	$6 + 0.07 = 6.07$	9.33
8	0.08	$6 + 0.08 = 6.08$	9.4
9	0.09	$6 + 0.09 = 6.09$	9.45
10	0.10	$6 + 0.10 = 6.1$	9.5

③ Find the limit of the model equation given equation

$$\lim_{x \rightarrow 3} \frac{3-x}{|3-x|}$$

Solution

$$\lim_{x \rightarrow 3^+} \frac{3 - (3+h)}{3 - (3+h)} = \frac{-h}{-h} = 1$$

$$\lim_{x \rightarrow 3^-} \frac{3 - (3-h)}{3 - (3-h)} = \frac{-h}{-h} = -1$$

$$\therefore \lim_{x \rightarrow 3} \frac{3-x}{|3-x|} \neq \frac{3-x}{|3-x|} \quad \lim_{x \rightarrow 3^-} \frac{3-x}{|3-x|}$$

④ Evaluate the limit of model given in equation (4) if it exists.

Solution

$$\lim_{x \rightarrow 3} \frac{3-3}{3-3} = \frac{0}{0}$$

Differentiate

$$\frac{x-3}{|x-3|} = \frac{1}{2}$$

$$\lim_{x \rightarrow 3} = \frac{1}{2} = \frac{1}{2}$$

Q) Show that the ~~function~~ ^{function} given in equation (5) $f(x) = \sqrt{x-4}$ is continuous on the interval $(4, 8)$

$$f(x) = \sqrt{x-4}$$
$$= (x-4)^{1/2}$$

$$y = (x-4)^{1/2}$$

$$\text{Let } u = x - 4$$

$$y = u^{1/2}$$

$$\frac{du}{dx} = 1$$

$$\frac{dy}{du} = \frac{1}{2} u^{-1/2}$$

$$\therefore \frac{dy}{dx} = \frac{du}{dx} \cdot \frac{dy}{du}$$

$$= 1 \cdot \frac{1}{2} u^{-1/2}$$

$$= \frac{1}{2} u^{-1/2}$$

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

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

$$= \frac{1}{2\sqrt{x-4}}$$