1. Which of the following is the inverse of \( f(x) = \frac{8x - 1}{2x + 5} \)?

(a) \( \frac{x - 8}{5x + 2} \)
(b) \( \frac{2x - 1}{8x + 5} \)
(c) \( \frac{2x + 5}{8x - 1} \)
(d) \( \frac{5x - 1}{2x + 8} \)
(e) \( \frac{5x + 1}{8 - 2x} \)

2. Simplify \((e^{3\ln x})(\ln(e^{2x}))\).

(a) \( 2x^4 \)
(b) \( x^5 \)
(c) \( 5x \)
(d) \( 6x^2 \)
(e) None of these

3. Find the derivative of \( f(x) = \ln(x^4e^x) \).

(a) \( \frac{1}{x^4} + \frac{1}{e^x} \)
(b) None of these
(c) \( \frac{4}{x} \)
(d) \( \frac{4}{xe^x} + \frac{1}{x^2} \)
(e) \( \frac{4}{x} + 1 \)
4. Simplify \( \tan \left( \arcsin \left( \frac{1}{4} \right) \right) \).

(a) \( \frac{\sqrt{15}}{4} \)
(b) None of these
(c) \( \frac{4}{\sqrt{15}} \)
(d) \( \sqrt{15} \)
(e) \( \frac{1}{\sqrt{15}} \)

5. Evaluate \( \lim_{x \to \pi} \frac{\sin x}{\pi^2 - x^2} \).

(a) None of these
(b) 0
(c) \( \frac{1}{2\pi} \)
(d) \( -\frac{1}{2\pi} \)
(e) 1

6. The graph of the DERIVATIVE of \( f \) is shown below. On which interval is \( f \) increasing and concave down?

(a) (0, 1)  (b) (1, 3)  (c) (3, 5)  (d) (5, 6)  (e) None of these

7. Find the absolute maximum of \( f(x) = \sin x \) on the interval \( [-\pi, \frac{\pi}{6}] \).

(a) \( \frac{1}{2} \)
(b) 1
(c) None of these
(d) \( -1 \)
(e) \( \frac{\sqrt{3}}{2} \)

8. If the DERIVATIVE of a function \( f \) is given by \( f'(x) = x^4 - 3x^3 + 2x^2 \), at which value(s) of \( x \) does \( f \) have a local maximum?

(a) \( x = \frac{9 + \sqrt{17}}{8} \) only
(b) None of these
(c) \( x = 0 \) and \( x = \frac{9 + \sqrt{17}}{8} \)
(d) \( x = 0 \) and \( x = 1 \)
(e) \( x = 1 \) only
9. Let \( f \) be a one-to-one function such that \( f(5) = 2 \), \( f(2) = 5 \), \( f'(5) = -3 \), and \( f'(2) = -\frac{1}{2} \). If \( g = f^{-1} \), what is \( g'(5) \)?

(a) \(-2\)
(b) \(\frac{1}{5}\)
(c) \(\frac{1}{2}\)
(d) None of these
(e) \(-\frac{1}{3}\)

10. Simplify \( \arccos \left( \cos \left( \frac{4\pi}{3} \right) \right) \).

(a) \(-\frac{2\pi}{3}\)
(b) \(\frac{4\pi}{3}\)
(c) None of these
(d) \(\frac{2\pi}{3}\)
(e) \(-\frac{\pi}{3}\)

11. Given the graph of the function \( f \) below, which statement is true?

![Graph of function f](image)

(a) \( f' > 0 \), \( f'' > 0 \)
(b) \( f' > 0 \), \( f'' < 0 \)
(c) \( f' < 0 \), \( f'' > 0 \)
(d) \( f' < 0 \), \( f'' < 0 \)
(e) None of these

12. Which of the following are critical values of \( f(x) = \frac{1}{3}x^2 - x^{2/3} \)?

(a) None of these
(b) \( x = 0 \) and \( x = \sqrt[3]{2} \)
(c) \( x = \sqrt[3]{2} \) only
(d) \( x = 0 \) and \( x = 8 \)
(e) \( x = 8 \) only
13. Given the DERIVATIVE of $f$ is $f'(x) = x^4 - \frac{4}{3}x^3 - 45$, what are the $x$-coordinates of the inflection points of $f$?

(a) 3 only
(b) 0, 1
(c) 1 only
(d) None of these
(e) 0, 3

14. Which of the following is an antiderivative of $f(x) = xe^x$?

(a) $(x + 1)e^x + C$
(b) $(x - 1)e^x + C$
(c) None of these
(d) $\frac{1}{2}x^2e^x + C$
(e) $-\frac{1}{2}x^2e^x + C$

15. A curve has slope $2x + 3$ at any point $(x, y)$. Find the equation of this curve if it passes through the point $(1, 2)$.

(a) $y = 2x^2 + 3x - 3$
(b) $y = 5x - 3$
(c) None of these
(d) $y = x^2 + 3x + 2$
(e) $y = x^2 + 3x - 2$

**PART II WORK OUT**

**Directions:** Present your solutions in the space provided. *Show all your work* neatly and concisely and *box your final answer*. You will be graded not merely on the final answer, but also on the quality and correctness of the work leading up to it.

16. (8 pts) The acceleration of an object in the plane is given by $a(t) = (1 + 3\sin t, 2 - \cos t)$. If the initial velocity is $v(0) = (5, 4)$, find the velocity of the object at any time $t$. 
17. (8 points each) Given \( f(x) = (1 - 3x)^{1/x} \):

(a) Find \( f'(x) \) (You do not have to simplify)

(b) Evaluate \( \lim_{x \to 0} f(x) \)
18. (7 points) Solve for $x$: $\log_4(-x) + \log_4(-3 - x) = 1$

19. A metal ball cools at a rate equal to one-third the difference between its temperature and the temperature of its surroundings. Suppose the ball is taken from outdoors where the temperature is 36$^\circ$C to a room where the temperature is 21$^\circ$C.

(a) (5 pts) Find the temperature of the ball after 2 minutes.

(b) (5 pts) When will the ball have a temperature of 25$^\circ$C?
20. (8 pts) Find the base of the rectangle with largest area which can be inscribed in the first quadrant of the ellipse 
\[ x^2 + \frac{y^2}{9} = 1. \] Clearly show that your answer yields maximum area.

21. (6 pts) Find the equation of the line tangent to \( f(x) = \arctan(-3x) \) at \( x = \frac{1}{2} \).