1: The derivative of the function $F(x) = \int_0^{3x} \sec t \, dt$ is

a. $\tan 3x$
b. $3 \tan 3x$
c. $3 \sec 3x$
d. $\sec 3x$
e. None of the above

2: The average value of the function x^n on the interval $[0, n]$ is

a. $\dfrac{n^n}{n+1}$ b. $\left(\dfrac{n}{2}\right)^n$ c. $\dfrac{1}{2}n^n$ d. $\dfrac{1}{2}\left(\dfrac{n^{n+1}}{n+1}\right)$ e. None of these

3: A solid of revolution is generated by revolving about the x-axis the area under the curve $y = \sec x$ between $x = 0$ and $x = \pi/4$. Its volume is:

a. 0 b. π c. 1 d. $\left(\dfrac{\pi}{4}\right)^2$ e. None of these

4: At the point $(1, 1)$, the curve $y^3 + 2x^2y - 3x^2 = 0$ has tangent line

a. $y = \dfrac{6}{5}x - \dfrac{1}{5}$ b. $y = \dfrac{6}{7}x + \dfrac{1}{7}$ c. $y = \dfrac{6}{7}x - \dfrac{1}{5}$ d. $y = \dfrac{2}{5}x + \dfrac{3}{5}$ e. None of these

5: Suppose that you want to build a rectangular fence along the side of a river (note that only three sides of fence are needed). Suppose that you have 1080 feet of fence material. Determine how to set up the fence so that the maximum amount of area is enclosed. Choose the appropriate answer.
a. It should be a 270 by 270 rectangular fence.
b. It should be a 270 by 540 rectangular fence.
c. It should be a 250 by 580 rectangular fence.
d. It should be a 580 by 580 rectangular fence.
e. None of the above

6: How many points of inflection are on the graph of the function $12x^3 + 14x^2 - 7x - 9$?
a. 3
b. 1
c. 4
d. 2
e. None of the above

7: For what values of c does the curve $f(x) = 5x^3 + cx^2 + 10x$ have both a local minimum and a local maximum?
a. $|c| > 15$
b. $|c| > \sqrt{150}$
c. $|c| > 1,500$
d. $|c| > \sqrt{30}$
e. None of the above

8: Find two positive numbers whose product is 144 and whose sum is a minimum.
a. 4, 36
b. 2, 72
c. 12, 12
d. 6, 24
e. None of the above

9: The function $f(x) = \sin 5\pi x$ satisfies all three conditions of Rolle's Theorem on the interval $[-2/5, 2/5]$. All the numbers c that satisfy Rolle's Theorem are:
a. $c_1 = \pm\frac{1}{10}, \quad c_2 = \frac{3}{10}$
b. $c_1 = -\frac{1}{10}, \quad c_2 = \pm\frac{1}{10}$
c. $c_1 = \frac{1}{10}, \quad c_2 = \pm\frac{3}{10}$
d. $c_1 = \pm\frac{1}{10}, \quad c_2 = \pm\frac{3}{10}$
e. None of the above

10: Find the most general antiderivative of the function $f(x) = \frac{1}{1+x^2} - \tan 3x + 9$.

a. $F(x) = \tan^{-1} x + \frac{1}{3}\ln[\sec(3x)] + 9x + C$
b. $F(x) = \tan^{-1} x + \frac{1}{3}\ln|\sec(3x)| + 9x + C$
c. $F(x) = \sin^{-1} x + \sec x + 9x + C$
d. $F(x) = \tan^{-1} x + \frac{1}{3}\ln\sec(3x) + C$
e. None of the above

11: What is the value of the definite integral

$$\int_0^1 \frac{e^x}{1 + e^{2x}}\, dx$$

a. $\arctan(e)$
b. $\pi/4$
c. $\frac{\pi}{4}\arctan(e)$
d. $\arctan(e) - \frac{\pi}{4}$
e. None of the above

12: The following limit defines some the derivative of function at some point.

$$\lim_{x \to 2} \frac{\ln x - \ln 2}{x - 2}$$

Which of the following choices gives the function and the point?
a. $f(x) = x^{-2}$ at $x = 1$
b. $f(x) = e^x$ at $x = 2$
c. $f(x) = x^{-1}$ at $x = 2$
d. $f(x) = \ln(x)$ at $x = 2$
e. None of the above

13: Given a continuous function $f(x)$ defined on the interval $[a, b]$, it must attain its absolute maximum and absolute minimum at some point $x = c$ in the interval $[a, b]$.
a. True
b. False
c. The function will attain its absolute maximum but not its absolute minimum
d. The function will attain its absolute minimum but not its absolute maximum
e. None of the above

14: Consider the limit

$$\lim_{x \to -\infty} \frac{x}{\sqrt{x^2 + 1}}$$

Which of the following gives the value of the limit?
a. 1
b. -1
c. 0
d. ∞
e. None of the above

15: What are all the asymptotes of the function

$$y = \frac{x^2 - 3x + 2}{x^2 - x}$$

a. $y = 1$, $x = 1$ and $x = 0$
b. $x = 0$ and $x = 1$
c. $y = 0$ and $x = 0$
d. $y = 1$ and $x = 0$
e. None of the above

16: For which values of a and b will the function

$$f(x) = \begin{cases} x+2 & \text{if } x < 2 \\ ax^2 - bx + 3 & \text{if } 2 \le x < 3 \\ 2x - a + b & \text{if } x \ge 3 \end{cases}$$

be continuous?
a. $a = 1$ and $b = 2$
b. $a = b = 1$
c. $a = b = 1/2$
d. $a = 3$ and $b = -1$
e. None of the above

17: What is the derivative of the function $f(x) = x^x$?
a. x^x
b. $x^x(1 + \ln x)$
c. x^{x-1}
d. $x^x \ln x$
e. None of the above

18: Consider the function

$$f(x) = (\ln(x+3))^2$$

Which of the following points are in the domain of the function, but are points where the derivative of $f(x)$ does not exist?
a. $x = 3$ and $x = -5$
b. $x = -3$ and $x = 5$
c. $x = 0$
d. $x = -3$
e. None of the above

19: Find the function $f(t)$ if $f'(t) = 2t - 3\sin t$ and $f(0) = 5$.
a. $f(t) = t^2 + 3\cos t + 2$
b. $f(t) = t^2 + 3\cos t$
c. $f(t) = 2t - 3\sin t + 5$
d. $f(t) = t^2 - 3\cos t - 5$
e. None of the above

20: Which of the following gives the range of the function $f(x) = 2e^{\sin x}$?
a. $[1, e]$
b. $(-\infty, \infty)$
c. $[2, 2e]$
d. $[2/e, 2e]$
e. None of the above