Problem 1. Calculate the area bounded by the graphs of $y = xe^{-3x^2}$, $y = x^2 - 4$ and the vertical lines $x = 0$ and $x = 2$. Draw an accurate picture of the region whose area you are supposed to compute.

Problem 2. Calculate the following integrals:
   (i) $\int x^2 \ln(x)\, dx = ?$
   (ii) $\int_0^{\pi/2} \sin(x)\sqrt{\cos(x)}\, dx = ?$

Problem 3. Calculate the length of the curve $\gamma\colon [0,1] \to \mathbb{R}^2$ given by $\gamma(t) = (t^2, t^3)$.

Problem 4. Calculate the area of the surface of revolution obtained by revolving around the x-axis the region bounded by $y = \sqrt{x}$ and $y = x$ between their intersection points. Draw a picture of this region.

Problem 5. Calculate the volume of the solid obtained by revolving around the x-axis the region between the graphs of $y = x$ and $y = \sin(x)$ for $0 \le x \le \pi$. Draw a picture of this region.

Problem 6. Calculate the integral $\int_{-\infty}^{\infty} \frac{1}{1+x^2}\, dx = ?$