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

   a) $-1 + \ln 2$
   b) $4 - \ln 2$
   c) $2 + \ln 2$
   d) $1 + \ln 2$
   e) $2 \ln 2$

2. If $x_1 = 1$ is an initial approximation of one of the zeros of the function $f(x) = 2x^4 - x^2$, using Newton's method to find the next approximation x_2 we get

   a) $\dfrac{5}{6}$
   b) $\dfrac{1}{6}$
   c) $\dfrac{2}{3}$
   d) $\dfrac{1}{2}$
   e) $\dfrac{1}{3}$

3. The equation of the oblique asymptote of the graph of $f(x) = \dfrac{3x^2 - 4}{x + 1}$ is

a) $y = 3x - 3$
b) $y = 3x - 2$
c) $y = 3x + 1$
d) $y = 3x$
e) $y = 3x + 4$

4. The value of c that satisfies the conclusion of the **Mean Value Theorem** for the function $f(x) = 2x^2 + 1$ on the interval $[1, 3]$ is

a) $c = 2$
b) $c = \dfrac{3}{2}$
c) $c = \dfrac{5}{2}$
d) $c = \dfrac{5}{4}$
e) $c = \dfrac{9}{4}$

5. The sum of the absolute maximum and absolute minimum values of $f(x) = \cos^2 x - \cos x$ in $[-\pi/2, \pi]$ is

   a) $\frac{7}{4}$
   b) 2
   c) $\frac{9}{4}$
   d) $\frac{2\pi}{3}$
   e) $-\frac{\pi}{4}$

6. The function $f(x) = \begin{cases} \frac{x^2 - 16}{x^2 - 3x - 4} & \text{if } x \neq 4 \\ k & \text{if } x = 4 \end{cases}$ is continuous at $x = 4$, then k is equal to

   a) $\frac{8}{5}$
   b) $\frac{3}{5}$
   c) $\frac{-1}{5}$
   d) $\frac{-2}{5}$
   e) $\frac{-9}{5}$

7. Let $\dfrac{ds}{dt} = 1 + \cos t,\ s(0) = 4$. Then $s\left(\dfrac{\pi}{2}\right) =$

a) $5 + \dfrac{\pi}{2}$

b) $-1 + \dfrac{\pi}{2}$

c) $2 + \pi$

d) $2 - \pi$

e) 0

8. If $f(x) = 2\cos(2\tan^{-1}\sqrt{x})$, then $f'(1) =$

a) -1

b) 1

c) $\dfrac{\pi}{2}$

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

e) $\dfrac{\pi}{4}$

9. Let $f(x) = x \ln x$. Then the graph of $f(x)$ is

a) increasing on $\left(\frac{1}{e}, \infty\right)$ and decreasing on $\left(0, \frac{1}{e}\right)$

b) increasing on $(0, \infty)$

c) deccreasing on $(0, \infty)$

d) increasing on $\left(0, \frac{1}{e}\right)$ and decreasing on $\left(\frac{1}{e}, \infty\right)$

e) increasing on(e, ∞) and decreasing on $(0, e)$

10. $\displaystyle\lim_{x \to 0} \frac{\sin(\sin^{-1} x)}{\frac{\pi}{2} - \cos^{-1} x} =$

a) 1

b) 0

c) ∞

d) $\frac{\pi}{2}$

e) π

11. The length L of a rectangle is decreasing at the rate of $2\,cm/sec$ while the width w is increasing at the rate of $2\,cm/sec$. When $L = 12cm$ and $w = 5cm$, then the area of the rectangle is increasing at a rate of (in cm^2/sec)

a) 14
b) 34
c) 24
d) 18
e) 30

12. The graph of $f(x) = \dfrac{8x+3}{|x|-1}$ has

a) two horizontal and two vertical asymptotes
b) one horizontal and one vertical asymptotes
c) two horizontal and one vertical asymptotes
d) two vertical and no horizontal asymptotes
e) one vertical and no horizontal asymptotes.

13. Let $f(x) = \frac{3}{8}x^{8/3} - \frac{6}{5}x^{5/3} + \frac{3}{2}x^{2/3}$. If

$$C = \text{the number of critical points of } f(x)$$

$$m = \text{the number of local minimum of } f(x)$$

$$M = \text{ the number of local maximum of } f(x)$$

then $2C + m - M =$

a) 5
b) 4
c) 3
d) 0
e) -1

14. $\lim_{x\to\infty} [x - \ln(1 + 2e^x)] =$

a) $-\ln 2$
b) ∞
c) 0
d) $\ln 2$
e) 1

15. If $\cos y + ye^x = x$, then $\dfrac{dy}{dx}$ is

a) $\dfrac{1 - ye^x}{e^x - \sin y}$

b) $\dfrac{1 + ye^x}{e^x - \sin y}$

c) $\dfrac{1 - ye^x}{e^x + \sin y}$

d) $\dfrac{3 - ye^x}{e^x - \sin y}$

e) $\dfrac{4 + ye^x}{e^x - \sin y}$

16. If α is constant, then $\lim\limits_{x\to\infty} \left(1 - \dfrac{2\alpha}{x}\right)^x =$

a) $e^{-2\alpha}$

b) $e^{2\alpha}$

c) $e^{-\alpha}$

d) e^{α}

e) 0

17. If $f(x) = \log_3 \sqrt{\left(\frac{2x}{x^3+1}\right)^{\ln 3}}$, then $f'(1) =$

a) $-\frac{1}{4}$
b) $\frac{1}{2}$
c) $-\frac{1}{3}$
d) $\frac{5}{4}$
e) $\ln 3$

18. If (α, β) is the point of inflection of the curve $f(x) = \tan x - 4x$ for $x \in \left(\frac{-\pi}{2}, \frac{\pi}{2}\right)$, then $2\alpha - \beta + 2$

a) 2
b) 0
c) $\frac{\pi}{4}$
d) $-\frac{\pi}{4}$
e) $1 - \pi$

19. If $y = (2 + \tan x)^x$, then $y'(0) =$

a) $\ln 2$

b) $\frac{1}{2} + \ln 2$

c) $2 \ln 2$

d) 4

e) 2

20. A rectangle has its base on the x-axis and its upper two vertices on the parabola $y = 12 - x^2$. The largest possible area of such rectangle is

a) 32

b) 30

c) $18\sqrt{3}$

d) $8\sqrt{3}$

e) 16

21. $\lim_{n\to\infty} \sum_{k=1}^{n} \left(\frac{1}{n} - \frac{k^2}{n^3} \right) =$

a) $\frac{2}{3}$
b) $\frac{1}{6}$
c) $\frac{1}{3}$
d) $\frac{5}{3}$
e) $\frac{7}{6}$

22. Using the linearization of $f(x) = \sin x$ at $a = \frac{\pi}{4}$ to approximate $\sin(44^\circ)$, we get $\sin 44^\circ \approx \alpha + \beta\pi$, then $2\alpha - 360\beta =$

a) $2\sqrt{2}$
b) 0
c) $\sqrt{2}$
d) $-2\sqrt{2}$
e) $-\sqrt{2}$

23. If $f(x) = x\sqrt{8 - x^2}$, then which one of the following statements is False?

a) The function is decreasing on$(-2, 2)$

b) The domain of the function is$[-2\sqrt{2}, 2\sqrt{2}]$

c) The function has an absolute minimum at $x = -2$

d) The function has an absolute maximum at $x = 2$

e) The function is increasing on $(-2, 2)$

24. If the **average value** $av(f)$ of $f(x) = \frac{1}{2} + \sin^2(\pi x)$ on the interval $[0, 2]$ is approximated by partitioning the interval into four subintervals of equal length and evaluating f at the subinterval midpoint, then $av(f) \approx$

a) 1

b) 2

c) $\frac{3}{2}$

d) 4

e) $\frac{5}{2}$

25. The minimum vertical distance between the parabolas $y = x^2 + 1$ and $y = x - x^2$ is equal to

a) $\frac{7}{8}$

b) $\frac{3}{4}$

c) $\frac{5}{8}$

d) $\frac{1}{4}$

e) $\frac{3}{8}$

26. $\int (e^{2\ln x} + e^{x\ln 2})\, dx =$

a) $\frac{x^3}{3} + \frac{2^x}{\ln 2} + C$

b) $\frac{x^2}{\ln x} + \frac{2^{x+1}}{x+1} + C$

c) $\frac{x^2}{4} + \frac{2^x}{\ln 2} + C$

d) $\frac{x^3}{3} + 2^x + C$

e) $2x + \frac{2^x}{\ln 2} + C$

27. Let $f(x) = x^2 - 4x - 5$ for $x > 2$. Then $(f^{-1})'(0) =$

a) $\frac{1}{6}$

b) $-\frac{1}{6}$

c) $\frac{1}{3}$

d) $\frac{2}{3}$

e) 0

28. If $f(x) = \begin{cases} C & \text{if} \quad x = 0 \\ Ae^x & \text{if} \quad 0 < x < 1 \\ \ln x + B & \text{if} \quad 1 \le x \le 2 \end{cases}$ satisfies the conditions of the Mean Value Theorem, then $A + B - C =$

a) 1

b) e

c) $\frac{1}{e}$

d) $\frac{1}{e^2}$

e) $1 + e$