Problem 1. Find the area enclosed by the line \( y = x + 1 \) and the parabola \( y^2 = 3x + 7 \).

Problem 2. Let \( S \) be the solid obtained by rotating about the \( y \)-axis the region bounded by \( y = 3 + 2x - x^2 \) and \( x + y = 3 \).

(1) Compute the volume of \( S \) by evaluating an integral with respect to the variable \( y \).

(2) Use the method of cylindrical shells to compute the volume of \( S \).

Problem 3.

(1) A 200-lb cable is 100 ft long and hangs vertically from the top of a tall building. How much work is required to lift the cable to the top of the building?

(2) A spring has natural length of 20 cm. Compare the work \( W_1 \) done in stretching the spring from 20 cm to 30 cm with the work \( W_2 \) done in stretching it from 30 cm to 40 cm. How are \( W_1 \) and \( W_2 \) related?

Problem 4. Evaluate the following integrals:

\[
\begin{align*}
\text{(a)} & \quad \int x^2 \ln x \, dx \\
\text{(b)} & \quad \int e^{-x} \cos(2x) \, dx \\
\text{(c)} & \quad \int \tan^3 x \, dx \\
\text{(d)} & \quad \int \frac{x^3}{\sqrt{x^2 + 9}} \, dx.
\end{align*}
\]