1. By definition, \( \ln 5 \) is a certain integral. What is it? (4 points)

2. For the function \( f(x) = 4^x^3 \)
   a. Find \( f'(x) \). (6 points)
   
   b. Write the equation of the tangent line to the curve when \( x = 1 \). (6 points)

For problems 3-5, find the derivative of the function. (6 points each)

3. \( g(x) = \left[ \arctan(\ln x) \right]^4 \)
4. \[ y = \frac{(x^2 + 1)^4 (x^3 - 1)^2}{(x^5 + 2)^3} \] (Use logarithmic differentiation.)

5. \[ y = (\tan x)^{5x} \]
For problems 6-8, evaluate the integral. If the method of substitution is required, be sure to write out $u$ and $du$. For a definite integral give the exact value. (8 points each)

6. \[ \int_{0}^{1} 5x^2 e^{-x^3} \, dx \]

7. \[ \int \frac{3x - x^3}{1 + x^4} \, dx \]
8. \[ \int_{0}^{1/2} \frac{\arcsin x}{\sqrt{1-x^2}} \, dx \]

9. Fifty animals were put on an island. Assume the population grew exponentially. Two years later there were 100 animals. (Use exact values.)

a. Find the expression for the number of animals after \( t \) years. (5 points)

b. Use calculus to find the rate of growth of the population at 6 years as an exact value. Simplify your answer. (5 points)
For problems 10-12, evaluate the limit. If any limit is indeterminate, give its form. Show all work. (6 points each)

10. \( \lim_{{x \to 0}} \frac{e^x - 1 - x}{3x^2} \)

11. \( \lim_{{x \to \infty}} \frac{\ln x}{\ln(\ln x)} \)

12. \( \lim_{{x \to 0^+}} \left(1 + 3x\right)^{\frac{1}{x}} \)
NOTE: When asked to set up an integral, do not simplify or evaluate the integral. All limits of integration must be written as exact values.

For problems 13-17, let R be the region bounded by \( y = 2x^2 \) and \( y = 2x \) from \( x = 0 \) to \( x = 1 \).

13. Shade the region on the graph below. (1 pt)

![Graph of the region R bounded by \( y = 2x^2 \) and \( y = 2x \) from \( x = 0 \) to \( x = 1 \).]

For problems 14-17, set up the integral that gives the volume when the region is revolved around the

14. y-axis using the shell method. (5 points)

15. y-axis using the disk/washer method. (5 points)
16. x-axis. State the method that you use. (5 points)

17. line $y = 2$. State the method that you use. (5 points)