1. Approximate $\int_4^4 \frac{1}{x + 3} \, dx$ using $n = 4$ and
   a) The midpoint rule.
   b) Simpson's rule.

2. Let $X$ be a random variable with probability density function $f(x) = \frac{1}{x^2}$, $[4, 12]$.
   a) Find the value of $k$.
   b) Find $P(X \leq 8)$.

3. Find $\int \frac{x^4 - 10x + 45}{x(x - 3)^2} \, dx$.

4. The waiting time $T$ in a ticket line is exponentially distributed, with a mean of 6 minutes.
   Find the probability that the waiting time is at least 3 minutes.

5. Find $\int \frac{x^3 - 13x}{x^3 - 2x - 8} \, dx$.

6. Find the area of the region bounded by the graphs of
   $y = \frac{\ln x}{x^2}$, $y = 0$, and $x = e^2$.

7. Evaluate $\int_4^6 \frac{20}{\sqrt{x + 6}} \, dx$, or show that it diverges.

8. Find $\int x^3 \sin x^2 \, dx$.

9. Find $\int \cos^3 \sqrt{t} \, dt$.

10. The time $T$ (in days) until recovery after a medical procedure is a random variable with probability density function $f(t) = \frac{1}{3\sqrt{t+1}}$, $[0, 6]$.
    Find the expected time for recovery.

11. Find the volume of the solid generated by revolving the region bounded by the graphs of $y = 20 \cos x$ and $y = 8 \tan x$ for $0 \leq x \leq \frac{\pi}{4}$ about the $x$-axis.