1. \[ f(x) = \begin{cases} \frac{2kx}{x-1}, & x < -1 \\ x-k, & x \geq -1 \end{cases} \], for what value of \( k \) is \( f(x) \) continuous?
   
   a. 2
   b. \(-1/2\)
   c. 2
   d. 0

2. Find the derivative of \( f(x) = \frac{x^2 - 4x}{3x + 1} \)
   
   a. \( f'(x) = \frac{3x^2 + 3x - 4}{(3x + 1)^2} \)
   b. \( f'(x) = \frac{-4}{3x + 1} \)
   c. \( f'(x) = \frac{3x^2 + 2x - 4}{(3x + 1)^2} \)
   d. \( f'(x) = \frac{2x - 4}{3} \)
   e. \( f'(x) = \frac{6x^2 + 9x - 4}{(3x + 1)^2} \)

3. Find the derivative of \( f(x) = 3x^2 \sin x \)
   
   a. \( f'(x) = 6x^2 \cos x \)
   b. \( f'(x) = 3x^2 \sin x + 6x \cos x \)
   c. \( f'(x) = 6x \sin x + 3x^2 \cos x \)
   d. \( f'(x) = 6x \cos x \)
4. Use implicit differentiation to find $\frac{dy}{dx}$ if $2y - 3x = y^2 + x$.

a. $\frac{2}{1 - y}$  
b. $y + 2$  
c. $-1$  
d. $2y + x$

5. What is the minimum value of $f(x) = -x^2 + 3x$ on $[0, 4]$?

a. 38  
b. 0  
c. 3/2  
d. 9/4  
e. -4

6. Find $y'$ if $y = x^{\cos 3x}$ (hint: use logarithmic differentiation)

a. $(\cos 3x) x^{\cos 3x - 1}$  
b. $\cos 3x \ln x$  
c. $-3\sin x x^{\cos 3x}$  
d. $\left(-3\sin x \ln x + \frac{\cos 3x}{x}\right) x^{\cos 3x}$  
e. $-3\sin x \ln x + \frac{\cos 3x}{x}$

7. Find $\lim_{x \to \infty} \frac{x^2}{e^{3x}}$ (Hint: Use L’Hopital’s rule)

a. 0  
b. 1  
c. 2/3  
d. $\infty$  
e. $-\infty$  
f. does not exist
8. Which of the following best illustrates the Mean Value Theorem?

9. Label each curve as $f$, $f'$, or $f''$.
10. Estimate the area under the graph of \( f(x) = x^2 + 5 \) from \( x = 1 \) to \( x = 7 \) using 3 rectangles and the midpoint rule.

a. 140 
b. 100 
c. 142 
d. 71 
e. 154 

11. Find \( \int 7 \sin x + 5e^x - 3x^{-1} \, dx \)

a. \( 7 \cos x + 5e^x - 3 \ln x + C \) 
b. \( -7 \cos x + 5e^x - 3 \ln x + C \) 
c. \( -7 \cos x + 5xe^{-x} + 3x^2 + C \) 
d. \( 7 \cos x + 5e^x + 3x^2 + C \) 

12. Evaluate \( \int_1^2 x^4 \, dx \)

a. 31/5 
b. 32/5 
c. 15 
d. 33/5 

13. Find \( f''(x) \) if \( f(x) = \int_3^{x^2} 5t \sin t \, dt \)

a. \( 10x^4 \sin x^2 \) 
b. \( 5x^2 \sin x^2 \) 
c. \( 10x^3 \sin x^2 \) 
d. \( 5x \sin x \)
14. Use the delta-epsilon definition of the limit to prove that $\lim_{x \to 1} (3x - 1) = 2$. Illustrate with a graph.
15. What is \( \frac{d}{dx} \tan^{-1} x \)? Prove it.
16. Sand is being poured into a sandlot at a rate of 20 ft$^3$/min. It forms a cone whose radius and height are always equal. How fast is the height of the pile increasing when the pile is 5 ft. high?

Ans____________________

17. Someone wants to raise moose for the novelty meat market. This person has a bunch of old telephone poles and plenty of barbed wire for 12,000 feet of fencing. He wants to build a rectangular pen for the moose, using a nearby cliff for one side of the pen (so no fencing is needed for this side). What dimensions should the pen be to maximize its area?

Ans_______________________________
18. Sketch the graph of $y = \frac{2x^2}{x^2 - 1}$, if $y' = \frac{-4x}{(x^2 - 1)^2}$ and $y'' = \frac{12x^2 + 4}{(x^2 - 1)^3}$. Be sure to label any asymptotes, intercepts, relative extrema or inflection points.