Instructions. This is a 50 minute exam. Show all the work that leads to your answers. No calculators are allowed. In problems 1-7, find the derivatives (no simplification is needed), in problems 8-12, find the antiderivatives or integrals.

1. \( y = x^2 e^{-x} \)
2. \( y = \ln(\sin(x)) \)
3. \( y = \frac{x\sqrt{x}}{\sec(x) - 2} \)
4. \( y = \cos^2(x^3) \)
5. \( f(s) = s \tan^2(s) \)
6. \( g(t) = \cos(t) + \tan(t) + \ln(t) \)
7. \( y = e^{e^x} \)
8. \( \int_{\pi}^{3\pi} \cos(3x + \pi) \, dx \)
9. \( \int_{0}^{1} \frac{e^{2x}}{\sqrt{1 - e^{2x}}} \, dx \)
10. \( \int \frac{\sin(t)}{3 + \cos(t)} \, dt \)
11. \( \int x^2 e^{x^3} \, dx \)
12. \( \int \sec^2(x) \, dx \)