The midterm exam will cover the Sections 13.7, 13.8, 14.1 - 14.4, 15.1 - 15.4, 15.6, 16.1, 16.2, 16.4, 16.5

1. Find the radius of convergence and interval of convergence of the series \( \sum_{n=0}^{\infty} \frac{n(x + 2)^n}{3^{n+1}} \)

2. Determine whether each of the following series converges or diverges. If it is convergent, find its sum. Show your reasoning.
   a) \( \sum_{n=0}^{\infty} \frac{3^n}{n^n} \)
   b) \( \sum_{n=1}^{\infty} \arctan(n) \)
   c) \( \sum_{n=1}^{\infty} \frac{3}{n(n + 1)} \)

3. Determine whether the given series converges absolutely, converges conditionally, or diverges. Show your reasoning.
   a) \( \sum_{n=1}^{\infty} (-1)^n \frac{2^n n!}{n^n} \)
   b) \( \sum_{n=1}^{\infty} (-1)^n \sin^2(1/n) \)

4. Establish the convergence or divergence of the following series by using the comparison test.
   a) \( \sum_{n=1}^{\infty} \frac{1}{5^n - n} \)
   b) \( \sum_{n=2}^{\infty} \frac{1}{(\ln(n))^n} \)

5. Establish the convergence or divergence of the following series by using the integral test.
   a) \( \sum_{n=1}^{\infty} \frac{n^2}{e^{n^2}} \)
   b) \( \sum_{n=1}^{\infty} \frac{1}{n^2 + 6n + 13} \)

6. Use power series to solve the differential equation \( y'' = xy' \).

7. Identify the type of conic section whose equation is \( x^2 = 4y - 2y^2 \). Find the vertices and foci.

8. Find the area enclosed by one loop of the six-leaved rose \( r^2 = 2\cos(3\theta) \).

9. Find the area that lies outside \( r = 2\sin(\theta) \) and inside \( r = 2\sin(2\theta) \).
10. Find the length of the polar curve \( r = \theta \), \( 0 \leq \theta \leq 1 \). Sketch the given curve.