Name:
Magic Number:

- There are three problems, front and back.
- Lengths are in cm. Units of work are in J (joules).
- Write small and legibly!

1. Find the average value of $h(x)$ on the interval $[a, b]$.

2. The region bounded by $y = f(x)$ and $y = g(x)$ is rotated about the vertical line $x = a$. Find the volume of the resulting solid via cylindrical shells. Set up the integral, writing down steps. Then compute it on your calculator (or by hand).

   [Plot of region, stripped of labeling, will be given.]
3. A spherical tank of radius $a$ m is filled with water, the mass density of which is $\rho = 1000$ kg/m$^3$. A spout is $b$ m above the top of the tank. Find the work required to pump the water out of the tank through the spout.  
*Set up* the integral, writing down steps. *Compute* it on your calculator (or by hand).  
[Illustrative diagrams will be provided.]