5.1 Continuity

(Previous Year Questions Solutions from 2015-2025)

McQ's:

1.

The function $f : R \rightarrow R$ given by $f(x) = -\,|x - 1|$ is

(A) continuous as well as differentiable at $x = 1$

(B) not continuous but differentiable at $x = 1$

(C) continuous but not differentiable at $x = 1$

(D) neither continuous nor differentiable at $x = 1$

2.

The value of k so that f defined by

$$f(x) = \begin{cases} x^2 \sin\left(\dfrac{1}{x}\right) & \text{if} \quad x \neq 0 \\ k & \text{if} \quad x = 0 \end{cases}$$

is continuous at $x = 0$ is

(A) 0

(B) $\dfrac{1}{2}$

(C) 1

(D) 2

3.

The value of λ so that the function f defined by

$$f(x) = \begin{cases} \lambda x, & \text{if} \quad x \leq \pi \\ \cos x, & \text{if} \quad x > \pi \end{cases}$$

is continuous at $x = \pi$ is __________ .

4.

If the function $f(x) = \begin{cases} \frac{x^2-1}{x-1} \text{ when } & x \neq 1 \\ k \text{ when } & x = 1 \end{cases}$ is given to be continuous at $x = 1$, then the value of k is _____

5.

The value of k (k < 0) for which the function f defined as

$$f(x) = \begin{cases} \frac{1-\cos kx}{x\sin x}, & x \neq 0 \\ \frac{1}{2}, & x = 0 \end{cases}$$

is continuous at $x = 0$ is:

a) ± 1	b) -1
c) $\pm\frac{1}{2}$	d) $\frac{1}{2}$

6.

The point(s), at which the function f given by $f(x) = \begin{cases} \frac{x}{|x|}, & x < 0 \\ -1, & x \geq 0 \end{cases}$

is continuous, is/are:

a) $x \epsilon$ R	b) $x = 0$
c) $x \epsilon$ R −{0}	d) $x = -1$ and 1

7.

The value of k for which the function f, given by

$$f(x) = \begin{cases} kx + 1, & \text{if } x \leq \pi \\ \cos x, & \text{if } x > \pi \end{cases}$$

is continuous at x = π, is :

(a) $\frac{2}{\pi}$ (b) $-\frac{\pi}{2}$

(c) $-\frac{2}{\pi}$ (d) $\frac{\pi}{2}$

2023 March:

1.

The value of k for which $f(x)=\begin{cases}3x+5, & x\ge 2\\ kx^2, & x<2\end{cases}$ is a continuous function, is :

(a) $-\frac{11}{4}$ (b) $\frac{4}{11}$

(c) 11 (d) $\frac{11}{4}$

2.

For what value of k may the function $f(x)=\begin{cases}k(3x^2-5x), & x\le 0\\ \cos x, & x>0\end{cases}$

become continuous ?

(a) 0 (b) 1

(c) $-\frac{1}{2}$ (d) No value

3.

The function $f(x) = |x| - x$ is :

(a) continuous but not differentiable at $x = 0$.

(b) continuous and differentiable at $x = 0$.

(c) neither continuous nor differentiable at $x = 0$.

(d) differentiable but not continuous at $x = 0$.

4.

The function $f(x) = x|x|$ is

(A) continuous and differentiable at $x = 0$.

(B) continuous but not differentiable at $x = 0$.

(C) differentiable but not continuous at $x = 0$.

(D) neither differentiable nor continuous at $x = 0$.

5.

If $f(x) = 2|x| + 3|\sin x| + 6$, then the right hand derivative of f(x) at $x = 0$ is :

(a) 6 (b) 5

(c) 3 (d) 2

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12.

The function $f(x) = |x|$ is

(a) continuous and differentiable everywhere.

(b) continuous and differentiable nowhere.

(c) continuous everywhere, but differentiable everywhere except at $x = 0$.

(d) continuous everywhere, but differentiable nowhere.

13.

The value of k for which function $f(x)=\begin{cases} x^2, & x \geq 0 \\ kx, & x < 0 \end{cases}$ is differentiable at $x = 0$ is :

(a) 1 (b) 2

(c) any real number (d) 0

14.

The function $f(x) = [x]$, where $[x]$ denotes the greatest integer less than or equal to x, is continuous at

(a) $x = 1$ (b) $x = 1.5$

(c) $x = -2$ (d) $x = 4$

2025 March:

1.

The function f defined by

$$f(x) = \begin{cases} x, & \text{if } x \le 1 \\ 5, & \text{if } x > 1 \end{cases}$$

is ***not*** continuous at :

(A) $x = 0$ (B) $x = 1$

(C) $x = 2$ (D) $x = 5$

2.

If $f(x) = \begin{cases} 3x - 2, & 0 < x \le 1 \\ 2x^2 + ax, & 1 < x < 2 \end{cases}$ is continuous for $x \in (0, 2)$, then a is equal to :

(A) -4 (B) $-\frac{7}{2}$

(C) -2 (D) -1

3.

If $f(x) = \begin{cases} 1, & \text{if } x \le 3 \\ ax + b, & \text{if } 3 < x < 5 \\ 7, & \text{if } 5 \le x \end{cases}$ is continuous in R, then the values of a and b are :

(A) $a = 3,\ b = -8$ (B) $a = 3,\ b = 8$

(C) $a = -3,\ b = -8$ (D) $a = -3,\ b = 8$

4.

If $f(x) = \begin{cases} 3ax - b, & x > 1 \\ 11, & x = 1 \\ -5ax - 2b, & x < 1 \end{cases}$

is continuous at $x = 1$, then the values of a and b are :

(A) $a = 3,\ b = 5$ (B) $a = 8,\ b = -1$

(C) $a = 1,\ b = -8$ (D) $a = -3,\ b = 5$

5.

If $f(x) = \begin{cases} \dfrac{\sin^2 ax}{x^2}, & x \neq 0 \\ 1, & x = 0 \end{cases}$

is continuous at x = 0, then the value of a is :

(A) 1 (B) –1

(C) ± 1 (D) 0

6.

If $f(x) = \begin{cases} \dfrac{\log(1+ax)+\log(1-bx)}{x}, & \text{for } x \neq 0 \\ k, & \text{for } x = 0 \end{cases}$

is continuous at x = 0, then the value of k is :

(A) a (B) a + b

(C) a – b (D) b

7.

If $f(x) = \begin{cases} \dfrac{1-\sin^3 x}{3\cos^2 x}, & \text{for } x \neq \dfrac{\pi}{2} \\ k, & \text{for } x = \dfrac{\pi}{2} \end{cases}$

is continuous at $x = \dfrac{\pi}{2}$, then the value of k is :

(A) $\dfrac{3}{2}$ (B) $\dfrac{1}{6}$

(C) $\dfrac{1}{2}$ (D) 1

8.

Assertion (A) : Let $f(x) = e^x$ and $g(x) = \log x$. Then $(f + g)\,x = e^x + \log x$ where domain of $(f + g)$ is R.

Reason (R) : $\text{Dom}(f + g) = \text{Dom}(f) \cap \text{Dom}(g)$.

9.

Assertion (A) : $f(x) = \begin{cases} 3x - 8, & x \leq 5 \\ 2k \ , & x > 5 \end{cases}$

is continuous at $x = 5$ for $k = \frac{5}{2}$.

Reason (R) : For a function f to be continuous at $x = a$,

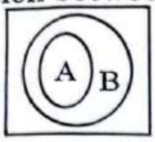
$\lim_{x \to a^-} f(x) = \lim_{x \to a^+} f(x) = f(a)$.

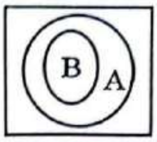
Assertion (A) : $f(x) = \begin{cases} x \sin \frac{1}{x} \ , & x \neq 0 \\ 0 \ , & x = 0 \end{cases}$ is continuous at $x = 0$.

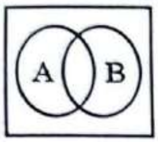
Reason (R) : When $x \to 0$, $\sin \frac{1}{x}$ is a finite value between -1 and 1.

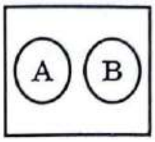
10.

If A denotes the set of continuous functions and B denotes set of differentiable functions, then which of the following depicts the correct relation between set A and B ?

(A) 

(B) 

(C) 

(D) 

5.1 Continuity :

I.Algebraic Function :

1. 2023

Find the points at which the function $f(x) = \dfrac{4+x^2}{4x-x^3}$ is discontinuous.

Sol.

$$f(x) = \frac{4+x^2}{x(2-x)(2+x)}$$

clearly f is not continuous when $x(2-x)(2+x)=0$

$\Rightarrow x = 0, 2, -2$

2.a

Find all points of discontinuity of f, where f is defined as following:

$$f(x) = \begin{cases} |x|+3 & , x \le -3 \\ -2x & , -3 < x < 3 \\ 6x+2 & , x \ge 3 \end{cases}$$

Finding the Constant Value if continuous :

2.b

Determine the value of the constant 'k' so that the function $f(x) = \begin{cases} \dfrac{kx}{|x|} & , \text{ if } x < 0 \\ 3 & , \text{ if } x \ge 0 \end{cases}$ is continuous at $x = 0$.

Sol.

$$\lim_{x \to 0_-} f(x) = \lim_{x \to 0_-} \frac{kx}{|x|} = -k$$

$$k = -3$$

2.c

Find the value of a and b so that function f defined as :

$$f(x) = \begin{cases} \dfrac{x-2}{|x-2|} + a, & \text{if } x < 2 \\ a + b, & \text{if } x = 2 \\ \dfrac{x-2}{|x-2|} + b, & \text{if } x > 2 \end{cases}$$ is a continuous function.

Sol.

$$f(x) = \begin{cases} \dfrac{x-2}{-(x-2)} + a & ; x < 2 \\ a + b & ; x = 2 \\ \dfrac{x-2}{(x-2)} + b & ; x > 2 \end{cases} \Rightarrow f(x) = \begin{cases} -1 + a & ; x < 2 \\ a + b & ; x = 2 \\ 1 + b & ; x > 2 \end{cases}$$

$\lim\limits_{x \to 2^-} f(x) = -1 + a, \lim\limits_{x \to 2^+} f(x) = 1 + b$ and $f(2) = a + b$

as f is continous at $x = 2 \therefore -1 + a = 1 + b = a + b$

$\Rightarrow a = 1, b = -1$

3.a

Find the value of k, so that the function $f(x) = \begin{cases} kx^2 + 5 & \text{if } x \le 1 \\ 2 & \text{if } x > 1 \end{cases}$

is continuous at x = 1.

Sol.

L.H.L. is $k + 5$

getting $k = -3$

3.b

Find the relationship between a and b so that the function f defined by

$$f(x) = \begin{cases} ax+1 & \text{if} \quad x \le 3 \\ bx+3 & \text{if} \quad x > 3 \end{cases}$$

is continuous at x = 3.

3.c

For what value of k is the following function continuous at x = 2?

$$f\ x = \begin{cases} 2x+1 & ; \quad x<2 \\ k & ; \quad x=2 \\ 3x-1 & ; \quad x>2 \end{cases}$$

3.d 2023

Function f is defined as

$$f(x) = \begin{cases} 2x+2, & \text{if} \quad x < 2 \\ k, & \text{if} \quad x = 2 \\ 3x, & \text{if} \quad x > 2 \end{cases}$$

Find the value of k for which the function f is continuous at x = 2.

Sol.

As f is continuous at $x=2$

$$\Rightarrow \lim_{x\to 2^+} f(x) = \lim_{x\to 2^-} f(x) = f(2)$$

$$\lim_{x\to 2^+} 3x = \lim_{x\to 2^-}(2x+2) = k$$

$$\Rightarrow k = 6$$

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3.e 2023

The function

$$f(x) = \begin{cases} 3ax + b, & \text{if} \quad x > 1 \\ 11, & \text{if} \quad x = 1 \\ 5ax - 2b, & \text{if} \quad x < 1 \end{cases}$$

is continuous at x = 1. Find the values of a and b.

Sol.

As f is continuous at $x = 1$

$$\Rightarrow \lim_{x \to 1^+} f(x) = \lim_{x \to 1^-} f(x) = f(1)$$

$$\lim_{x \to 1^+} (3ax + b) = \lim_{x \to 1^-} (5ax - 2b) = 11$$

$$\Rightarrow 3a + b = 11 \text{ and } 5a - 2b = 11$$

solving, we get $a = 3, b = 2$

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4.a

If the function f defined as

$$f(x) = \begin{cases} \dfrac{x^2 - 9}{x - 3} & , x \neq 3 \\ k & , x = 3 \end{cases}$$

is continuous at $x = 3$, find the value of k.

Answer:

$$\lim_{x \to 3} \frac{x^2 - 9}{x - 3} = 6, \quad \therefore \quad k = 6$$

4.b

Determine the value of 'k' for which the following function is continuous at x = 3 :

$$f(x) = \begin{cases} \dfrac{(x+3)^2 - 36}{x - 3} & , \quad x \neq 3 \\ k & , \quad x = 3 \end{cases}$$

Ans.

k = 12.

4.c

Find the value of k for which the function

$$f(x)=\begin{cases}\dfrac{x^2+3x-10}{x-2}, & x \neq 2\\ k, & x=2\end{cases}$$

is continuous at $x = 2$.

Sol.

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

$$\lim_{x\to 2} \frac{(x+5)\cancel{(x-2)}}{\cancel{x-2}} = k$$

$\therefore \quad k = 7$ prepared by : BALAJI KANCHI

4.d 2025

Find k so that $f(x) = \begin{cases}\dfrac{x^2-2x-3}{x+1}, & x \neq -1\\ k, & x=-1\end{cases}$ is continuous at x = – 1.

Sol.

$$\lim_{x\to -1}\frac{x^2-2x-3}{x+1}=\lim_{x\to -1}\frac{(x-3)(x+1)}{x+1}=\lim_{x\to -1}(x-3)=-4$$

Also, $f(-1)=k$

as f is continuous, $k=-4$ prepared by : BALAJI KANCHI

II.Trigonometric Functions :

1.a

If the following function f(x) is continuous at $x = 0$, then write the value of k.

$$f(x) = \begin{cases} \dfrac{\sin \frac{3x}{2}}{x} & , x \neq 0 \\ k & , x = 0 \end{cases}$$

Sol.

$$\lim_{x \to 0} \frac{\sin \frac{3x}{2}}{2} = \lim_{x \to 0} \frac{3}{2} \cdot \frac{\sin \frac{3x}{2}}{\frac{3x}{2}} = \frac{3}{2}$$

$$\Rightarrow \quad k = \frac{3}{2}$$

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1.b

For what value of 'k' is the function $f(x) = \begin{cases} \dfrac{\sin 5x}{3x} + \cos x, & \text{if } x \neq 0 \\ k, & \text{if } x = 0 \end{cases}$

continuous at x = 0 ?

Sol.

$$\lim_{x \to 0} \left(\frac{\sin 5x}{3x} + \cos x \right) = \frac{8}{3} \Rightarrow k = \frac{8}{3}$$

2.

The value of k for which the function f given by

$f(x) = \begin{cases} \dfrac{k \cos x}{\pi - 2x}, & \text{if } x \neq \frac{\pi}{2} \\ 5, & \text{if } x = \frac{\pi}{2} \end{cases}$ is continuous at $x = \frac{\pi}{2}$, is :

(a) 6 (b) 5

(c) $\frac{5}{2}$ (d) 10

3.a

Verify whether the function f defined by

$$f(x) = \begin{cases} x\sin\left(\frac{1}{x}\right) & , \ x \neq 0 \\ 0 & , \ x = 0 \end{cases}$$

is continuous at $x = 0$ or not.

Sol.

$$\lim_{x\to 0} f(x) = \lim_{x\to 0} x.\sin\frac{1}{x} = 0 \times \text{Finite value in } [-1,1] = 0 = f(0)$$

$\therefore$ **f is a continuous function.**

prepared by : **BALAJI KANCHI**

3.b

Find the value(s) of 'λ', if the function

$$f(x) = \begin{cases} \frac{\sin^2 \lambda x}{x^2} & , \ \text{if } x \neq 0 \\ 1 & , \ \text{if } x = 0 \end{cases}$$ is continuous at $x = 0$.

Sol.

$$\lim_{x\to 0} f(x) = \lim_{x\to 0}\left(\frac{\sin^2 \lambda x}{x^2}\right) = \lim_{x\to 0}\left[\frac{\sin^2 \lambda x}{(\lambda x)^2} . \lambda^2\right] = \lambda^2$$

Since f(x) is continuous at x = 0

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

$\Rightarrow \lambda^2 = 1 \Rightarrow \lambda = \pm 1$

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4.a

Find the value of p for which the function

$$f(x) = \begin{cases} \frac{1-\cos 4x}{x^2}, & x \neq 0 \\ p, & x = 0 \end{cases}$$

is continuous at $x = 0$.

Sol.

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

$$\lim_{x \to 0} \frac{4 \times 2\sin^2 2x}{4x^2} = p$$

$$p = 8$$

OR

$$\text{LHL} = \lim_{x \to 0-} \frac{2\sin^2 2x}{x^2} = 2.4 = 8$$

$$f(0) = k$$

$$k = 8$$

4.b

Find the value of k for which the function f given as

$$f(x) = \begin{cases} \frac{1-\cos x}{2x^2}, & \text{if } x \neq 0 \\ k, & \text{if } x = 0 \end{cases} \text{ is continuous at } x = 0.$$

$$f(x) = \begin{cases} \frac{1-\cos kx}{x\sin x} & if\ x \neq 0 \\ \frac{1}{2} & if\ x = 0 \end{cases}$$

4.c

If $f(x) = \begin{cases} \dfrac{1-\cos 4x}{x^2}, & \text{when } x < 0 \\ a, & \text{when } x = 0 \\ \dfrac{\sqrt{x}}{\left(\sqrt{16+\sqrt{x}}\right)-4}, & \text{when } x > 0 \end{cases}$

and f is continuous at $x = 0$, find the value of a.

4.d

Find the value of k for which the given function f(x) is continuous at $x = 0$.

$$f(x) = \begin{cases} \dfrac{2-2\cos 2x}{x^2}; & x < 0 \\ k; & x = 0 \\ \dfrac{\sqrt{x}}{\sqrt{4+\sqrt{x}}-2}; & x > 0 \end{cases}$$

Sol.

LHL at $x = 0$	RHL at $x = 0$	$f(0)$
$\lim\limits_{h\to 0} f(0-h)$	$\lim\limits_{h\to 0} \dfrac{\sqrt{h}}{\sqrt{4+\sqrt{h}}-2}$	k
$\lim\limits_{h\to 0} \dfrac{2-2\cos(-2h)}{(-h)^2}$	$\lim\limits_{h\to 0} \dfrac{\sqrt{h}(\sqrt{4+\sqrt{h}}+2)}{\cancel{4}+\sqrt{h}-\cancel{4}}$	
$\lim\limits_{h\to 0} \dfrac{4\sin^2 h}{h^2}$	$2+2$	
4	4	

$\therefore f(x)$ is continuous at $x = 0$ if $k = 4$

5.a

Find k, if $f(x)=\begin{cases} k\sin\frac{\pi}{2}(x+1), & x\le 0 \\ \dfrac{\tan x-\sin x}{x^3}, & x>0 \end{cases}$ is continuous at $x=0$.

5.b

.Find the value of 'a' for which the function f defined as

$$f(x)=\begin{cases} a\sin\frac{\pi}{2}(x+1), & x\le 0 \\ \dfrac{\tan x-\sin x}{x^3}, & x>0 \end{cases}$$

is continuous at x = 0.

Sol.

$$\text{LHL} = \lim_{x\to 0^-} k.\sin\frac{\pi}{2}(x+1) = k$$

$$\text{RHL} = \lim_{x\to 0^+} \frac{\tan x(1-\cos x)}{x^3}$$

$$= \lim_{x\to 0^+} \frac{\tan x}{x}.2\left(\frac{\sin x/2}{2x/2}\right)^2 = \frac{1}{2}$$

$$\Rightarrow \quad k = \frac{1}{2}$$

prepared by : BALAJI KANCHI

6.

If $f(x) = \begin{cases} \dfrac{\sin(a+1)x + 2\sin x}{x}, & x < 0 \\ 2, & x = 0 \\ \dfrac{\sqrt{1+bx}-1}{x}, & x > 0 \end{cases}$

is continuous at $x = 0$, then find the values of a and b.

Sol.

L.H.L = a + 3

R.H.L = b/2

f(x) is continuous at x = 0. So, a + 3 = 2 = b/2

$\Rightarrow$ a = –1 and b = 4

7.

Find the value of k for which the function $f(x) = \begin{cases} \dfrac{\sin x - \cos x}{4x - \pi}, & x \neq \dfrac{\pi}{4} \\ k, & x = \dfrac{\pi}{4} \end{cases}$

is continuous at $x = \dfrac{\pi}{4}$.

Sol.

$$\lim_{x \to \pi/4} f(x) = f(\pi/4)$$

$$\lim_{x \to \pi/4} \frac{\sqrt{2}\sin(x - \pi/4)}{4(x - \pi/4)} = k$$

$$\therefore \quad k = \frac{\sqrt{2}}{4}$$

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8.

Find the values of p and q, for which

$$f(x) = \begin{cases} \dfrac{1 - \sin^3 x}{3\cos^2 x} & , \text{ if } x < \dfrac{\pi}{2} \\ p & , \text{ if } x = \pi/2 \\ \dfrac{q(1 - \sin x)}{(\pi - 2x)^2} & , \text{ if } x > \pi/2 \end{cases}$$

is continuous at $x = \pi/2$.

9.

Determine the values of 'a' and 'b' such that the following function is continuous at $x = 0$:

$$f(x) = \begin{cases} \dfrac{x + \sin x}{\sin(a+1)x}, \text{ if } -\pi < x < 0 \\ 2, \text{if } x = 0 \\ 2\dfrac{e^{\sin bx} - 1}{bx}, \text{if } x > 0 \end{cases}$$

III. Exponential function:

1.

Show that the function f given by :

$$f(x)=\begin{cases}\dfrac{e^{1/x}-1}{e^{1/x}+1} & ,\text{if } x\neq 0\\ -1 & ,\text{if } x=0\end{cases}$$

is discontinuous at $x=0$.

Sol.

$$f(x)=\begin{cases}\dfrac{e^{\frac{1}{x}}-1}{e^{\frac{1}{x}}+1} & x\neq 0\\ -1 & x=0\end{cases}$$

$$\text{LHL: } \lim_{x\to 0^-}\frac{e^{\frac{1}{x}}-1}{e^{\frac{1}{x}}+1}$$

$$=\lim_{h\to 0}\frac{e^{-\frac{1}{h}}-1}{e^{-\frac{1}{h}}+1}=\frac{0-1}{0+1}=-1$$

$$\text{RHL: } \lim_{h\to 0}\frac{e^{\frac{1}{h}}-1}{e^{\frac{1}{h}}+1}=\lim_{h\to 0}\frac{1-e^{-\frac{1}{h}}}{1+e^{-\frac{1}{h}}}=1$$

$\text{LHL}\neq\text{RHL}$

prepared by : **BALAJI KANCHI**

$\therefore$ f(x) is discontinuous at x = 0

2.

Determine the values of 'a' and 'b' such that the following function is continuous at $x = 0$:

$$f(x)=\begin{cases}\dfrac{x+\sin x}{\sin(a+1)x}, & \text{if } -\pi<x<0\\ 2, & \text{if } x=0\\ 2\dfrac{e^{\sin bx}-1}{bx}, & \text{if } x>0\end{cases}$$

3.

The function $f(x) = \begin{cases} \dfrac{e^{3x} - e^{-5x}}{x}, & \text{if } x \neq 0 \\ k, & \text{if } x = 0 \end{cases}$

is continuous at $x = 0$ for the value of k, as

(a) 3 (b) 5

(c) 2 (d) 8

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