1. Let \( R \) be the region bounded by the graph of \( y = \sin(2x) \) and the \( x \)-axis for \( 0 \leq x \leq \frac{\pi}{2} \).

   (a) (2 points) Sketch a graph of \( R \).

   (b) (7 points) A solid is generated by revolving the region \( R \) about the \( x \)-axis. Set up, but do not evaluate, a definite integral for the volume of the resulting solid of revolution.

   (c) (7 points) A solid is generated by revolving the region \( R \) about the line \( x = -\pi \). Set up, but do not evaluate, a definite integral for the volume of the resulting solid of revolution.
2. (16 points) Let $R$ be the region bounded by the graphs of $y = x^2$ and $y = a$, where $a$ is a positive constant. Find the centroid of the region $R$. Make a sketch of the region and use symmetry where possible. Your answer should be simplified.
3. (16 points) An exotic aquarium with a flat base has height of 10 ft and is filled with water. At height $y$ above the base of the aquarium, a cross section of the aquarium taken parallel to the base has area $A(y) = 20 + \sqrt{y}$ square feet. The water in the aquarium is pumped to a platform 5 ft above the top of the tank. Calculate the work done. [Use $\delta$ lb/ft$^3$ for the weight-density of water.]
4. Let $G$ be the graph of the curve described by the parametric equations

$$x = x(t) = 3 + e^{2t}, \quad y = y(t) = 3 + \ln(2t), \quad \text{for} \quad 1 \leq t \leq e.$$ 

(a) (8 points) Set up, but do not evaluate, an integral for the length of $G$.

(b) (8 points) Set up, but do not evaluate, the area of the surface generated when $G$ is revolved about the $x$-axis.