1. Calculate the area of a solid whose base lies within the region bounded between the y-axis and the parabola $x = 1 - y^2$. The cross-sections perpendicular to the x-axis are semi-circles.

2. Find the volume of a solid of revolution obtained by rotating about the line $y = -1$ the region bounded by the curves $y = x$ and $y = 2\sqrt{x}$.

3. Let $\mathcal{R}$ be the area enclosed by $y = \cos(x)$ and $y = 2 - \cos(x)$ with $0 \leq x \leq 2\pi$

(1) Sketch the region $\mathcal{R}$ and calculate its area.

(2) Let $\mathcal{S}$ be the solid obtained by a rotating about the line $x = 2\pi$ the region $\mathcal{R}$. Sketch the cross-section of the solid $\mathcal{S}$ in the xy-plane, and the thin cylinder obtained by this rotation of $\mathcal{R}$ between x and $x + \Delta x$ for a general x and Δx very small (i.e. a typical shell at a sample point $x_i^* \in [x_{i-1}, x_i]$). Label its dimentions. What is a good estimate for the radius r, the height h and the volume V_i of this one cylindrical shell?

(3) Write down the integral that computes the volume of $\mathcal{S}$ and evaluate it.

4. Assume you have a chain of uniform density 80 g/m to lift a bag of coal of 400 N from the bottom to the top of a mine of height 170 m. Compute the work done.

5. Consider a reservoir filled with water, created by inverting a 10-m tall pyramid with rectangular base, where the tip of the pyramid is cut off 5 m from the base. The (un-inverted) pyramid's base rectangle is 4 by 5 metres. Compute the work required to pump the water to 1 m over the top of the reservoir.

6. A leaky bucket with mass 5 kg filled with water is lifted from 0 m to 13 m with a rope of negligible weight. At the beginning, the bucket contains 40 L of water and when it arrives at 13 m it only contains 1 L of water. Assume it loses water at a constant rate. What work is required to lift it?