1. If \( y = 3\sqrt{x} + (\sqrt{x})^3 \), then \( y'(1) = \).

2. Let \( f(x) = \frac{4!}{ax+1} \), where \( a \) is a nonzero constant. If \( f^{(5)}(0) = -(4!)^2 \), then \( a^5 = \).

3. If \( c \) is the number satisfying the conclusion of the Mean Value Theorem for \( f(x) = -4 + \sqrt{3x+1} \) on the interval \([1, 5]\), then \( c = \).

4. Which of the following statements is **TRUE** about the graph of the function \( f(x) = x^2 - 18 \ln x \)?
   (a) The graph has one inflection point.
   (b) The graph is concave upward on \((0, 3)\).
   (c) The graph is concave downward on \((3, \infty)\).
   (d) The graph is increasing on \((0, 3)\).
   (e) The graph is decreasing on \((3, \infty)\).

5. The function \( f(x) = 3 \cos x - \cos^3 x, \ 0 < x < \frac{5\pi}{3} \), has . . . . . . **critical points**.

6. The asymptotes of the function \( f(x) = \frac{x^7 - x^6 - 2x^2}{x^6 + x^5 + x^2 + 1} \) are

7. \( \lim_{h \to 0} \frac{\tan^{-1}(2x+h) - \tan^{-1}(2x)}{h} = \).

8. A particle with position function \( s(t) = t^3 - 3t^2 - 9t, \ t \in [0, 7] \), moves in the positive direction when \( t \in (a, b) \). Then \( b^a = \).

9. If \( h(2) = \sqrt{2} \) and \( h'(2) = -\sqrt{2} \), then \( \frac{d}{dx}(\frac{h(x)}{x^2})|_{x=\sqrt{2}} \) is equal to

10. \( \lim_{x \to \pi} \frac{\sin x}{\sin(\sin x)} = \)

11. If \( f(x) = xg(x) \), where \( f \) and \( g \) are differentiable function, \( f(2) = -6 \) and \( f'(2) = -5 \). The equation of the tangent line to the curve \( y = g(x) \) at \( x = 2 \) is

12. Let \( f(x) = \begin{cases} \sqrt{x}e^x, & \text{when } x \geq 0; \\ \log_4(-x), & \text{when } x < 0. \end{cases} \) The value of \( f'(1) + f'(\frac{1}{\ln 4}) \) equal to

13. If \( f(x) = 5x + 3e^{7x}, \) then \( (f^{-1})'(3) = \)
14. If \( f(x) = (ex)^\pi x \), then \( f'(\frac{1}{e}) = \)

15. \( \frac{d^2y}{dx^2} (x \cos x) = \)

16. A glass window has a shape of a square with a semicircle on its top. Suppose that the area of the square is changing at the rate of \( \frac{2}{e} \text{ cm}^2/\text{min} \). Then the area of the semicircle will be changing at the rate of \( R \text{ cm}^2/\text{min} \), where \( R = \)

17. If \( x_1 = 1 \) is an approximation to the real root of the equation \( x^3 + 5x - 7 \), then the next approximation \( x_2 \) given by Newton’s Method is

18. If \( f'(x) = (x - \frac{1}{\sqrt{x}})^2 \) and \( f(1) = 1 \), then \( f(4) = \)

19. If \( y = (3x + 1)^{5/2} \sqrt{\frac{2x+2}{x^2+3}} \), then \( y'(1) = \)

20. The linearization \( L(x) \) of \( f(x) = (7 - 3x)^{2/3} \) at \( a = 1 \) is

21. If \( y = L \) and \( y = M \) are the equations of the horizontal asymptotes to the graph of the function \( f(x) = \frac{\pi}{2} - \cos^{-1}(\frac{\sqrt{3x^2+1}}{2x+1}) \), then \( L + M = \)

22. \( \left[ \cosh\left(\frac{3x}{2}\right) + \sinh\left(\frac{3x}{2}\right) \right]^{4/3} = \)

23. \( \frac{d}{dx} \left[ 2x \sinh(3x) + 2x \sin^{-1} x + \frac{2x}{\sqrt{1-x^2}} \right] = \)

24. If \( x^2 + y^3 = 10 \), then \( \frac{d^2y}{dx^2}(x,y)=(3,1) = \)

Dr. M. R. Alfuraidan

Page 2