1. Let $f(x)$ be a continuously differentiable function, and consider $f(x^2)$. How many of the following statements are true?

- $f(x^2) > 0$ for all $x$.
- If $f'(x) > 0$ for all $x$, then $(f(x^2))' > 0$ for all $x$.
- If $f'(x) > 0$ for all $x$ and $f''(x) > 0$ for all $x$, then $(f(x^2))'' > 0$ for all $x$.
- There is a function $f(x)$ such that $f(x^2)$ has no horizontal tangent lines.

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

2. If $f(x) = \sin(x)$, find $f^{(103)}(\pi/2)$.

   a) 0  
b) 1  
c) -1  
d) 1/2  
e) None of the above.

3. How many horizontal tangent lines does the function $f(x) = \tan(x)$ have in the interval $[-\pi, \pi]$?

   a) 0  
b) 1  
c) 2  
d) 3  
e) 4
4. Find $f'(1)$ if $f(x) = \frac{\sqrt{x} + \sqrt{x}}{\sqrt{x}}$

   a) 1  
   b) -1/4  
   c) 1/3  
   d) 2  
   e) None of the above.

5. Suppose that $Q(x) = \frac{f(x)}{g(x)}$, and that $f(0) = 2$, $f'(0) = -3$, $g(0) = 1$ and $g'(0) = 4$. Find $Q'(0)$.

   a) 8  
   b) 1  
   c) 0  
   d) -3/4  
   e) -11

6. If $f(x) = 2x^3$ and $g(x)$ is the inverse of $f(x)$, find $g'(2)$.

   a) -1/6  
   b) -6  
   c) 1/6  
   d) 6  
   e) The function is not differentiable at $x = 2$. 
7. Consider the ellipse given by the equation \( \frac{(x - 2)^2}{25} + \frac{(y - 3)^2}{81} = 1 \). Find the equation of the tangent line to the ellipse at the point where \( x = 2 \) and \( y > 0 \).

8. Evaluate \( \frac{d}{dx}(e^\pi + e^{x^2}) \).

9. If the position of a particle is given by \( s(t) = 9t^2 + 10t - 2 \), what is the particle’s velocity at time \( t = 3 \)?
10. Find $\frac{dy}{dx}$ if $3 + \cos(xy) = x^2 \ln(y)$

11. Find the equation of the tangent line to the curve $y = 4 + \frac{x}{2x+1}$ at $x = 0$

12. Use logarithmic differentiation to find $\frac{dy}{dx}$ if $y = x^{5x}(2 + 3x^2)^4$. 
13. Suppose there is a gas contained in a shrinking container. Boyle’s Law says that 
\[ P = \frac{C}{V}, \] 
where \( C \) is a constant, \( P \) is the pressure in the container, and \( V \) is the 
volume of the container. If \( V(t) = e^{-t} \), what is the rate of change of the pressure with 
respect to time?

14. What is an example of a function that is continuous but not differentiable?