1. If $0 < f(x) < x\cos\left(\frac{1}{x}\right)$, for $0 < x < 1$, then $\lim_{x\to 0^+} f(x)$

(a) equals 0 (correct)

(b) equals ∞

(c) does not exist

(d) equals 1

(e) equals -1

2. An equation of the tangent line to the curve of

$$y^2 - x = \sin(3x^2 - 3)$$

at the point $(1, 1)$ is

(a) $y = \frac{7}{2}x - \frac{5}{2}$ (correct)

(b) $y = \frac{9}{2}x - \frac{7}{2}$

(c) $y = \frac{3}{2}x - \frac{1}{2}$

(d) $y = \frac{5}{2}x - \frac{3}{2}$

(e) $y = \frac{1}{2}x + \frac{1}{2}$

3. If $y = \dfrac{\sqrt{8x+1}\ (x^2-2)^3}{e^{2\tan x}\ (x+1)^6}$, then $\left.\dfrac{dy}{dx}\right|_{x=0} =$

(a) 32 (correct)

(b) 24

(c) 28

(d) 36

(e) 20

4. $\displaystyle\lim_{x \to -\infty} \frac{\sqrt{9x^2-2}}{6x+1} =$

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

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

(c) $-\dfrac{1}{3}$

(d) $\dfrac{1}{3}$

(e) $-\dfrac{1}{6}$

5. If $f(t) = te^{2t} + 3^{2t+1}$, then $f'\left(\frac{1}{2}\right) =$

(a) $2e + 18\ln 3$ (correct)

(b) $2e + 9\ln 3$

(c) $e + 6\ln 3$

(d) $2e + 12\ln 3$

(e) $e + 11\ln 3$

6. $\frac{d}{dx}\left(x\sin^{-1}x + \sqrt{1-x^2}\right) =$

(a) $\sin^{-1}x$ (correct)

(b) $\frac{2x}{\sqrt{1-x^2}} + \sin^{-1}x$

(c) $\frac{x}{\sqrt{1-x^2}} + \sin^{-1}x$

(d) $-\frac{x}{\sqrt{1-x^2}} + \sin^{-1}x$

(e) $\frac{2x-1}{2\sqrt{1-x^2}} + \sin^{-1}x$

7. Using the Intermediate Value Theorem, we conclude that the equation

$$x^5 = 2x^3 + 2$$

has at least one root in the interval

(a) $(0, 2)$ (correct)
(b) $(0, 1)$
(c) $(-1, 1)$
(d) $(-1, 0)$
(e) $(2, 3)$

8. The function $f(x) = \begin{cases} \dfrac{5}{x+1}, & \text{if } x < 0 \\ 5 - x, & \text{if } 0 \leq x < 5 \\ 4 & \text{if } x = 5 \\ (x-5)^2, & \text{if } x > 5 \end{cases}$ has

(a) one removable discontinuity and one infinite discontinuity (correct)
(b) two jump discontinuities
(c) two removable discontinuities
(d) only one infinte discontinuity
(e) one jump discontinuity and one infinite discontinuity

9. If $L(x)$ is the linearization of $f(x) = 2 + \ln(1 - 4x)$ at $a = 0$, then $L(-1) =$

(a) 6 (correct)

(b) -1

(c) 8

(d) 5

(e) -2

10. $\lim_{x\to\infty} \dfrac{3e^x + 2x}{\sinh x} =$

(a) 6 (correct)

(b) 4

(c) 8

(d) 10

(e) 9

11. The local minimum of

$$f(x) = x - \frac{1}{6}x^2 - \frac{2}{3}\ln x$$

occurs at

(a) $x = 1$ (correct)

(b) $x = 2$

(c) $x = 4$

(d) $x = 3$

(e) $x = \frac{1}{2}$

12. If M and m are the absolute maximum and the absolute minimum values, respectively, of $f(x) = x^3 - 12x + 2$ on the interval $[0, 3]$, then $8M + m =$

(a) 2 (correct)

(b) 9

(c) 4

(d) 65

(e) 16

13. The graph of the function

$$f(x) = \frac{5}{2}x^{\frac{2}{3}} - x^{\frac{5}{3}}$$

is concave upward on the interval

(a) $(-\infty, -\frac{1}{2})$ (correct)

(b) $(-\infty, 0)$

(c) $(-3, 4)$

(d) $(-2, \infty)$

(e) $(-7, 3)$

14. If $f'(x) = \dfrac{x^2 + \sqrt{x} + 1}{x}$ and $f(1) = \dfrac{3}{2}$, then $f(x) =$

(a) $\frac{1}{2}x^2 + 2\sqrt{x} + \ln x - 1$ (correct)

(b) $\frac{1}{2}x^2 - 3\sqrt{x} + \ln x + 4$

(c) $\frac{3}{2}x^2 + 2\sqrt{x} + \ln x - 2$

(d) $\frac{1}{2}x^2 + \frac{1}{2\sqrt{x}} + \ln x + \frac{1}{2}$

(e) $\frac{1}{2}x^2 + 2\sqrt{x} + \ln x + 1$

15. Using Newton's Method and starting with $x_1 = 2$, the second approximation x_2 of the root of the equation $x^3 = 4x - 2$, is

(a) $\frac{7}{4}$ (correct)

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

(c) $\frac{9}{4}$

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

(e) $\frac{5}{4}$

16. If a circular plate of metal is heated in an oven, its radius increases at the rate of 0.01 cm/min. When the radius is 50 cm, the plate's area is increasing with rate

(a) π cm^2/min (correct)

(b) 2π cm^2/min

(c) $\frac{\pi}{2}$ cm^2/min

(d) $\frac{\pi}{50}$ cm^2/min

(e) 50π cm^2/min

17. $\lim_{x\to\infty}\left(\frac{2x-5}{2x+3}\right)^{2x+1} =$

(a) e^{-8} (correct)

(b) e^{-16}

(c) e^{-24}

(d) 1

(e) e^{-20}

18. If $\tanh x = \frac{4}{5}$, then $\cosh x =$

(a) $\frac{5}{3}$ (correct)

(b) $\frac{5}{4}$

(c) $-\frac{5}{3}$

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

(e) $-\frac{5}{4}$

19. The shortest distance between the point $(6, 0)$ and the line $y = x$ is

(a) $3\sqrt{2}$ (correct)

(b) $\sqrt{2}$

(c) $2\sqrt{2}$

(d) $4\sqrt{2}$

(e) $5\sqrt{2}$

20. The function $f(x) = \dfrac{\sin(x^2 - 1)}{x - 1}$ has

(a) only one horizontal asymptote (correct)

(b) two horizontal asymptotes and one vertical asymptote

(c) one horizontal asymptote and two vertical asymptotes

(d) one horizontal asymptote and one vertical asymptote

(e) only one vertical asymptote

21. The **sum** of all the numbers, that satisfy the conclusion of the Mean Value Theorem for the function

$$f(x) = \begin{cases} 3x - x^2, & \text{if } x \geq 0 \\ x^3 + 2x^2 + 3x, & \text{if } x < 0 \end{cases}$$

on the interval $[-2, 2]$, is

(a) $-\dfrac{5}{6}$ (correct)

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

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

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

(e) $-\dfrac{4}{3}$

1. If $0 < f(x) < x\cos\left(\frac{1}{x}\right)$, for $0 < x < 1$, then $\lim_{x\to 0^+} f(x)$

(a) equals 0 (correct)

(b) equals ∞

(c) does not exist

(d) equals 1

(e) equals -1

2. An equation of the tangent line to the curve of

$$y^2 - x = \sin(4x^2 - 4)$$

at the point $(1, 1)$ is

(a) $y = \frac{9}{2}x - \frac{7}{2}$ (correct)

(b) $y = \frac{7}{2}x - \frac{5}{2}$

(c) $y = \frac{3}{2}x - \frac{1}{2}$

(d) $y = \frac{5}{2}x - \frac{3}{2}$

(e) $y = \frac{1}{2}x + \frac{1}{2}$

3. If $y = \dfrac{\sqrt{8x+1}\ (x^2-2)^3}{e^{2\tan x}\ (x+1)^5}$, then $\left.\dfrac{dy}{dx}\right|_{x=0} =$

(a) 24 (correct)

(b) 32

(c) 28

(d) 36

(e) 20

4. $\displaystyle\lim_{x\to-\infty} \frac{\sqrt{4x^2-2}}{6x+1} =$

(a) $-\dfrac{1}{3}$ (correct)

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

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

(d) $\dfrac{1}{3}$

(e) $-\dfrac{1}{6}$

5. If $f(t) = te^{3t} + 2^{3t+1}$, then $f'\left(\frac{1}{3}\right) =$

(a) $2e + 12\ln 2$ (correct)

(b) $2e + 4\ln 2$

(c) $e + 6\ln 2$

(d) $2e + 10\ln 2$

(e) $e + 7\ln 2$

6. $\frac{d}{dx}\left(x\sin^{-1}x + \sqrt{1-x^2}\right) =$

(a) $\sin^{-1}x$ (correct)

(b) $\frac{2x}{\sqrt{1-x^2}} + \sin^{-1}x$

(c) $\frac{x}{\sqrt{1-x^2}} + \sin^{-1}x$

(d) $-\frac{x}{\sqrt{1-x^2}} + \sin^{-1}x$

(e) $\frac{2x-1}{2\sqrt{1-x^2}} + \sin^{-1}x$

7. Using the Intermediate Value Theorem, we conclude that the equation

$$x^5 = 2x^3 + 2$$

has at least one root in the interval

(a) $(0, 2)$ (correct)

(b) $(0, 1)$

(c) $(-1, 1)$

(d) $(-1, 0)$

(e) $(2, 3)$

8. The function $f(x) = \begin{cases} \dfrac{5}{x+1}, & \text{if } x < 0 \\ 5 - x, & \text{if } 0 \le x < 5 \\ 0 & \text{if } x = 5 \\ (x-5)^2, & \text{if } x > 5 \end{cases}$ has

(a) only one infinte discontinuity (correct)

(b) two jump discontinuities

(c) two removable discontinuities

(d) one removable discontinuity and one infinite discontinuity

(e) one jump discontinuity and one infinite discontinuity

9. If $L(x)$ is the linearization of $f(x) = 2 + \ln(1 - 3x)$ at $a = 0$, then $L(-1) =$

(a) 5 (correct)

(b) -1

(c) 8

(d) 6

(e) -2

10. $\lim_{x \to \infty} \dfrac{2e^x + 3x}{\sinh x} =$

(a) 4 (correct)

(b) 6

(c) 8

(d) 10

(e) 9

11. The local minimum of

$$f(x) = x - \frac{1}{10}x^2 - \frac{6}{5}\ln x$$

occurs at

(a) $x = 2$ (correct)

(b) $x = 1$

(c) $x = 4$

(d) $x = 3$

(e) $x = \frac{1}{2}$

12. If M and m are the absolute maximum and the absolute minimum values, respectively, of $f(x) = x^3 - 12x + 4$ on the interval $[0, 3]$, then $4M + m =$

(a) 4 (correct)

(b) 11

(c) 75

(d) 16

(e) 12

13. The graph of the function

$$f(x) = \frac{5}{2}x^{\frac{2}{3}} - x^{\frac{5}{3}}$$

is concave upward on the interval

(a) $(-\infty, -\frac{1}{2})$ (correct)

(b) $(-\infty, 0)$

(c) $(-3, 4)$

(d) $(-2, \infty)$

(e) $(-7, 3)$

14. If $f'(x) = \dfrac{x^2 + \sqrt{x} + 1}{x}$ and $f(1) = \dfrac{1}{2}$, then $f(x) =$

(a) $\frac{1}{2}x^2 + 2\sqrt{x} + \ln x - 2$ (correct)

(b) $\frac{1}{2}x^2 - 3\sqrt{x} + \ln x + 4$

(c) $\frac{3}{2}x^2 + 2\sqrt{x} + \ln x - 1$

(d) $\frac{1}{2}x^2 + \frac{1}{2\sqrt{x}} + \ln x + \frac{1}{2}$

(e) $\frac{1}{2}x^2 + 2\sqrt{x} + \ln x + 1$

15. Using Newton's Method and starting with $x_1 = 2$, the second approximation x_2 of the root of the equation $x^3 = 4x - 4$, is

(a) $\frac{3}{2}$ (correct)

(b) $\frac{7}{4}$

(c) $\frac{9}{4}$

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

(e) $\frac{5}{4}$

16. If a circular plate of metal is heated in an oven, its radius increases at the rate of 0.02 cm/min. When the radius is 50 cm, the plate's area is increasing with rate

(a) $2\pi \quad \text{cm}^2/\text{min}$ (correct)

(b) $\pi \quad \text{cm}^2/\text{min}$

(c) $\frac{\pi}{2} \quad \text{cm}^2/\text{min}$

(d) $\frac{\pi}{50} \quad \text{cm}^2/\text{min}$

(e) $50\pi \quad \text{cm}^2/\text{min}$

17. $\lim_{x\to\infty}\left(\frac{2x-3}{2x+5}\right)^{2x+1} =$

(a) e^{-8} (correct)

(b) e^{-16}

(c) e^{-24}

(d) 1

(e) e^{-20}

18. If $\tanh x = \frac{3}{5}$, then $\cosh x =$

(a) $\frac{5}{4}$ (correct)

(b) $-\frac{5}{3}$

(c) $\frac{5}{3}$

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

(e) $-\frac{5}{4}$

19. The shortest distance between the point $(4, 0)$ and the line $y = x$ is

(a) $2\sqrt{2}$ (correct)

(b) $\sqrt{2}$

(c) $3\sqrt{2}$

(d) $4\sqrt{2}$

(e) $5\sqrt{2}$

20. The function $f(x) = \dfrac{\sin(x^2 - 1)}{x - 1}$ has

(a) only one horizontal asymptote (correct)

(b) two horizontal asymptotes and one vertical asymptote

(c) one horizontal asymptote and two vertical asymptotes

(d) one horizontal asymptote and one vertical asymptote

(e) only one vertical asymptote

21. The **sum** of all the numbers, that satisfy the conclusion of the Mean Value Theorem for the function

$$f(x) = \begin{cases} 3x - x^2, & \text{if } x \geq 0 \\ x^3 + 2x^2 + 3x, & \text{if } x < 0 \end{cases}$$

on the interval $[-2, 2]$, is

(a) $-\frac{5}{6}$ (correct)

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

(c) $\frac{1}{2}$

(d) $-\frac{1}{2}$

(e) $-\frac{4}{3}$