1. Find the antiderivative \( \int \sin^3 x \cos^2 x \, dx \).

2. Find the antiderivative \( \int \frac{2x^2 + 3x + 2}{x^3 + x} \, dx \).

3. Find the antiderivative \( \int x^3 \ln(x) \, dx \).

4. Does the series \( \sum_{k=1}^{\infty} \frac{k}{\sqrt[8]{k^3} - 1} \) converge or diverge? Justify your statement.
5. Does the series \( \sum_{k=1}^{\infty} 7 \left( \frac{2}{3} \right)^k \) converge or diverge? Justify your statement.

6. Exactly one of the following two improper integrals converges. Identify which, and evaluate.

   (a) \( \int_{\frac{e}{2}}^{20} \frac{1}{\sqrt{2x-3}} \, dx \)

   (b) \( \int_{20}^{+\infty} \frac{1}{\sqrt{2x-3}} \, dx \)

7. A solid is formed by rotating the region bounded by the curves \( y = \sqrt{x} \) and \( y = x \), about the \( x \) axis. Find its volume.

8. Find the interval of convergence of the power series \( \sum_{k=1}^{\infty} \frac{(x + 5)^k}{k \cdot 3^k} \). At each endpoint of the interval of convergence, specify whether the series diverges, converges conditionally, or converges absolutely.
9. One of the three curves shown below is the polar plot of \( r = 2 \sin(2\theta) \). Identify which.

Find the area of the region in the first quadrant outside of \( r = 1 \) and inside of \( r = 2 \sin(2\theta) \).

10. Evaluate the limit \( \lim_{x \to \infty} (1 + x)^{\frac{1}{x}} \).

11. Find the Taylor series expansion centered at \( a = 1 \) of \( \ln(x) \).