The density of water is 1000 kg/m³ and the weight density of water is 62.5 lb/ft³. The acceleration due to gravity is 9.8 m/sec² or 32 ft/sec².

Error Bounds. Suppose \( |f''(x)| \leq K \) for \( a \leq x \leq b \). If \( E_T \) and \( E_M \) are the errors in the Trapezoidal and Midpoint Rules, then
\[
|E_T| \leq \frac{K(b - a)^3}{12n^2} \quad \text{and} \quad |E_M| \leq \frac{K(b - a)^3}{24n^2}.
\]

Suppose \( |f^{(4)}(x)| \leq K \) for \( a \leq x \leq b \). If \( E_S \) is the error involved in using Simpson’s Rules, then
\[
|E_S| \leq \frac{K(b - a)^5}{180n^4}.
\]
1. (a) Sketch the curve of the polar equation $r = 4 - sin(\theta)$.

(b) Find an equation in Cartesian coordinates for the curve given in part (a).

(c) Find the area enclosed by the polar curve given in part (a).
2. (a) Sketch the curve of the parametric equations $x = 4 \cos^3(\theta)$, $y = 4 \sin^3(\theta)$, $0 \leq \theta \leq \pi/2$.

(b) Calculate the length of the curve given in part (a).

(c) Find the area of the surface obtained by rotating the curve given in part (a) about the $y$-axis.
3. (a) Sketch the curve of the parametric equations \( x = t^3 - 3t^2, \ y = t^3 - 3t \) and indicate with an arrow the direction in which the curve is traced as the parameter \( t \) increases.

(b) Find the points on the curve given in part (a) where the tangent line is horizontal or vertical—and draw these tangents on your plot of the curve.
4. Find the area under one arch of the cycloid $x = t - \sin(t)$, $y = 1 - \cos(t)$, $0 \leq t \leq 2\pi$. 
5. How large should we take $n$ in order to guarantee that the Trapezoidal and Simpson's rule approximations for $\int_{1}^{2} \frac{1}{x} \, dx$ are accurate to within 0.0001?
6. A large tank is designed with ends in the shape of a truncated parabola: the region between the curves $y = x^2/2$ and $y = 12$, measured in meters. The problem is to find the hydrostatic force on one end of the tank if it is filled to a depth of 8 meters with gasoline (assume that the density of gasoline is 800 $kg/m^3$).

(a) On the picture included below, insert an axes and draw an appropriate arbitrary approximating rectangle $R$ (differential element).

![Diagram of a tank](image)

(b) Find the area of the differential element $R$ and the force on the differential element $R$.

(c) Approximate the hydrostatic force against the end of the tank by a Riemann sum. Then let $n$ approach infinity to express the force as an integral and evaluate it.
7. Derive the trapezoidal rule formula for approximating the integral \( \int_a^b f(x)dx \). Include a drawing on the plot of \( f \) given below that illustrates your derivation.