

Name: _____

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

1. [8 points] A spring has a natural length of 1 m. It takes 20 J to stretch the spring from 1 m to 1.5 m. How much work would it take to stretch the spring from 1 m to 2 m? Include units with your answer.

2. [8 points] Find the work required to pump all the water out of a cylinder that has a circular base with radius 10 ft and height of 10 ft. Use the fact that the density of water is 62lb/ft^3 . Include units with your answer.

3. [4 points] Find the center of mass, \bar{x} , of a 1-dimensional rod of length L with density $\rho = 3x^2$. (Assume the rod starts at $x = 0$ and ends at $x = L$.) Simplify your answer.

4. [5 points] Let R be the region bounded by $y = \sqrt{x}$ and $y = \frac{1}{2}x$. Suppose R has density $\rho = 2$. Set up the integrals needed to calculate \bar{x} , the x -coordinate of the center of mass of R and show how \bar{x} is calculated.

$$m = \int_a^b \rho(x)(f(x) - g(x)) dx, \quad M_y = \int_a^b \rho(x)x(f(x) - g(x)) dx, \quad M_x = \int_a^b \frac{\rho(x)}{2} ((f(x))^2 - (g(x))^2) dx$$