1. (5 pts) The shaded region in the figure below is bounded by the y-axis and the graphs of
\[ y = 2 - \sqrt{x}, \quad y = 1. \]
Find the volume of the solid obtained by rotating this above region about the x-axis.

![Shaded Region](image)

**Solution.** First solve for the intersection: \( 2 - \sqrt{x} = 1, \ x = 1 \). The cross-sections are washer-typed.

\[
\text{Volume} = \int_{0}^{1} \pi \left( (2 - \sqrt{x})^2 - 1^2 \right) dx
\]
\[
= \pi \int_{0}^{1} (4 + x - 4\sqrt{x} - 1) \ dx
\]
\[
= \pi \int_{0}^{1} (3 + x - 4\sqrt{x}) \ dx
\]
\[
= \pi \left[ 3x + \frac{x^2}{2} - 4\frac{x^{\frac{3}{2}}}{\frac{3}{2}} \right]_{0}^{1}
\]
\[
= \pi \left( 3 + \frac{1}{2} - \frac{8}{3} - 0 \right)
\]
\[
= \frac{5}{6} \pi
\]

2. (5 pts) Evaluate the integral
\[ I = \int_{0}^{1} x^2 e^x \ dx \]

**Solution.**

\[ I = \int_{0}^{1} x^2 e^x \ dx \]
\[
= x^2 e^x \bigg|_{0}^{1} - \int_{0}^{1} 2xe^x \ dx
\]
\[
= (e - 0) - 2 \int_{0}^{1} xe^x \ dx
\]
\[
= e - 2 \left[ xe^x \bigg|_{0}^{1} - \int_{0}^{1} e^x \ dx \right]
\]
\[
= e - 2 \left( e - e^1 \bigg|_{0}^{1} \right)
\]
\[
= e - 2 (e - (e - 1))
\]
\[
= e - 2 \cdot 1
\]
\[
= e - 2
\]