

1. Determine whether the following series converge or diverge. Show all your work and clearly indicate any tests that you use.

- (a). $\sum_{n=1}^{\infty} \frac{5n^2 + n}{3 - 2n^2}$ Diverges by the Test for Divergence
- (d). $\sum_{n=1}^{\infty} \frac{(n!)^2 3^n}{(2n)!}$ Converges by Ratio Test
- (b). $\sum_{n=1}^{\infty} \frac{5\sqrt{n} + 1}{3 + 2n^2}$ Converges by Limit Comparison Test
- (e). $\sum_{n=1}^{\infty} \left(\frac{n}{2n-1} \right)^{3n}$ Converges by the Root Test
- (c). $\sum_{n=1}^{\infty} \frac{\ln n}{n}$ Diverges by Integral Test
- (f). $\sum_{n=1}^{\infty} \frac{\cos n}{n^2}$ Since $\sum_{n=1}^{\infty} \left| \frac{\cos n}{n^2} \right|$ converges by the Comparison Test (needed positive values), then $\sum_{n=1}^{\infty} \frac{\cos n}{n^2}$ converges (absolutely) by Absolute Convergence Test

[More practice can be found in Section 11.7 and the Chapter 11 Review.]

2. Does $\sum_{n=2}^{\infty} (-1)^{n-1} \frac{1}{\ln n}$ converge absolutely, converge conditionally, or diverge. Converges Conditionally since
- $\sum_{n=2}^{\infty} \left| (-1)^{n-1} \frac{1}{\ln n} \right| = \sum_{n=2}^{\infty} \frac{1}{\ln n}$ diverges (by the Comparison Test), but $\sum_{n=2}^{\infty} (-1)^{n-1} \frac{1}{\ln n}$ converges (by the Alternating Series Test).

3. Given $\sum_{n=0}^{\infty} (-1)^n \frac{1}{n+4}$

(a). Find the 5th partial sum s_5 .

$$s_5 = \sum_{n=0}^5 (-1)^n \frac{1}{n+4} \approx 0.0877$$

(b). If s_5 is used to approximate the infinite series, what is the bound for the maximum possible error? (i.e. bound on $|R_5|$?)

$$|R_5| < b_6 = \frac{1}{6+4} = \frac{1}{10} = 0.1$$

(c). How many terms are needed for error to be less than 0.001.

996 terms

4. How many terms of the series $\sum_{n=1}^{\infty} \frac{3}{n^4}$ are needed to find its sum within 0.01?

$n = 5$

5. Find the interval and radius of convergence for the following series.

- (a). $\sum_{n=1}^{\infty} \frac{3^n x^n}{n^n}$ $R = \infty$
 $(-\infty, \infty)$
- (b). $\sum_{n=1}^{\infty} \frac{(-1)^n (x+2)^n}{n}$ $R = 1$
 $(-3, -1]$
- (c). $\sum_{n=1}^{\infty} \frac{(2x+4)^n}{n4^n}$ $R = 2$
 $[-4, 0)$

6. Find the radius of convergence for the following series.

(a). $\sum_{n=0}^{\infty} \frac{(3x-2)^n}{n}$ $R = \frac{1}{3}$

(b). $\sum_{n=0}^{\infty} \frac{n^n x^n}{n!}$ $R = \frac{1}{e}$

7. Use a known power series to find a power series representation for the $f(x) = \frac{1}{1+3x^2}$. $= \sum_{n=0}^{\infty} (-1)^n 3^n x^{2n}$

8. Find a Taylor series for $f(x) = \sqrt{x}$ centered at $a = 4$. $f(x) = 2 + \sum_{n=1}^{\infty} \frac{(-1)^{n+1} 1 \cdot 3 \cdot 5 \cdot \dots \cdot (2n-3)}{2^{3n-1} n!} (x-4)^n$

9. Use a known Maclaurin series to find the Maclaurin Series for $f(x) = e^{x/2}$ $e^{x/2} = \sum_{n=0}^{\infty} \frac{(x/2)^n}{n!} = \sum_{n=0}^{\infty} \frac{x^n}{2^n n!}$

10. Use a known Maclaurin series to evaluate $\int \sin(x^2) dx$ as an infinite series. $C + \sum_{n=0}^{\infty} \frac{(-1)^n}{(2n+1)!} \frac{x^{4n+3}}{4n+3}$

11. Find the sum of the series $\sum_{n=0}^{\infty} \frac{x^{4n}}{n!}$. $\sum_{n=0}^{\infty} \frac{(x^4)^n}{n!} = e^{x^4}$