1. **Convergence Buddies**

   Can the integral $\int_{100}^{\infty} f(x)\,dx$ be used to test the convergence of $\sum_{n=1}^{\infty} f(n)$? Explain why or why not.

2. Is $y = \sin^2(x^2)$ a solution to the differential equation $y' = 4x \cdot \cos(x^2) \cdot y$? Explain why your answer is correct.

3. Find the area enclosed by one petal of the four petal polar graph of $r(\theta) = \cos(2\theta)$.

4. Consider the sequence $\left\{\frac{n!}{n^n}\right\}_{n=1}^{\infty}$. Explain to our inquisitive 8th grade girl why this sequence converges.

5. Here are ten differential equations. Some of them are separable, and some are not. For now, you do *not* have to solve any of them. For each one, classify it as separable or inseparable. If it is separable, separate it.

   1. $y' = \dfrac{x}{\sqrt{y}}$
   2. $y' = x + y$
   3. $y' = \ln(xy)$
   4. $y' = \dfrac{\ln x + x}{\ln y + y}$
   5. $y' = ye^{\sin x + \cos y}$
   6. $y' = \ln(x^y)$
   7. $y' = \sin(x^y)$
   8. $y' = y\sin x + xy$
   9. $y' = \dfrac{xy + y}{2x - 3xy}$
   10. $y' = xy - 2x + y - 2$

   Good work. Now go back and start solving some of the separable DEs.

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