0. (1 point) Carefully read and complete the instructions at the top of this exam sheet.

1. (6 points) Compute the volume of the solid whose base in the $xy$-plane is bounded by the semicircle $y = \sqrt{16 - x^2}$ and the $x$-axis, and whose cross-sections perpendicular to the $x$-axis are squares.

2. (6 points) Compute the derivative $\frac{d}{dx} \int_0^{2\ln(x)} \cos(t^2) \, dt$.

3. (6 points) When a hot object is placed in a water bath whose temperature is 25$^\circ$C, it cools from 100$^\circ$C to 50$^\circ$C in 150 seconds. In another bath, the same cooling occurs in 120 seconds. Find the temperature of the second bath.

4. (6 points) Use the limit comparison test to determine whether the series $\sum_{n=2}^{\infty} \frac{1}{n^2 - \sqrt{n}}$ converges or diverges.

5. (6 points) Write the complex number $(1 + i)^{21}$ in the form $a + bi$. You need not simplify numbers like $2^{\frac{15}{2}}$. (Suggestion: you may wish to first put $1 + i$ into polar form.)

6. (6 points) Compute the following indefinite integrals.
   
   (a) $\int \sin(x^2) \cos(x^2) \, x \, dx$

   (b) $\int x^3 \ln(x) \, dx$
7. (6 points) Evaluate \( \int e^{2ix} \sin(5x) \, dx \). Leave the result in complex exponential form.

8. (a) (5 points) Find the partial fraction expansion of \( \frac{10x^2 + 2x - 6}{x^3 - x} \).

(b) (3 points) Evaluate \( \int \frac{10x^2 + 2x - 6}{x^3 - x} \, dx \).

9. (6 points) Find the first four terms of the Taylor series for \( f(x) = \ln(2x) \) centered at \( x = 1 \), and determine its radius of convergence.