You may keep this page of questions. Turn in your answers with all of your work on the colored paper. NO calculators are allowed on THIS exam.

(1a) 12 Points. Find the area of the region in the $xy$-plane that is bounded by $y = 0$ and $y = 4x^2 - x^3$.

(1b) 8 Points. Find the mass of the region in the $xy$-plane that is bounded by $y = 0$ and $y = 4x^2 - x^3$ if the density $\delta$ at a point $(x, y)$ within the region is given by $\delta = \frac{1}{16}x$.

(1c) 8 Points. Find the moment with respect to the $y$-axis for the region in the $xy$-plane that is bounded by $y = 0$ and $y = 4x^2 - x^3$ if the density $\delta$ at a point $(x, y)$ within the region is given by $\delta = \frac{1}{16}x$.

(2) 18 Points. Find the volume of the solid of revolution that is generated by revolving the region bounded by $x = 0, y = 0$ and $x + y = 2$ about the line $x = 3$.

(3) 12 Points. A cable that is 12 meters long hangs vertically from a winch. If the cable weighs 7 newtons per meter, how much work is done winding the cable onto the winch?

(4) 12 Points. Find the slope of the polar curve $r = 4\sin \theta$ at the polar point $(r, \theta) = (2, \frac{5}{6}\pi)$.

(5a) 14 Points. Analyze and evaluate $\int_0^\infty \frac{dx}{9 + x^2}$.

(5b) 8 Points. Let $f(x) = \begin{cases} 0 & \text{if } x < 0 \\ \frac{k}{9 + x^2} & \text{if } x \geq 0 \end{cases}$ For what value of $k$ will $f(x)$ be a probability density function?

(5c) 8 Points. Using the value of $k$ for part (5b), find the median, $T$, for the probability distribution having density function $f(x) = \begin{cases} 0 & \text{if } x < 0 \\ \frac{k}{9 + x^2} & \text{if } x \geq 0 \end{cases}$