Question 1) Evaluate the following integrals using the method of substitution.

a) \[
\int \frac{2x + 3}{(x^2 + 3x + 5)^4} \, dx.
\]

b) \[
\int_0^1 \frac{x^2}{1 + x^6} \, dx.
\]
Question 2) Set up, but do not evaluate, the integral for the volume of the solid formed when the region bounded by \( y = e^x, y = 0, x = 1 \) and \( x = 0 \) is revolved around the \( y \)-axis.
Question 3) Consider the initial value problem (IVP) \( y' = x^2y \) with \( y(2) = 3 \). Use separation of variables to find the solution to the IVP.
Question 4) Let \( I = \int_0^1 2x^3 \, dx \).

a) Compute the approximation \( T_5 \) for the integral \( I \).

b) How many subdivisions are required to obtain a midpoint sum approximation with error at most \( 1/10000 \)?

Recall that the error bound estimates for midpoint sums may be determined using

\[
|I - M_n| \leq \frac{K_2(b - a)^3}{24n^2}.
\]
Question 5) Consider the IVP $y' = xy^2$ with $y(0) = 2$. Estimate $y(2)$ using 4 Euler steps.
Question 6) A bucket that weighs 60 lb when filled with water is lifted from the bottom of a well that is 65 ft deep. However, the bucket has a hole in it, and so the bucket weighs only 30 lb when it reaches the top of the well. Suppose that water leaks from the bucket at a constant rate and that the rope weighs 0.65 lb/ft. Find the work required to lift the bucket from the bottom of the well to the top.