1) The series \( \sum_{n=1}^{\infty} \frac{(-1)^{n+1}}{(n+1)^2 + 3^n} \) is
(a) convergent by the integral test.
(b) conditionally convergent.
(c) divergent.
(d) divergent by the alternating series test.
(e) absolutely convergent.
(f) none of the above

First we study \( \sum |a_n| \)

\[ \frac{(n+1)^2}{(n+1)^2 + 3^n} < \frac{1}{3^n} \quad \text{(conv)} \]

By comparison test \( \sum \frac{1}{3^n} \) is \( \text{AC} \)

2) The series \( \sum_{n=1}^{\infty} \frac{(-1)^n \sin(n)}{n(n+1)} \) is
(a) absolutely convergent.
(b) conditionally convergent.
(c) convergent as its sum is zero.
(d) divergent by the alternating series test.
(e) convergent as its sum is \text{ln} 2
(f) none of the above

\[ \sum_{n=1}^{\infty} \frac{1}{n(n+1)} = \sum_{n=1}^{\infty} \left( \frac{1}{n} - \frac{1}{n+1} \right) = \text{ln} 2 \quad \text{(by partial sums)} \]

3) The series \( \sum_{n=1}^{\infty} \frac{1}{\sqrt{n}(y^2 + n+1)} \)
(a) converges by the integral test.
(b) diverges by the ratio test.
(c) converges by the ratio test.
(d) converges by the root test.
(e) diverges by the limit comparison test.
(f) none of the above

**Note:** The limit comparison test requires a suitable companion function.

4) The series \( \sum_{n=1}^{\infty} \frac{(-1)^n (n+1)!}{4n+3} \) is
(a) a divergent \( p \)-series.
(b) conditionally convergent.
(c) divergent by the ratio test.
(d) absolutely convergent.
(e) a series for which the Ratio test is inconclusive.
(f) none of the above

\[ \frac{\alpha_{n+1}}{\alpha_n} = \frac{(n+1)!}{4(n+4)} \]

5) The series \( \sum_{n=1}^{\infty} \frac{n^n}{2n^n} \)
(a) a convergent \( p \)-series.
(b) converges by the root test.
(c) a series for which the root test is inconclusive.
(d) a divergent geometric series.
(e) diverges by the root test.
(f) none of the above

**Note:** The root test requires calculating the limit as \( n \to \infty \).
6) The series \( \sum_{n=1}^{\infty} (-1)^n (\sqrt{n+1} - \sqrt{n} - 2) \) is
(a) divergent by the limit comparison test
(b) converges conditionally
(c) converges absolutely
(d) divergent by the ratio test
(e) diverges by the nth-term test for divergence.
(i) none of the above.

7) The series \( \sum_{n=1}^{\infty} \left( \frac{3}{n^2} \right)^n \) is
(a) divergent by ratio test
(b) diverges by the divergence test
(c) convergent by comparison test
(d) divergent by the integral test
(e) converges by the ratio test
(f) none of the above.

8) The series \( \sum_{n=1}^{\infty} (3-\sqrt{n})^2 \) is
(a) converges by root test
(b) diverges by the root test
(c) the root test is inconclusive
(d) a divergent geometric series
(e) converges by the comparison test
(i) none of the above.

9) By applying the ratio test to the series \( \sum_{n=1}^{\infty} \frac{1}{n^{1/2}} \) we conclude that
(a) the series is absolutely convergent
(b) the series is convergent
(c) the series is divergent
(d) the test is inconclusive
(e) the series is conditionally convergent
(f) none of the above.

10) The series \( \sum_{n=1}^{\infty} (-1)^n (n+1) \) is
(a) divergent
(b) absolutely convergent
(c) conditionally convergent
(d) neither convergent nor divergent
(e) a convergent p-series
(f) none of the above.