Part I. All problems in part I count for 10 points.

(1) Find the area bounded by the parabola $x = y^2 - 2$ and the line $x = 2y + 1$.

(2) Set up an integral for the volume of the solid of revolution obtained by rotating the area bounded by the graphs of $y = \sin(x) + 5$, $y = e^x + 1$ and the lines $x = 0$ and $x = 1$ about the line $x = 7$. You don’t need to compute or simplify the integral.
Evaluate the following integrals or state does not exist (like always, you must justify your answer!):

(3) \( \int_{1}^{\infty} \frac{1}{x^2} \, dx \).

(4) \( \int_{-1}^{1} \frac{1}{x^2} \, dx \).

(5) Find \( n \) such that the approximation to the integral \( \int_{0}^{1} \sin(x^2) \, dx \) using the midpoint rule makes an error less than \( \frac{1}{10,000} \).
(6) Set up an integral for the arc length of the curve

\[
\begin{align*}
  x &= t \sin(t) \\
  y &= te^{5t}
\end{align*}
\]

for \(0 \leq t \leq 1\). You don’t need to simplify or compute the integral.

**Part II.** Both problems in Part II count for 20 points each.

(7) Find the volume of the solid whose cross sections with planes perpendicular to the \(x\)-axis are squares one side of which stretches from the graph of \(y = x + 1\) to the graph of \(y = 2x - 1\) for \(0 \leq x \leq 1\).
(8) Find the work done in pumping water out of a full trough whose vertical cross sections are inverted triangles, with base 3\( m \) and height 5\( m \), which is 10\( m \) long. (You can use that water has a density of 1,000\( kg/m^3 \) and that \( g \approx 10 m/sec^2 \).)