1. Find the output of the following Maple statement:

\[ \text{> limit((x^3-1)/(x^2-2),x=1);} \]

(a) 0  (b) 1  (c) 2  (d) 3  (e) 4

2. The function \( f(x) = x^3 + 3x - 1 \) has a root:

(a) between \(-1\) and 0
(b) between 0 and 1
(c) between 1 and 2
(d) between 2 and 3
(e) between 3 and 4

3. Find the output of the following Maple statement:

\[ \text{> subs(x=9,diff(sqrt(1+sqrt(x)),x));} \]

(a) 1/3  (b) -1/3  (c) 0  (d) 1/48  (e) 1/24

4. The line tangent to the graph of \( f(x) = x^3 - 2x + 1 \) at the point (2,5) is

(a) \( y = 5x - 23 \)  (b) \( y = 10x - 48 \)  (c) \( y = 10x - 15 \)
(d) \( y = 4x - 3 \)  (e) \( y = 5x - 5 \)

5. If \( f(x) = \begin{cases} x^2 + 2 & \text{for } x \leq 1 \\ 2x + 1 & \text{for } x > 1 \end{cases} \), then

(a) \( f(x) \) is not continuous at \( x = 1 \)
(b) \( f(x) \) is continuous at \( x = 1 \) but \( f'(1) \) does not exist
(c) \( f'(1) \) exists and equals 1
(d) \( f'(1) = 2 \)
(e) \( \lim_{x \to 1} f(x) \) does not exist
6. Let \( u(x) = \sqrt{f(x)} \) and suppose \( f(3) = 1 \), \( f'(3) = 8 \) and \( f''(3) = -2 \). Then the value of \( \frac{d^2u}{dx^2} \) at \( x = 3 \) is

(a) 0  (b) 1  (c) −9  (d) 9  (e) −17

7. Evaluate \( \frac{d}{dx} \left( \frac{1}{2} \sin(x^2) \cos(x^2) \right) \).

(a) \( x \)  (b) \( \frac{1}{2} \)  (c) \( x \cos^2(x^2) - \sin^2(x^2) \)  (d) \( \frac{1}{2} \cos^2(x^2) - \sin^2(x^2) \)  (e) \( -2x^2 \cos(x^2) \sin(x^2) \)

8. The position function of a mass suspended from a spring is given by

\[
s(t) = 4 \sin \left( 5t - \frac{\pi}{3} \right)
\]

where \( s \) is in cm and \( t \) is in seconds. Its acceleration (in cm/sec\(^2\)) at time \( t = \pi/6 \) seconds is

(a) −100  (b) −4  (c) −20  (d) 0  (e) none of the above

9. An asteroid hits the Atlantic Ocean and creates an expanding circular wave. If the area enclosed by this wave increases at the rate of 200 km\(^2\)/min, how fast is the diameter of the wave expanding when its radius is 20 km?

(a) \( \pi/5 \) km/min  (b) \( \pi/10 \) km/min  (c) \( 5/\pi \) km/min  (d) \( 10/\pi \) km/min  (e) \( 5\pi \) km/min

10. \( \lim_{h \to 0} \frac{\sqrt{8 + h} - 2}{h} \) is

(a) 0  (b) \( \frac{1}{12} \)  (c) \( \frac{2}{3} \)  (d) \( \frac{1}{24} \)  (e) \( \infty \)
11. The two tangents that can be drawn from the point (3,5) to the parabola \( y = x^2 \) have slopes

(a) 1 and 5  (b) 0 and 4  (c) 2 and 10  (d) 2 and \(-\frac{1}{2}\)  (e) 2 and 4

12. Suppose \( f(x) = \begin{cases} \frac{x^2 - 4ax + 3a^2}{x - a} & \text{for } x \neq a \\ 2 & \text{for } x = a \end{cases} \) and that \( f \) is continuous for all real \( x \). Then which of the following must be true?

(a) \( a = -1 \)  (b) \( a = 0 \)  (c) \( a = 1 \)  (d) \( a = 2 \)  (e) \( a = 3 \)

13. Suppose \( f \) is a twice-differentiable function which is strictly concave upward everywhere (i.e., \( f'' > 0 \) everywhere), and suppose \( f(3) = 2 \) and \( f(7) = 4 \). Which of the following is a possible tangent line to the graph of \( f \)?

(a) \( y = x - 1 \)  (b) \( y = x + 1 \)  (c) \( x - 2y = -1 \)  (d) \( y = 4 \)  (e) \( x + y = 5 \)

14. A particle moves along a horizontal line in such a way that its position at time \( t \) seconds is \( s = 2t^4 - 12t^3 + 24t^2 + 5t - 4 \) meters to the right of the origin. For what values of \( t \) is the velocity of the particle increasing?

(a) \( t > 1 \)  (b) \( 1 < t < 2 \)  (c) \( t < 2 \)  (d) \( t < 1 \) and \( t > 2 \)  (e) \( t > 0 \)

15. Let the continuous function \( f(x) \) be increasing and concave down for \(-1 < x < 0\) and decreasing and concave up for \(0 < x < 1\). Then

(a) \( f''(0) = 0 \)
(b) \( f'(0) = 0 \)
(c) \( f'(0) \) does not exist
(d) \( f \) has a local maximum at \( x = 0 \)
(e) Both (c) and (d)
16. The tangent line to $x^3 + y^3 = 6xy$ at $(3, 3)$ is:

(a) $y = 8x - 21$  
(b) $x + y = 6$  
(c) $3y = x + 6$
(d) $y = 8x + 3$  
(e) does not exist

17. We know that the graph of a function $f(x)$ passes through the point $(4, 6)$. We also know that $-1 \leq f'(x) \leq 3$ for all $x$ in the interval $[0, 10]$. What are the minimum and maximum values possible values for $f(7)$?

(a) min = 7, max = 16  
(b) min = 4, max = 7  
(c) min = -1, max = 4
(d) min = 6, max = 10  
(e) min = 3, max = 15

18. The graph of $y = \frac{1}{4 + x^2}$ is concave down for

(a) $-2 < x < 2$  
(b) $-\sqrt{3} < x < \sqrt{3}$  
(c) $-\frac{1}{\sqrt{3}} < x < \frac{1}{\sqrt{3}}$
(d) $-\frac{2}{\sqrt{3}} < x < \frac{2}{\sqrt{3}}$  
(e) $-\frac{4}{\sqrt{3}} < x < \frac{4}{\sqrt{3}}$