1. The Ratio Test and Root Test are based on the properties of convergence of
A. a p-series, $p \neq 1$. B. the harmonic series C. the alternating series D. a television series E. the world series. F. a geometric series

2. Which of these will help you determine if the series $\sum_{n=0}^{\infty} 2e^n$ converges or diverges? Select all possible answers.

A. limit comparison test with a p-series, $p \neq 1$. B. limit comparison test with the harmonic series C. a geometric series $r = e$
D. alternating series test E. absolute convergence test (i.e., convergence of $\sum |a_n|$ implies convergence of $\sum a_n$)
E. integral test F. ratio test G. nth Term Test for Divergence You can use root test too since this is equivalent to $2\sum e^n$

3. Which of these will help you determine if the series $\sum_{n=0}^{\infty} e^{-2n}$ converges or diverges? Select all possible answers.

A. limit comparison test with a p-series, $p \neq 1$. B. limit comparison test with the harmonic series C. a geometric series $r = e^{-2}$
D. alternating series test E. absolute convergence test (i.e., convergence of $\sum |a_n|$ implies convergence of $\sum a_n$)
E. integral test F. ratio test G. nth Term Test for Divergence You can use root test too

4. Which of these will help you determine if the series $\sum_{n=1}^{\infty}\left(\frac{(-1)^{n+1}}{n^2}\right)$ converges or diverges? Select all possible answers. it conveges absolutely

A. limit comparison test with a p-series, $p \neq 1$. B. limit comparison test with the harmonic series C. a geometric series
D. alternating series test E. absolute convergence test (i.e., convergence of $\sum |a_n|$ implies convergence of $\sum a_n$)
E. ratio test F. nth Term Test for Divergence

5. Which of these will help you determine if the series $\sum_{n=1}^{\infty}\left(\frac{(-1)^{n+1}}{\sqrt{n}}\right)$ converges or diverges? Select all possible answers. it converges conditionally

A. limit comparison test with a p-series, $p \neq 1$. B. limit comparison test with the harmonic series C. a geometric series
D. alternating series test E. absolute convergence test (i.e., convergence of $\sum |a_n|$ implies convergence of $\sum a_n$)
E. ratio test F. nth Term Test for Divergence

6. Which of these will help you determine if the series $\sum_{n=1}^{\infty}\left(\frac{n+2}{n!}\right)$ converges or diverges? Select all possible answers.

A. limit comparison test with a p-series, $p \neq 1$. B. limit comparison test with the harmonic series C. a geometric series
D. alternating series test E. absolute convergence test (i.e., convergence of $\sum |a_n|$ implies convergence of $\sum a_n$)
E. integral test F. ratio test G. nth Term Test for Divergence

$$\lim_{n\to\infty}\left|\frac{a_{n+1}}{a_n}\right| = \lim_{n\to\infty} \frac{n+3}{(n+1)!}\cdot\frac{n!}{n+2} = \lim_{n\to\infty}\left(\frac{\cancel{n!}(n+3)}{\cancel{n!}(n+1)(n+2)}\right) = 0 < 1$$

7. Use the Ratio Test for each.

a. The series $\sum_{n=1}^{\infty}\frac{(-2)^n}{n!}$ will ____________ by the Ratio Test because $\lim_{n\to\infty}$ $\boxed{\frac{2}{n+1}}$ = $\boxed{0}$ $0<1$
{converge, diverge}

$$\left|\frac{a_{n+1}}{a_n}\right| = \frac{2^{n+1}}{(n+1)!}\cdot\frac{n!}{2^n} = \frac{2^n\cdot 2\,\cancel{n!}}{(n+1)\cancel{n!}\,2^n}$$

Write in the box a **simplified expression** involving n.

Write in the box an **exact** number or DNE or ∞ or $-\infty$.

b. The series $\sum_{n=1}^{\infty}\frac{4^n}{n^{800}}$ will ____________ by the Ratio Test because $\lim_{n\to\infty}$ $\boxed{\frac{4n^{800}}{(n+1)^{800}}}$ = $\boxed{4}$. $4>1$
{converge, diverge}

$$\left|\frac{a_{n+1}}{a_n}\right| = \frac{4^{n+1}}{(n+1)^{800}}\cdot\frac{n^{800}}{4^n} = \frac{4\cdot\cancel{4^n}\cdot n^{800}}{\cancel{4^n}\cdot(n+1)^{800}}$$

Write in the box a **simplified expression** involving n.

Write in the box an **exact** number or DNE or ∞ or $-\infty$.

8. Use the Root Test for each.

a. The series $\sum_{n=1}^{\infty}(-1)^{n+1}\left(\frac{8n^4}{7n^4+n+5}\right)^n$ will ______ {converge, diverge} by the Root Test because $\lim_{n\to\infty} \boxed{\frac{8n^4}{7n^4+n+5}} = \boxed{\frac{8}{7}}$

$\frac{8}{7}>1$

Write in the box a **simplified expression** involving n.

Write in the box an **exact** number or DNE or ∞ or $-\infty$.

$\lim_{n\to\infty}|a_n|^{\frac{1}{n}} = \lim_{n\to\infty}\left(\frac{8n^4}{7n^4+n+5}\right)^{n/n} =$

b. The series $\sum_{n=1}^{\infty}(-1)^{n+1}\left(\frac{2n}{3n+2}\right)^n$ will ______ {converge, diverge} by the Root Test because $\lim_{n\to\infty} \boxed{\frac{2n}{3n+2}} = \boxed{\frac{2}{3}}$.

$\frac{2}{3}<1$

Write in the box a **simplified expression** involving n.

Write in the box an **exact** number or DNE or ∞ or $-\infty$.

$\lim_{n\to\infty}|a_n|^{\frac{1}{n}} = \lim_{n\to\infty}\left(\frac{2n}{3n+2}\right)^{n/n} =$

c. $\sum_{n=1}^{\infty}(-1)^{n+1}\left(\frac{n+1}{n}\right)^{n^2}$ will ______ {converge, diverge} by the Root Test because $\lim_{n\to\infty} \boxed{\left(1+\frac{1}{n}\right)^n} = \boxed{e}$.

$e>1$

Write in the box a **simplified expression** involving n.

Write in the box an **exact** number or DNE or ∞ or $-\infty$.

$\lim_{n\to\infty}|a_n|^{\frac{1}{n}} = \lim_{n\to\infty}\left(\frac{n+1}{n}\right)^{n^2/n} = \lim_{n\to\infty}\left(1+\frac{1}{n}\right)^n$

9. Consider the series $\sum_{n=1}^{\infty}\left(1+\frac{a}{n}\right)^{18n}$ for some real number a.

a. The series will ______ {converge, diverge}.

b. Circle the best answer to determine part **a**.

A. It is a p-series. B. It is a geometric series C. Use the Ratio Test D. Use the Root Test
E. Use the nth Term Test for Divergence

c. Explain more fully below how part **b** justifies part **a**. $\lim_{n\to\infty}\left(1+\frac{a}{n}\right)^{18n} = \lim_{n\to\infty}\left(\left(1+\frac{a}{n}\right)^n\right)^{18} = e^{a\cdot 18} \neq 0$

10. Consider the series $\sum_{n=1}^{\infty}(-2)^n$

a. The series will ______ {converge, diverge}.

b. Which of these will help you determine if the series $\sum_{n=1}^{\infty}(-2)^n$ converges or diverges? Select all possible answers.

A. It is a p-series. B. It is a geometric series C. Use the Ratio Test D. Use the Root Test
E. Use the nth Term Test for Divergence

c. Explain more fully below how part **b** justifies part **a** for each of your choices.

n^{th} term test: $\lim_{n\to\infty}(-2)^n = DNE \neq 0$

root test: $\lim_{n\to\infty}\left|(-2)^{\cancel{n}}\right|^{\cancel{\frac{1}{n}}} = 2>1$

ratio test: $\lim_{n\to\infty}\left|\frac{(-2)^{n+1}}{(-2)^n}\right| = \lim_{n\to\infty}\left|\frac{\cancel{2^n}\cdot 2}{\cancel{2^n}}\right| = 2>1$

geometric series: $r=-2>-1$

11. Consider the series $\sum_{n=1}^{\infty}n(-0.5)^n$

a. The series will ______ {converge, diverge}.

b. Justify your claim in part a.

ratio test: $\lim_{n\to\infty}\left|\frac{(n+1)(-.5)^{n+1}}{n(-.5)^n}\right| = \lim_{n\to\infty}\left|(.5)\cdot\frac{n+1}{n}\right| = 0.5<1$

Note: $\lim_{n\to\infty}\frac{n+1}{n}=1$