1. Find the integrals: The answer alone is insufficient for any points.

a) \[ \int_{2}^{4} \frac{e^{\sqrt{x}}}{\sqrt{x}} \, dx \]

b) \[ \int_{0}^{2} \frac{x^2}{1 + x^2} \, dx \]

2. Integrate \[ \int \frac{u + 1}{u(u - 1)} \, du \]

3. Integrate \[ \int xe^x \, dx \]

4. The population of Sourwater Canyon, New Mexico has been continuously decreasing at a steady rate for decades. Assuming continued decay at the same rate, if the population ten years ago was 8,000 and today it is 5,000, when will there be only 2 people left in Sourwater Canyon?

5. Find the limit. Show your work.

a) \[ \lim_{x \to 2} \frac{x - 2}{x^2 - 4} = \]

b) \[ \lim_{x \to 0} x \ln x = \]

c) \[ \lim_{x \to \infty} \frac{x^2}{(2x + 1)^2} = \]

6. Find the integral

a) \[ \int_{2}^{\infty} \frac{dx}{x^{10}} \]

b) \[ \int_{0}^{2} \frac{dx}{x^{11}} \]
7. The function \( f(x) \) is defined for \(-3 \leq x \leq 3\), and has the Maclaurin series at the origin:

\[
f(x) = \sum_{n=0}^{\infty} \frac{(n+1)^2}{n!} x^n.
\]

a) What is the radius of convergence of this series?

b) What is the Maclaurin series for \( F(x) = \int_0^x f(t) \, dt \)?

c) What is the Maclaurin series for \( x^2 F(x) \)?

8. Find the focus of the parabola given by the equation \( x^2 - 8y + 2x + 17 = 0 \).

9. Find the area of the region enclosed by the curve given in polar coordinates by \( r = 2 \cos \theta \sqrt{\sin \theta} \), \( 0 \leq \theta \leq \pi/2 \).

10. Find the general solution, for \( x > 0 \) of the differential equation

\[
x \frac{dy}{dx} + \ln x = 0.
\]