1. Let $s(t) = 3 + t\,e^t$ be the position function of a particle moving in a linear motion. Then the **average velocity** of the object over the time interval $[0, 3]$ is

(a) e^3

(b) $3\,e^3$

(c) $1 + e^3$

(d) $1 + 3\,e^3$

(e) $3 + 3\,e^3$

2. The function $f(x) = \dfrac{x^2 - 4x + 3}{x^2 - 5x + 4}$ has the vertical asymptote(s):

(a) $x = 4$ only

(b) $x = 4$ and $x = 1$

(c) $x = 1$ only

(d) $x = 3$ only

(e) $x = 4$ and $x = 3$

3. Let $f(x)$ be a function such that $f(1) = 1$ and $\lim_{x\to 1} \dfrac{f(x)-1}{x-1} = \dfrac{1}{2}$. The equation of the tangent line to the graph of $f(x)$ at $x = 1$ is given by

(a) $2y - x - 1 = 0$

(b) $y - 2x + 1 = 0$

(c) $2y + x + 1 = 0$

(d) $y - 2x - 1 = 0$

(e) $2y - 2x + 3 = 0$

4. $\lim_{x\to 0^-} \ln(-\sin x) =$

(a) $-\infty$

(b) ∞

(c) 0

(d) 1

(e) e

5. The function $f(x) = \dfrac{x^2 - 6x - 16}{(x^2 - 7x - 8)\sqrt{x^2 - 4}}$ is continuous on

(a) $(-\infty, -2) \cup (2, 8) \cup (8, \infty)$

(b) $(-2, -1) \cup (2, 8)$

(c) $(-\infty, -1) \cup (2, 8) \cup (8, \infty)$

(d) $(-2, -1) \cup (-1, 2)$

(e) $(-\infty, -2) \cup (2, \infty)$

6. The **number of discontinuities** of the function $f(x) = \dfrac{\ln(\cos^2 x)}{x^2 - 1}$ in the interval $(0, 3\pi)$ is

(a) 4

(b) 5

(c) 3

(d) 2

(e) ∞

7. Given that $\lim_{x\to 2}(5x+2) = 12$, and using the $(\varepsilon, \delta)-$ definition, the largest possible value of δ that corresponds to $\varepsilon = 0.05$ is:

(a) 0.01

(b) 0.05

(c) 0.10

(d) 0.02

(e) 0.001

8. $\lim_{x\to 3} \dfrac{1-\sqrt{4-x}}{3-x} =$

(a) $-\dfrac{1}{2}$

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

(c) 0

(d) 3

(e) does not exist

9. From the given graph of $f(x)$, the function

(a) f is not differentiable at $-2, 1, 3$

(b) f is differentiable at $-2, -1, 0$

(c) f is not differentiable at $-3, 1, 4$

(d) f is differentiable at $0, 2, 3$

(e) f is not differentiable at $0.5, 1, 1.5$

10. Let

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

then $f'(4) =$

(a) $-\frac{1}{3}$

(b) $\frac{1}{3}$

(c) $-\frac{1}{6}$

(d) $\frac{1}{6}$

(e) $\frac{1}{4}$

11. Let $f(x)$ be continuous on the interval $[-3, 6]$. If $f(-3) = -1$ and $f(6) = 3$, which of the following must be true?

(a) $f(c) = 1$ for at least one c between -3 and 6

(b) $f(c) = 0$ for at least one c between -1 and 3

(c) $f(c) = 5$ for at least one c between -3 and 6

(d) $-1 \leq f(x) \leq 3$ for all x between -3 and 6

(e) $f(0) = 0$

12. $\lim_{x \to 0} \cos\left(x^2 \sin \frac{3}{2x}\right) =$

(a) 1

(b) 2

(c) 3

(d) 0

(e) does not exist

13. The horizontal asymptote(s) of $f(x) = \dfrac{|x| + \sin x}{x+1}$ is (are):

(a) $y = -1$ and $y = 1$

(b) $y = -1$ only

(c) $y = 1$ only

(d) $y = 0$, $y = 1$ and $y = -1$

(e) $y = 0$ and $y = 2$

14. If $\lim_{x \to 5} f(x) = 2$, then $\lim_{x \to 2} x^2 f(x+3) =$

(a) 8

(b) 4

(c) 5

(d) 0

(e) does not exist

15. If the function $f(x) = \begin{cases} 3x^2 - a & \text{if} \quad x > 1 \\ a + b & \text{if} \quad x = 1 \\ x - 2b & \text{if} \quad x < 1 \end{cases}$

is continuous then $a - 2b =$

(a) 2

(b) 0

(c) 1

(d) 5

(e) 3

16. If $\lim_{x \to 0} [f(x) + g(x)] = 2$ and $\lim_{x \to 0} [f(x) - g(x)] = 1$ then $\lim_{x \to 0} [f(x) \cdot g(x)] =$

(a) $\frac{3}{4}$

(b) 1

(c) 3

(d) -1

(e) $\frac{3}{2}$

17. The function $f(x) = \dfrac{x^2}{x^3 - x}$ has

(a) one removable and two infinite discontinuities

(b) two removable and one infinite discontinuities

(c) three infinite discontinuities

(d) three removable discontinuities

(e) one jump and two infinite discontinuities

18. Let $f(x) = [\![n - x]\!] - [\![x + 1]\!]$ where n is an integer and $[\![x]\!]$ is the greatest integer less than or equal to x.

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

(a) -2

(b) 2

(c) 1

(d) -1

(e) 0

19. The equation of the line tangent to the graph of $y = x^2$ and intersects the x-axis at $x = 1$ is

(a) $y = 4x - 4$

(b) $y = 4x - 2$

(c) $y = 4x + 4$

(d) $y = 4x + 2$

(e) $y = 2x + 2$

20. Let f be defined everywhere and satisfies the following conditions

$$f(1) = 5, \quad f(3) = 21, \text{ and } \quad f(a+b) - f(a) = 4ab + 2b^2$$

for all real numbers a and b. Then $f'(3) =$

(a) 12

(b) 10

(c) 9

(d) 14

(e) 15

Answer KEY

Q	MM	V1	V2	V3	V4	V5
1	a	b	a	e	d	d
2	a	a	b	d	e	c
3	a	a	d	b	c	d
4	a	b	c	b	a	e
5	a	d	c	c	c	e
6	a	b	a	b	d	c
7	a	e	d	c	d	a
8	a	b	a	d	e	a
9	a	d	d	b	e	b
10	a	b	c	c	b	a
11	a	c	a	a	b	b
12	a	e	a	b	e	e
13	a	a	d	d	c	d
14	a	d	e	b	c	a
15	a	c	d	a	d	a
16	a	a	c	b	a	e
17	a	c	a	e	c	c
18	a	b	a	b	e	a
19	a	d	c	c	e	d
20	a	e	c	e	b	b