

YOUR NAME: _____

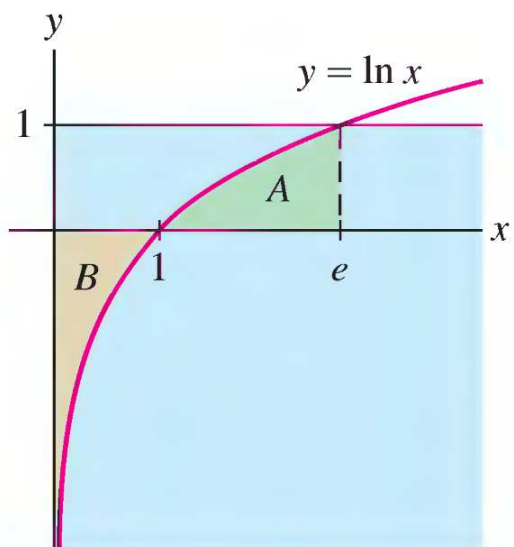
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Read each problem **very carefully** before starting to solve it. Each problem is worth 10 points. It is necessary to show **all** your work. Correct answers without explanations are worth 0 points. GOOD LUCK!!

1. Evaluate the integral $\int_0^e \frac{\ln x}{x} dx$. Show **all steps properly**.

2. Find the arc length of $f(x) = \ln(\cos x)$ over the interval $[0, \frac{\pi}{4}]$.
(You may use the formula $\int \sec x dx = \ln|\sec x + \tan x| + C$ if needed.)

3. Calculate the fluid force on one side of the plate in the shape of region A . The water surface is at $y = 1$, the fluid has density ρ and the acceleration of gravity is g .



4. Solve the differential equation

$$xy' = x^{-2} - \frac{3y}{x}.$$

5. Determine the limits of the sequences, **explicitly stating** the criterion on which you are relying:

(a) $\lim \frac{4 + n - 3n^2}{4n^2 + 1}$

(b) $\lim \left(\frac{1}{3}\right)^n$

(c) $\lim e^{4n/(3n+9)}$

(d) (Hint: Rely on the Monotone Bounded Criterion; **Show all steps.**)
 $\lim \frac{2^n}{n!}$