**Math 252: Quiz 4** **22 September, 2022**

**Name:** _____ | _____ / **25**

30 minutes maximum. No aids (book, calculator, etc.) are permitted. Show all work and use proper notation for full credit. Answers should be in reasonably-simplified form. 25 points possible.

1. **[10 points]** Find the work required to pump all the water out of a cylinder which has a circular base of radius 4 meters and height 10 meters. Use the fact that water has a mass density of 1000 $\mathrm{kg}/\mathrm{m}^3$, and use $g = 10\ \mathrm{m}/\mathrm{s}^2$ as an approximation of the acceleration of gravity. (*Hint: Start by drawing a decent sketch and considering a slice of water; a good sketch is worth 2 points. Simplify your answer and give units.*)

**2. [8 points]** Find the derivative $\frac{dy}{dx}$ or the indefinite integral. (*Hint: Use "+C" where needed.*)

**a.** $y = \log_{10} x$

**b.** $\displaystyle\int \frac{(\ln x)^2\, dx}{x} =$

**c.** $y = x^{(ex)}$

**d.** $y = \ln\left(\frac{x+a}{x-a}\right)$

**3. [7 points]** A 1 meter car antenna has linear mass density, starting from the base at $x = 0$, of $\rho(x) = 2 + \dfrac{x}{100}$ grams per centimeter. What is its mass? Simplify your answer and give units.

**EC. [1 points]** (**Extra Credit**) Assuming $x > 0$, fully simplify:

$$\frac{d}{dx}\left(\int_x^{x^2} \frac{dt}{t}\right) =$$

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