

Name: _____

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30 minutes. No aids (book, notes, calculator, internet, etc.) are permitted. Show all work and use proper notation for full credit. Put answers in reasonably-simplified form. 25 points possible.

1. **[7 points]** A 2 meter fishing rod is made of solid fiberglass and tapers at the end. Assume it has a linear mass density function of $\rho(x) = 4 - \frac{x^2}{10000}$ grams per centimeter, where $x = 0$ is the thick end. What is its mass? Give your answer as a simplified number, with units.

2. **[10 points]** Find the derivative, indefinite integral, or definite integral. Write “+C” if appropriate.

a. Find $\frac{dy}{dx}$ if $y = \ln(\tan x)$.

b. $\int_0^{\pi/4} \tan x dx =$

c. Find $\frac{dy}{dx}$ if $y = \log_{10} x$.

d. $\int \frac{dx}{x \ln x} =$

e. Find $\frac{dy}{dx}$ if $y = e^{\cos x}$. (*Hint. Differentiate $\ln y$.*)

3. [8 points] It requires 10 Newtons of force to stretch a spring 0.25 m from its natural length. How much work is required to stretch the spring one meter from its natural length? Give your answer with units, and in simplified form. (*Hint. First, what is the spring constant?*)

EC. [1 points] (Extra Credit) Assume $a > 0$ and $b > 0$ are positive numbers. Simplify both integrals as far as possible. (*Credit is given only if both answers are correct and fully simplified.*)

$$\int_1^b \frac{1}{t} dt =$$

$$\int_a^{ab} \frac{1}{t} dt =$$

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