

Assignment 1

Chapter-11: Limits, Continuity and Differentiability

EE24BTECH11049

Patnam Shariq Faraz Muhammed

D: MCQs WITH ONE OR MORE THAN ONE CORRECT

1) Let $g(x) = x.f(x)$, where

$$f(x) = \begin{cases} x \cdot \sin \frac{1}{x}, & x \neq 0 \\ 0, & x = 0 \end{cases} \text{ . At } x = 0 \quad (1995)$$

- (a) g is differentiable but g' is not continuous
- (b) g is differentiable while f is not
- (c) both f and g are differentiable
- (d) g is differentiable and g' is continuous

2) The function $f(x) = \max\{(1-x), (1+x), 2\}$,
 $x \in (-\infty, \infty)$

(1995)

- (a) continuous at all points
- (b) differentiable at all points
- (c) differentiable at all points except at $x = l$ and $x = -1$
- (d) continuous at all points except at $x = l$ and $x = -1$ where it is discontinuous

3) Let $h(x) = \min\{x, x^2\}$

(1998 – 2marks)

- (a) h is continuous for all x
- (b) h is differentiable for all x
- (c) $h'(t) = 1$, for all $x > 1$
- (d) h is not differentiable at two values of x

4) $\lim_{x \rightarrow 1} \frac{\sqrt{1 - \cos 2(x-1)}}{x-1}$

(1998 – 2marks)

- (a) exists and it equals $\sqrt{2}$
- (b) exists and it equals $-\sqrt{2}$
- (c) does not exist because $x-1 \mapsto 0$
- (d) does not exist because the left-hand limit is not equal to the right-hand limit

5) If $f(x) = \min\{1, x^2, x^3\}$

(2006, 5M, -1)

(a) $f(x)$ is continuous $\forall x \in R$

(b) $f(x)$ is continuous and differentiable everywhere

(c) $f(x)$ is not differentiable at two points

(d) $f(x)$ is not differentiable at one point

6) Let $L = \lim_{x \rightarrow 0} \frac{a - \sqrt{a^2 - x^2 - \frac{x^2}{4}}}{x^4}$, $a > 0$.

If L is finite, then

(2009)

(a) $a = 2$

(b) $a = 1$

(c) $L = \frac{1}{64}$

(d) $L = \frac{1}{32}$

7) Let $f : R \mapsto R$ be a function such that $f(x+y) = f(x) + f(y)$, $\forall x, y \in R$. If $f(x)$ is differentiable at $x = 0$, then

(2011)

(a) $f(x)$ is differentiable only in a finite interval containing zero

(b) $f(x)$ is continuous $\forall x \in R$

(c) $f'(x)$ is constant $\forall x \in R$

(d) $f(x)$ is differentiable except at finitely many points

8) If $f(x) = \begin{cases} -x - \frac{\pi}{2}, & x \leq \frac{\pi}{2} \\ -\cos x, & \frac{\pi}{2} < x \leq 0 \\ x - 1, & 0 < x \leq 1 \\ \ln x, & x > 1 \end{cases}$

(2011)

(a) $f(x)$ is continuous at $x = \frac{\pi}{2}$

(b) $f(x)$ is not differentiable at $x = 0$

(c) $f'(x)$ is differentiable at $x = 1$

(d) $f(x)$ is differentiable at $x = \frac{3}{2}$

9) For every integer n , let a_n and b_n , be real numbers. Let function $f(x) : IR \mapsto IR$ be given

by $f(x) = \begin{cases} a_n + \sin \pi x, & \text{for } x \in [2n, 2n+1] \\ b_n + \cos \pi x, & \text{for } x \in (2n-1, 2n) \end{cases}$
for all integers n . If f is continuous, then which of the following hold(s) for all n

(2012)

- (a) $a_{n-1} - b_{n-1} = 0$
- (b) $a_n - b_n = 1$
- (c) $a_n - b_{n+1} = 1$
- (d) $a_{n-1} - b_n = -1$

10) For $a \in R$ (the set of all real numbers), $a \neq -1$

$$\lim_{n \rightarrow \infty} \frac{(1^a + 2^a + \cdots + n^a)}{(n+1)^a \cdot [(na+1) + (na+2) + \cdots + (na+n)]}$$

= $\frac{1}{60}$ Then $a =$

(JEE Adv.2013)

- (a) 5
- (b) 7
- (c) $\frac{-15}{2}$
- (d) $\frac{-17}{2}$

11) Let $f : [a, b] \mapsto [1, \infty)$ be a continuous function and let $g : R \mapsto R$ be defined as $f(x) =$

$$\begin{cases} 0, & \text{if } x < a, \\ \int_a^x f(t) dt, & \text{if } a \leq x \leq b; \\ \int_a^b f(t) dt, & \text{if } x > b \end{cases}$$

(JEE Adv.2013)

- (a) $g(x)$ is continuous but not differentiable at a
- (b) $g(x)$ is differentiable on R
- (c) $g(x)$ is continuous but not differentiable at b
- (d) $g(x)$ is continuous and differentiable at either (a) or (b) but not both

12) For every pair of continuous functions $f, g : [0, 1] \mapsto R$ such that $\max \{f(x) : x \in [0, 1]\} = \max \{g(x) : x \in [0, 1]\}$, the correct statement(s) is(are):

(JEE Adv.2014)

- (a) $(f(c))^2 + 3 \cdot f(c) = (g(c))^2 + 3 \cdot g(c)$ for some $c \in [0, 1]$
- (b) $(f(c))^2 + f(c) = (g(c))^2 + 3 \cdot g(c)$ for some $c \in [0, 1]$
- (c) $(f(c))^2 + 3 \cdot f(c) = (g(c))^2 + g(c)$ for some $c \in [0, 1]$
- (d) $(f(c))^2 = (g(c))^2$ for some $c \in [0, 1]$

13) Let $g : R \mapsto R$ be a differentiable function with $g(0) = 0$, $g'(0) = 0$ and $g'(1) \neq 0$. Let

$$f(x) = \begin{cases} \frac{x}{|x|} \cdot g(x), & x \neq 0 \\ 0, & x = 0 \end{cases} \text{ and } h(x) = e^{|x|} \text{ for all } x \in R. \text{ Let } (f \circ h)(x) \text{ denote } f(h(x)) \text{ and}$$

$(h \circ f)(x)$ denote $h(f(x))$. Then which of the following is(are) true?

(JEE Adv.2015)

- (a) f is differentiable at $x = 0$
 - (b) h is differentiable at $x = 0$
 - (c) $f \circ h$ is differentiable at $x = 0$
 - (d) $h \circ f$ is differentiable at $x = 0$
- 14) Let $a, b \in R$ and $f : R \mapsto R$ be defined by $f(x) = a \cdot \cos(|x^3 - x|) + b \cdot |x| \cdot \sin(|x^3 + x|)$. Then f is

(JEE Adv.2016)

- (a) differentiable at $x = 0$ if $a = 0$ and $b = 1$
 - (b) differentiable at $x = 1$ if $a = 1$ and $b = 0$
 - (c) NOT differentiable at $x = 0$ if $a = 1$ and $b = 0$
 - (d) NOT differentiable at $x = 1$ if $a = 0$ and $b = 1$
- 15) Let $f : [-\frac{1}{2}, 2] \mapsto R$ and $g : [-\frac{1}{2}, 2] \mapsto R$ be functions defined by $f(x) = [x^2 - 3]$ and $g(x) = |x| \cdot f(x) + |4x - 7| \cdot f(x)$, where $[y]$ denotes the greatest integer less than or equal to y for $y \in R$. Then

(JEE Adv.2016)

- (a) f is discontinuous exactly at three points in $[-\frac{1}{2}, 2]$
- (b) f is discontinuous exactly at four points in $[-\frac{1}{2}, 2]$
- (c) g is NOT differentiable exactly at four points in $[-\frac{1}{2}, 2]$
- (d) g is NOT differentiable exactly at five points in $[-\frac{1}{2}, 2]$