1. 8 points Differentiate.

\[ g(x) = x^7 \cos x \]

2. 8 points If \( f(t) = \sqrt{4t + 1} \), find \( f''(2) \).

3. 8 points Differentiate the function.

\[ G(u) = \ln \sqrt{\frac{3u + 6}{3u - 6}} \]
4. **8 points** If \( f(x) = x (\ln x)^{-1} \), find \( f'(e^3) \).

5. **8 points** Find the limit.

\[
\lim_{{x \to 0}} \frac{x - 1}{x^2 (x + 5)}
\]

6. **8 points** The position \((s \text{ in meters, and } t \text{ in seconds})\) function of a particle is given by \( s = t^3 - 3t^2 - 5t \), for \( t \geq 0 \). When does the particle reach a velocity of 139 meters per second?
7. **10 points** A spherical balloon is being inflated. Find the rate of increase of the surface area with respect to the radius \( r \) when \( r = 1 \) foot.

8. **10 points** Find the limit.

\[
\lim_{x \to 2} \frac{2 - x}{|2 - x|}
\]

9. **8 points** If \( g(x) = \sqrt{3 - 5x} \), find the domain of \( g'(x) \).
10. **8 points** Find the points on the curve \( y = 2x^3 + 3x^2 - 12x + 1 \) where the tangent is horizontal.

11. **8 points** Find the first and the second derivatives of the function.

   \[
   y = \frac{x}{3 - x}
   \]

12. **8 points** Find the limit.

   \[
   \lim_{x \to \frac{\pi}{4}} \frac{\sin x - \cos x}{\cos 2x}
   \]