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104 Chapter 12 Practice Problems

Multiple Choice
Identify the choice that best completes the statement or answers the question.

____ 1. Find a formula for the general term a_n of the sequence $\left\{1, -\frac{1}{2}, \frac{1}{4}, -\frac{1}{8}, \ldots\right\}$.

a. 2^{1-n}
b. 2^{n-1}
c. $(-2)^n$
d. $(-2)^{n-1}$
e. $(-1)^{2n}$
f. $(-2)^{1-n}$
g. $(-2)^{2n}$
h. 2^{-n}

____ 2. Find a formula for the general term a_n of the sequence $\{1, 6, 120, 5040, \ldots\}$.

a. $3^n(n+1)!$
b. $3^n n!$
c. $(n+1)!$
d. $(n+2)!$
e. $(2n)!$
f. $n!$
g. $(2n-1)!$
h. $2^n n!$

____ 3. Find a formula for the general term a_n of the sequence $\left\{2, 1, \frac{8}{9}, 1, \frac{32}{25}, \frac{64}{36}, \frac{128}{49}, \ldots\right\}$.

a. $\dfrac{2^{n+1}}{n^2}$
b. $\dfrac{2^n}{(n+1)^2}$
c. $\dfrac{2^n}{n^2}$
d. $\dfrac{2^n}{(n-1)^2}$
e. $\dfrac{2^{n-1}}{n^2}$
f. $\dfrac{2n}{n^2}$
g. $\dfrac{2^{n-1}}{n^2}$
h. None of these

____ 4. Find a formula for the general term a_n of the sequence $\left\{1, -\frac{12}{10}, \frac{19}{15}, -\frac{26}{20}, \frac{33}{25}, \ldots\right\}$.

a. $\dfrac{(-1)^{n-1}(5+7n)}{5(n+1)}$
b. $\dfrac{(-1)^n(5+7n)}{5n}$
c. $\dfrac{(5+7n)}{5(n+1)}$
d. $\dfrac{(-1)^n(5-7n)}{5(n+1)}$
e. $\dfrac{(-1)^n(5+7n)}{(n+1)}$
f. $\dfrac{(-1)^{n+1}(5-7n)}{5(n+1)}$
g. $\dfrac{(-1)^n(5+7n)}{5(n+1)}$
h. None of these

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____ 5. Find a formula for the general term a_n of the sequence $\left\{-\frac{1}{2}, 0, \frac{1}{10}, \frac{2}{17}, \frac{3}{26}, \ldots\right\}$.

a. $\frac{(n-2)}{(n^2+1)}$
b. $\frac{(n-2)}{(n^2-1)}$
c. $\frac{(n+2)}{(n^2+1)}$
d. $\frac{(-1)^n(n-2)}{(n^2+1)}$
e. $\frac{(n-2)}{n^2}$
f. $\frac{n}{(n^2+1)}$
g. $\frac{(n-1)}{(n^2+1)}$
h. None of these

____ 6. Determine the limit of the sequence $a_n = \frac{\sqrt{n+1}-\sqrt{n}}{\sqrt{n+1}+\sqrt{n}}$.

a. $\frac{1}{4}$
b. $\sqrt{2}$
c. 4
d. $\frac{1}{\sqrt{2}}$
e. 0
f. Divergent
g. 2
h. $\frac{1}{2}$

____ 7. Find the limit of the sequence $a_n = 1+\left(-\frac{4}{5}\right)^n$.

a. 0
b. $-\frac{4}{5}$
c. $\frac{4}{5}$
d. $-\frac{1}{5}$
e. 1
f. $\frac{1}{5}$
g. –1
h. Divergent

____ 8. Find the limit of the sequence $a_n = 1+\left(-\frac{5}{4}\right)^n$.

a. 0
b. $-\frac{5}{4}$
c. $\frac{5}{4}$
d. $-\frac{1}{4}$
e. 1
f. $\frac{1}{4}$
g. –1
h. Divergent

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____ 9. Find the limit of the sequence $a_n = \dfrac{\ln(3n)}{\ln n}$.

a. 3
b. 1
c. –3
d. $-\dfrac{1}{3}$
e. –1
f. $\dfrac{1}{3}$
g. 2
h. Divergent

____ 10. Find the limit of the sequence $a_n = \cos\left(\dfrac{n\pi}{2}\right)$.

a. 0
b. 1
c. $\dfrac{3\pi}{2}$
d. $-\dfrac{3\pi}{2}$
e. –1
f. $\dfrac{\pi}{2}$
g. $-\dfrac{\pi}{2}$
h. Divergent

____ 11. Find the limit of the sequence $a_n = ne^{1/n}$.

a. 0
b. 2
c. –4
d. 4
e. –1
f. 1
g. –2
h. Divergent

____ 12. Find the limit of the sequence $a_n = (n + e^n)^{1/n}$.

a. 1
b. 2
c. e
d. $1 + e$
e. –1
f. 1
g. 3
h. Divergent

____ 13. Find the limit of the sequence $a_n = \dfrac{e^n}{n!}$.

a. $\dfrac{e^2 - 1}{e}$
b. $\sqrt{e}$
c. e
d. e^2
e. 0
f. $\dfrac{e-1}{e}$
g. Divergent
h. 1

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____ 14. Find the limit of the sequence $\left\{\sqrt{3}, \sqrt{3\sqrt{3}}, \sqrt{3\sqrt{3\sqrt{3}}}, \ldots\right\}$.

a. 1
b. e^3
c. $e^{3/2}$
d. 3
e. $\frac{1}{3}$
f. $e^{\sqrt{3}}$
g. π
h. Divergent

____ 15. If $a_1 = 1$ and $a_{n+1} = \sqrt{1+a_n}$ for $n \geq 1$ and $\lim_{n\to\infty} a_n = L$ is assumed to exist, then what must L be?

a. $\sqrt{2}$
b. $\sqrt{3}$
c. $\sqrt{5}$
d. $\sqrt{7}$
e. $\frac{1+\sqrt{2}}{2}$
f. $\frac{2+\sqrt{3}}{4}$
g. $\frac{1+\sqrt{5}}{2}$
h. $\frac{3+\sqrt{7}}{2}$

____ 16. Determine the limit of the sequence $a_n = \frac{(-1)^n}{\sqrt{n}}$.

a. –1
b. 0
c. $\frac{1}{2}$
d. 1
e. $\sqrt{2}$
f. 2
g. e
h. Divergent

____ 17. Determine the limit of the sequence $a_n = \frac{(-2)^n}{n}$.

a. –2
b. 0
c. ln 2
d. $\sqrt{2}$
e. e^2
f. $-\frac{1}{2}$
g. 1
h. Divergent

____ 18. Determine the limit of the sequence $a_n = \frac{5\cos n}{n}$.

a. 0
b. 1
c. 2
d. 3
e. 4
f. 5
g. 6
h. Divergent

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____ 19. Determine the limit of the sequence $a_n = \left[\ln(n+1) - \ln(n)\right]$.

a. $\frac{1}{e}$
b. 1
c. 2
d. 0
e. e
f. $\frac{1}{4}$
g. $\ln 2$
h. Divergent

____ 20. Determine the limit of the sequence $a_n = \frac{\sin n}{\sqrt{n}}$.

a. 0
b. 1
c. 2
d. 3
e. 4
f. 5
g. $\sqrt{e}$
h. Divergent

____ 21. If $a_1 = 1$ and $a_{n+1} = 3 - \left(\frac{1}{a_n}\right)$ for $n \geq 1$, find the limit of the sequence a_n.

a. 2
b. $\sqrt{2}$
c. $\sqrt{3}$
d. $\sqrt{5}$
e. $\frac{2+\sqrt{3}}{4}$
f. $\frac{3+\sqrt{5}}{2}$
g. $\frac{5+\sqrt{7}}{2}$
h. $\frac{5+2\sqrt{2}}{3}$

____ 22. Determine the limit of the sequence $a_n = \frac{n!}{(n+3)!}$.

a. 0
b. 1
c. 2
d. e
e. 3
f. $\frac{1}{2}$
g. $\frac{1}{3}$
h. Divergent

____ 23. Determine the limit of the sequence $a_n = (-1)^n \left(1 - \frac{1}{\sqrt{n}}\right)$.

a. –2
b. 0
c. ln 2
d. $\sqrt{2}$
e. e^2
f. $-\frac{1}{2}$
g. 1
h. Divergent

____ 24. Determine the limit of the sequence $a_n = \dfrac{5\cos n + n}{n^2}$.

a. 0
b. 1
c. 2
d. 3
e. 4
f. 5
g. 6
h. Divergent

____ 25. Find the sum of the series $2 + \dfrac{1}{2} + \dfrac{1}{8} + \dfrac{1}{32} + \cdots$.

a. $\dfrac{15}{7}$
b. $\dfrac{8}{3}$
c. $\dfrac{7}{3}$
d. $\dfrac{13}{6}$
e. $\dfrac{16}{7}$
f. $\dfrac{5}{2}$
g. $\dfrac{17}{6}$
h. Divergent

____ 26. Find the sum of the series $\sum_{n=1}^{\infty} (-1)^{n+1} \dfrac{2^n}{3^n}$.

a. $\dfrac{1}{3}$
b. $\dfrac{1}{2}$
c. $\dfrac{3}{5}$
d. 1
e. $\dfrac{3}{2}$
f. $\dfrac{2}{5}$
g. 3
h. Divergent

____ 27. Find the sum of the series $0.9 + 0.09 + 0.009 + 0.0009 + \cdots$.

a. 9
b. 0
c. 0.999
d. 0.9999
e. 9.9
f. 2
g. 1
h. Divergent

____ 28. Find the sum of the series $\sum_{n=1}^{\infty} \dfrac{(-3)^{n-1}}{4^n}$.

a. $-\dfrac{3}{4}$
b. $-\dfrac{1}{4}$
c. $-\dfrac{1}{7}$
d. $\dfrac{1}{7}$
e. $\dfrac{1}{4}$
f. $\dfrac{3}{4}$
g. 0
h. Divergent

____ 29. Find the sum of the series $\sum_{n=0}^{\infty} 3\left[\left(\frac{1}{2}\right)^n + \left(-\frac{1}{2}\right)^n\right]$.

a. $\frac{4}{3}$
b. $\frac{5}{3}$
c. 8
d. 3
e. 4
f. 5
g. 6
h. Divergent

____ 30. Express the number 1.363636... as a ratio of integers.

a. $\frac{17}{13}$
b. $\frac{31}{19}$
c. $\frac{30}{19}$
d. $\frac{15}{13}$
e. $\frac{17}{11}$
f. $\frac{22}{17}$
g. $\frac{15}{11}$
h. $\frac{21}{17}$

____ 31. Find the values of x for which the series $\sum_{n=1}^{\infty} (x-1)^n$ converges.

a. $0 < x \le 2$
b. $-2 \le x < 0$
c. $-2 < x \le 0$
d. $0 \le x < 2$
e. $-2 < x < 0$
f. $0 < x < 2$
g. $0 \le x \le 2$
h. $-2 \le x \le 0$

____ 32. A rubber ball is dropped from a height of 10 feet and bounces to $\frac{3}{4}$ its height after each fall. If it continues to bounce until it comes to rest, find the total distance in feet it travels.

a. 55
b. 70
c. 40
d. 65
e. 35
f. 45
g. 50
h. 60

____ 33. Find the sum of the series $\sum_{n=1}^{\infty} \frac{1}{n(n+2)}$.

a. $\frac{3}{4}$
b. $\frac{1}{2}$
c. $\frac{3}{5}$
d. $\frac{9}{10}$
e. $\frac{7}{10}$
f. $\frac{4}{5}$
g. $\frac{2}{3}$
h. Divergent

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____ 34. Find the sum of the series $\sum_{n=4}^{\infty} \ln\left(\frac{n+1}{n}\right)$.

a. $\frac{1}{4}$
b. $\frac{1}{3}$
c. 0
d. ln 2
e. $\frac{3}{4}$
f. $\ln(n+1)$
g. $\ln\frac{3}{2}$
h. Divergent

____ 35. Find the sum of the series $\sum_{n=3}^{\infty} \frac{1}{4n^2-1}$.

a. $\frac{1}{5}$
b. $\frac{1}{20}$
c. $\frac{1}{2}$
d. $\frac{1}{10}$
e. $\frac{1}{4}$
f. $\frac{1}{3}$
g. $\frac{1}{6}$
h. Divergent

____ 36. Find the sum of the series $\sum_{n=2}^{\infty} \frac{1}{n^2-1}$.

a. 1
b. $\frac{5}{12}$
c. $\frac{1}{2}$
d. $\frac{1}{10}$
e. $\frac{1}{4}$
f. $\frac{3}{4}$
g. $\frac{3}{2}$
h. Divergent

____ 37. Find the sum of the series $\sum_{n=1}^{\infty} \frac{1}{(5n-1)(5n+1)}$.

a. $\frac{1}{5}$
b. $\frac{1}{6}$
c. $\frac{1}{2}$
d. $\frac{1}{10}$
e. 1
f. $\frac{3}{4}$
g. $\frac{3}{2}$
h. Divergent

____ 38. Find the sum of the series $\sum_{n=1}^{\infty} \frac{n}{(\sqrt{n}+1)}$.

a. $\frac{1}{5}$
b. $\frac{1}{6}$
c. $\frac{1}{2}$
d. $\frac{1}{10}$
e. 1
f. $\frac{3}{4}$
g. $\frac{3}{2}$
h. Divergent

____ 39. Find the sum of the series $\sum_{n=1}^{\infty} \frac{1}{(-2n+1)}$.

a. $\frac{1}{5}$
b. $\frac{1}{6}$
c. $\frac{1}{2}$
d. $\frac{1}{10}$
e. 1
f. $\frac{3}{4}$
g. $\frac{3}{2}$
h. Divergent

____ 40. Find the sum of the series $\sum_{n=1}^{\infty} \frac{1-n^2}{4n^2+n+1}$.

a. $\frac{1}{5}$
b. $\frac{1}{6}$
c. $\frac{1}{2}$
d. $\frac{1}{10}$
e. 1
f. $\frac{3}{4}$
g. $\frac{3}{2}$
h. Divergent

____ 41. Find the values of x for which the series $\sum_{n=1}^{\infty} \left(\frac{1}{x^2+2}\right)^n$ converges.

a. $\left(-\frac{1}{5}, \frac{1}{5}\right)$
b. $\left(-\frac{1}{6}, \frac{1}{6}\right)$
c. $\left(-\frac{1}{2}, \frac{1}{2}\right)$
d. 0
e. $(-1, 1)$
f. $\left(-\frac{3}{4}, \frac{3}{4}\right)$
g. $\left(-\frac{3}{2}, \frac{3}{2}\right)$
h. $(-\infty, \infty)$

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____ 42. Find the values of x for which the series $\sum_{n=1}^{\infty} (2x)^n$ converges.

a. $\left[-\frac{1}{2}, \frac{1}{2}\right)$
b. $\left(-\frac{1}{2}, \frac{1}{2}\right]$
c. $\left(-\frac{1}{2}, \frac{1}{2}\right)$
d. 0
e. $(-1, 1)$
f. $\left[-\frac{1}{2}, \frac{1}{2}\right]$
g. $(-2, 2)$
h. $(-\infty, \infty)$

____ 43. Find the values of x for which the series $\sum_{n=1}^{\infty} \left(2x + \frac{1}{2}\right)^n$ converges.

a. $\left(-\frac{3}{2}, \frac{1}{2}\right)$
b. $\left(-\frac{3}{2}, \frac{1}{2}\right]$
c. $\left(-\frac{1}{2}, \frac{1}{2}\right)$
d. 0
e. $\left[-\frac{3}{4}, \frac{1}{4}\right)$
f. $\left[-\frac{3}{2}, \frac{1}{2}\right]$
g. $\left(-\frac{3}{4}, \frac{1}{4}\right)$
h. $(-\infty, \infty)$

____ 44. Which of the three series below converges?

1) $\sum_{n=1}^{\infty} \frac{1}{n}$ 2) $\sum_{n=1}^{\infty} \frac{1}{n^{1.1}}$ 3) $\sum_{n=1}^{\infty} \frac{1}{n^{0.9}}$

a. 1, 2
b. 1
c. None
d. 3
e. 2
f. 2, 3
g. 1, 2, 3
h. 1, 3

____ 45. Which of the three series below converges?

1) $\sum_{n=2}^{\infty} \frac{1}{n \ln n}$ 2) $\sum_{n=1}^{\infty} \frac{1}{n(\ln n)^2}$ 3) $\sum_{n=2}^{\infty} \frac{1}{n(\ln n)^3}$

a. 2
b. 1, 2, 3
c. 1, 3
d. 2, 3
e. 3
f. None
g. 1, 2
h. 1

____ 46. According to the estimates found in the justification for the Integral Test, the sum of the series $\sum_{n=1}^{\infty} \frac{1}{n^{1.001}}$ must lie between what two values?

a.	101 & 102	e.	1002 & 1003
b.	102 & 103	f.	1000 & 1001
c.	999 & 1000	g.	99 & 100
d.	1001 & 1002	h.	100 & 101

____ 47. What is the value of *p* that marks the boundary between convergence and divergence of the series $\sum_{n=2}^{\infty} \frac{1}{n(\ln n)^{p}}$?

a.	$\frac{1}{2}$	e.	1
b.	$\frac{1}{3}$	f.	ln 3
c.	Diverges for all *p*	g.	Converges for all *p*
d.	ln 2	h.	$\frac{1}{e}$

____ 48. The series $\sum_{n=0}^{\infty} r^{n}$ converges if and only if

a.	$-1 \le r \le 1$	e.	$-1 < r < 1$
b.	$-1 \le r < 1$	f.	$-1 < r \le 1$
c.	$r \le -1$	g.	$r < 1$
d.	$r \ge 1$	h.	$r > 1$

____ 49. The series $\sum_{n=1}^{\infty} \frac{1}{n^{\alpha}}$ converges if and only if

a.	$\alpha < 1$	e.	$\alpha \ge 1$
b.	$-1 < \alpha < 1$	f.	$\alpha < -1$
c.	$\alpha \le 1$	g.	$\alpha > -1$
d.	$\alpha > 1$	h.	$-1 > \alpha > 1$

____ 50. Which of the three series below converges?

1) $\sum_{n=0}^{\infty} \left(-\frac{3}{4}\right)^{n}$ 2) $\sum_{n=0}^{\infty} \left(\frac{e}{\pi}\right)^{n}$ 3) $\sum_{n=0}^{\infty} (-1)^{n}$

a.	None	e.	1, 2
b.	1	f.	1, 3
c.	2	g.	2, 3
d.	3	h.	1, 2, 3

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____ 51. Which of the following three tests will establish that the series $\sum_{n=1}^{\infty} \frac{3}{n(n+2)}$ converges?

1) Comparison Test with $\sum_{n=1}^{\infty} 3n^{-2}$

2) Limit Comparison Test with $\sum_{n=1}^{\infty} n^{-2}$

3) Comparison Test with $\sum_{n=1}^{\infty} 3n^{-1}$

a. None
b. 1
c. 2
d. 3
e. 1, 2
f. 1, 3
g. 2, 3
h. 1, 2, 3

____ 52. Which of the following three tests will establish that the series $\sum_{n=1}^{\infty} \frac{n}{\sqrt{2n^5+1}}$ converges?

1) Comparison Test with $\sum_{n=1}^{\infty} n^{-5/2}$

2) Comparison Test with $\sum_{n=1}^{\infty} n^{-3/2}$

3) Comparison Test with $\sum_{n=1}^{\infty} n^{-1/2}$

a. None
b. 1
c. 2
d. 3
e. 1, 2
f. 1, 3
g. 2, 3
h. 1, 2, 3

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____ 53. Which of the following three tests will establish that the series $\sum_{n=1}^{\infty} \frac{n}{\sqrt{7n^3+46}}$ diverges?

1) Limit Comparison Test with $\sum_{n=1}^{\infty} n^{-1}$

2) Comparison Test with $\sum_{n=1}^{\infty} n^{-1}$

3) Comparison Test with $\sum_{n=1}^{\infty} n^{-1/2}$

a. None
b. 1
c. 2
d. 3
e. 1, 2
f. 1, 3
g. 2, 3
h. 1, 2, 3

____ 54. Which of the following series converges?

1) $\sum_{n=1}^{\infty} \frac{1}{n^2+\sqrt{n}}$ 2) $\sum_{n=1}^{\infty} \frac{\sqrt{n}}{n^2+\ln n}$ 3) $\sum_{n=1}^{\infty} \frac{n}{\sqrt{n^3+2n^2}}$

a. None
b. 1
c. 2
d. 3
e. 1, 2
f. 1, 3
g. 2, 3
h. 1, 2, 3

____ 55. Which of the following series converges?

1) $\sum_{n=1}^{\infty} n^{-n}$ 2) $\sum_{n=1}^{\infty} e^{100-n}$ 3) $\sum_{n=1}^{\infty} \frac{n^n}{n!}$

a. None
b. 1
c. 2
d. 3
e. 1, 2
f. 1, 3
g. 2, 3
h. 1, 2, 3

____ 56. Which of the following series converges?

1) $\sum_{n=1}^{\infty} \frac{n}{\ln(n+1)}$ 2) $\sum_{n=1}^{\infty} \frac{1}{\left[\ln(n+1)\right]^2}$ 3) $\sum_{n=1}^{\infty} \frac{1}{\left[\ln(n+1)\right]^3}$

a. None
b. 1
c. 2
d. 3
e. 1, 2
f. 1, 3
g. 2, 3
h. 1, 2, 3

____ 57. Which of the following series converges?

1) $\sum_{n=1}^{\infty} \frac{1}{e^n}$ 2) $\sum_{n=1}^{\infty} \frac{1}{\sqrt{e^n}}$ 3) $\sum_{n=1}^{\infty} \frac{1}{\sqrt[3]{e^n}}$

a. None
b. 1
c. 2
d. 3
e. 1, 2
f. 1, 3
g. 2, 3
h. 1, 2, 3

____ 58. Which of the following series converges?

1) $\sum_{n=1}^{\infty} \frac{3^{2n}}{2^{3n}}$ 2) $\sum_{n=1}^{\infty} \frac{1}{(n+1)^3}$ 3) $\sum_{n=1}^{\infty} \frac{n+1}{\sqrt{n^3+2}}$

a. None
b. 1
c. 2
d. 3
e. 1, 2
f. 1, 3
g. 2, 3
h. 1, 2, 3

____ 59. Which of the following series converges?

1) $\sum_{n=1}^{\infty} (-1)^n$ 2) $\sum_{n=1}^{\infty} 2^n$ 3) $\sum_{n=1}^{\infty} \frac{1}{2+n^3}$

a. None
b. 1
c. 2
d. 3
e. 1, 2
f. 1, 3
g. 2, 3
h. 1, 2, 3

____ 60. Which of the following series converges?

1) $\sum_{n=1}^{\infty} \left(\frac{1}{\sqrt{n}} + \frac{2}{n^3}\right)$ 2) $\sum_{n=1}^{\infty} \left(\frac{1}{n} - \frac{1}{n+1}\right)$ 3) $\sum_{n=1}^{\infty} \frac{\cos(1/n)}{n^2}$

a. None
b. 1
c. 2
d. 3
e. 1, 2
f. 1, 3
g. 2, 3
h. 1, 2, 3

____ 61. Which of the three series below converges?

1) $\sum_{n=1}^{\infty}\left(\frac{1}{\sqrt[5]{n^4}}+\frac{2}{n^3}\right)$ 2) $\sum_{n=1}^{\infty}\frac{\ln n}{n^2}$ 3) $\sum_{n=1}^{\infty}\frac{\sin(1/n)}{n}$

a. None
b. 1
c. 2
d. 3
e. 1, 2
f. 1, 3
g. 2, 3
h. 1, 2, 3

____ 62. Which of the three series below converges?

1) $\sum_{n=1}^{\infty}\left(\frac{2n-1}{3n}\right)^n$ 2) $\sum_{n=1}^{\infty}\frac{1}{2^n+n}$ 3) $\sum_{n=1}^{\infty}\frac{2^n+(-3)^n}{3^n}$

a. None
b. 1
c. 2
d. 3
e. 1, 2
f. 1, 3
g. 2, 3
h. 1, 2, 3

____ 63. Which one of the following series converges?

a. $\sum_{n=1}^{\infty}\frac{1}{n^{1.0001}}$
b. $\sum_{n=1}^{\infty}\frac{1}{n}$
c. $\sum_{n=1}^{\infty}\frac{1}{n^{0.99}}$
d. $\sum_{n=1}^{\infty}\frac{1}{n^{-4}}$
e. None of these

____ 64. Which one of the following series converges?

a. $\sum_{n=1}^{\infty}\frac{1}{n^{3/4}}$
b. $\sum_{n=1}^{\infty}\frac{1}{n}$
c. $\sum_{n=1}^{\infty}\frac{1}{n^{0.99}}$
d. $\sum_{n=1}^{\infty}\frac{1}{n^{-4}}$
e. None of these

____ 65. Which one of the following series diverges?

a. $\sum_{n=1}^{\infty} \frac{1}{n^{1.0001}}$

b. $\sum_{n=1}^{\infty} \left(\frac{\pi}{4}\right)^n$

c. $\sum_{n=1}^{\infty} \frac{1}{n + \ln n}$

d. $\sum_{n=1}^{\infty} \frac{1}{n^4}$

e. None of these

____ 66. Which one of the following series diverges?

a. $\sum_{n=1}^{\infty} \frac{1}{n^{1.0001}}$

b. $\sum_{n=1}^{\infty} \left(\frac{\pi}{4}\right)^n$

c. $\sum_{n=1}^{\infty} \frac{1}{n + e^n}$

d. $\sum_{n=1}^{\infty} \frac{n + n^3}{n^4 + 1}$

e. None of these

____ 67. Which one of the following series diverges?

a. $\sum_{n=1}^{\infty} \frac{n}{e^n}$

b. $\sum_{n=1}^{\infty} (-1)^n \left(\frac{2}{3}\right)^n$

c. $\sum_{n=1}^{\infty} \frac{n + n^3}{n^4}$

d. $\sum_{n=1}^{\infty} \frac{1}{n(\ln n)^2}$

e. None of these

____ 68. Which of the following are alternating series?

1) $\frac{(-1)^{2n}}{n}$ 2) $\sum_{n=1}^{\infty} \frac{(-1)^{n-1}}{n}$ 3) $\sum_{n=1}^{\infty} \frac{\cos n\pi}{n}$

a. None
b. 1
c. 2
d. 3
e. 1, 2
f. 1, 3
g. 2, 3
h. 1, 2, 3

____ 69. Which of the following are alternating series?

1) $\sum_{n=0}^{\infty}\left(-\frac{3}{4}\right)^n$ 2) $\sum_{n=1}^{\infty}\frac{(-1)^{2n+1}}{n}$ 3) $\sum_{n=0}^{\infty}\cos(3n\pi)$

a. None
b. 1
c. 2
d. 3
e. 1, 2
f. 1, 3
g. 2, 3
h. 1, 2, 3

____ 70. Which of the following series converges?

1) $\sum_{n=1}^{\infty}\frac{(-1)^n}{\ln(n+1)}$ 2) $\sum_{n=1}^{\infty}(-1)^n\ln(n+1)$ 3) $1-\frac{1}{2}+\frac{2}{3}-\frac{3}{4}+\frac{4}{5}-\frac{5}{6}+\cdots$

a. None
b. 1
c. 2
d. 3
e. 1, 2
f. 1, 3
g. 2, 3
h. 1, 2, 3

____ 71. Which of the following series converges?

1) $\sum_{n=1}^{\infty}\frac{(-1)^n n}{n+1}$ 2) $\sum_{n=1}^{\infty}\frac{\sqrt{n+1}}{n^2+2}$ 3) $\sum_{n=1}^{\infty}\frac{(-1)^{n-1}}{\sqrt{n+1}}$

a. None
b. 1
c. 2
d. 3
e. 1, 2
f. 1, 3
g. 2, 3
h. 1, 2, 3

____ 72. Which of the following series converges?

1) $\sum_{n=1}^{\infty}\frac{1}{n}$ 2) $\sum_{n=1}^{\infty}\frac{(-1)^n n}{\ln n}$ 3) $\sum_{n=1}^{\infty}\frac{(-1)^n}{n}$

a. None
b. 1
c. 2
d. 3
e. 1, 2
f. 1, 3
g. 2, 3
h. 1, 2, 3

____ 73. Which of the following series converges?

1) $\sum_{n=1}^{\infty}\left(\frac{n}{2+3n}\right)^n$ 2) $\sum_{n=2}^{\infty}\frac{n+1}{\sqrt{n^4-1}}$ 3) $\sum_{n=1}^{\infty}\frac{1}{1+n^2}$

a. None
b. 1
c. 2
d. 3
e. 1, 2
f. 1, 3
g. 2, 3
h. 1, 2, 3

____ 74. Which of the following series diverges?

1) $\sum_{n=1}^{\infty} \frac{n+2}{n^2+1}$ 2) $\sum_{n=1}^{\infty} \frac{n!}{2^n}$ 3) $\sum_{n=1}^{\infty} \left(\frac{2n-1}{n+3}\right)^n$

a. None
b. 1
c. 2
d. 3
e. 1, 2
f. 1, 3
g. 2, 3
h. 1, 2, 3

____ 75. Which one of the following series diverges?

a. $\sum_{n=1}^{\infty} \left(\frac{3}{\pi}\right)^n$
b. $\sum_{n=2}^{\infty} \frac{1}{\sqrt{n^3+1}}$
c. $\sum_{n=4}^{\infty} \frac{(-1)^n}{\ln n}$
d. $\sum_{n=2}^{\infty} \frac{3}{n \ln n}$
e. $\sum_{n=1}^{\infty} \left(\frac{1}{n} - \frac{1}{n+1}\right)$
f. $\sum_{n=1}^{\infty} \left(\frac{2}{e}\right)^n$
g. $\sum_{n=1}^{\infty} \frac{3}{n^2 \ln n}$
h. $\sum_{n=1}^{\infty} 3n^{-3/2}$

____ 76. Which one of the following series is divergent?

a. $\sum_{n=1}^{\infty} \left(\frac{2}{3}\right)^n$
b. $\sum_{n=1}^{\infty} \frac{1}{n^2+1}$
c. $\sum_{n=1}^{\infty} \frac{1}{n5^n}$
d. $\sum_{n=2}^{\infty} \frac{n}{n^2-1}$
e. $\sum_{n=1}^{\infty} \frac{n^3}{n^5+2}$
f. $\sum_{n=1}^{\infty} \frac{2^n}{n!}$
g. $\sum_{n=1}^{\infty} \frac{\pi}{n^2}$
h. $\sum_{n=1}^{\infty} (-1)^{n-1} \frac{\pi}{n}$

____ 77. If we add the first 100 terms of the alternating series $1-\frac{1}{2}+\frac{1}{3}-\frac{1}{4}+\frac{1}{5}-\cdots$, how close can we determine the partial sum s_{100} to be to the sum s of the series?

a. $s_{100} > s$, with $s_{100} - s < \frac{1}{101}$
b. $s_{100} > s$, with $s_{100} - s < \frac{1}{e^{100}}$
c. $s_{100} > s$, with $s_{100} - s < \frac{1}{100}$
d. $s_{100} < s$, with $s - s_{100} < \frac{1}{e^{101}}$
e. $s_{100} > s$, with $s_{100} - s < \frac{1}{e^{101}}$
f. $s_{100} < s$, with $s - s_{100} < \frac{1}{101}$
g. $s_{100} < s$, with $s - s_{100} < \frac{1}{100}$
h. $s_{100} < s$, with $s - s_{100} < \frac{1}{e^{100}}$

____ 78. How many terms of the alternating series $\sum_{n=1}^{\infty}(-1)^{n+1}n^{-2}$ must we add in order to be sure that the partial sum s_n is within 0.0001 of the sum s?

a. 10
b. 300
c. 30,000
d. 30
e. 3
f. 10,000
g. 100
h. 1000

____ 79. Which of the following series is absolutely convergent?

1) $\sum_{n=1}^{\infty}\frac{(-1)^n}{n^2}$ 2) $\sum_{n=1}^{\infty}\frac{(-1)^n}{n}$ 3) $\sum_{n=1}^{\infty}\frac{1}{n^3}$

a. None
b. 1
c. 2
d. 3
e. 1, 2
f. 1, 3
g. 2, 3
h. 1, 2, 3

____ 80. Which of the following series is absolutely convergent?

1) $\sum_{n=0}^{\infty}\left(-\frac{3}{4}\right)^n$ 2) $\sum_{n=2}^{\infty}\frac{(-1)^n}{n\ln n}$ 3) $\sum_{n=0}^{\infty}\left(-\frac{4}{3}\right)^n$

a. None
b. 1
c. 2
d. 3
e. 1, 2
f. 1, 3
g. 2, 3
h. 1, 2, 3

____ 81. Examine the two series below for absolute convergence (A), convergence that is not absolute (C), or divergence (D).

1) $\sum_{n=1}^{\infty} (-1)^n$ 2) $\sum_{n=1}^{\infty} (-1)^{n-1} n^{-1}$

a. 1A, 2A
b. 1A, 2C
c. 1A, 2D
d. 1C, 2A
e. 1C, 2C
f. 1C, 2D
g. 1D, 2A
h. 1D, 2C

____ 82. Examine the two series below for absolute convergence (A), convergence that is not absolute (C), or divergence (D).

1) $\sum_{n=1}^{\infty} (-1)^{n-1} n^{-1}$ 2) $\sum_{n=1}^{\infty} (-1)^{n-1} n^{-2}$

a. 1A, 2A
b. 1A, 2C
c. 1A, 2D
d. 1C, 2A
e. 1C, 2C
f. 1C, 2D
g. 1D, 2A
h. 1D, 2C

____ 83. Examine the two series below for absolute convergence (A), convergence that is not absolute (C), or divergence (D).

1) $\sum_{n=1}^{\infty} (-1)^{n-1} \frac{(n+2)\, 3^n}{2^{2n+1}}$ 2) $\sum_{n=1}^{\infty} (-1)^{n-1} \frac{(n+3)\, 2^{2n}}{3^{n+100}}$

a. 1A, 2A
b. 1A, 2C
c. 1A, 2D
d. 1C, 2A
e. 1C, 2C
f. 1C, 2D
g. 1D, 2A
h. 1D, 2C

____ 84. Examine the two series below for absolute convergence (A), convergence that is not absolute (C), or divergence (D).

1) $\sum_{n=1}^{\infty} \frac{(-1)^{n-1}}{\ln(n+1)}$ 2) $\sum_{n=1}^{\infty} \frac{(-1)^{n-1}}{(\ln(n+1))^2}$

a. 1A, 2A
b. 1A, 2C
c. 1A, 2D
d. 1C, 2A
e. 1C, 2C
f. 1C, 2D
g. 1D, 2A
h. 1D, 2C

____ 85. Examine the two series below for absolute convergence (A), convergence that is not absolute (C), or divergence (D).

1) $\sum_{n=1}^{\infty} (-1)^{n-1} \dfrac{n+1}{\ln(n+1)}$ 2) $\sum_{n=1}^{\infty} (-1)^{n-1} \dfrac{\ln(n+1)}{n+1}$

a. 1A, 2A
b. 1A, 2C
c. 1A, 2D
d. 1C, 2A
e. 1C, 2C
f. 1C, 2D
g. 1D, 2A
h. 1D, 2C

____ 86. Which of the following series will, when rearranged, converge to different values?

1) $\sum_{n=1}^{\infty} n^{-1}$ 2) $\sum_{n=1}^{\infty} (-1)^{n-1} n^{-1}$ 3) $\sum_{n=1}^{\infty} (-1)^{n-1} n^{-2}$

a. None
b. 1
c. 2
d. 3
e. 1, 2
f. 1, 3
g. 2, 3
h. 1, 2, 3

____ 87. Which of the following series are convergent, but not absolutely convergent?

1) $\sum_{n=1}^{\infty} (-e)^{-n}$ 2) $\sum_{n=1}^{\infty} (-1)^{-n} n^{-1}$ 3) $\sum_{n=1}^{\infty} (-1)^{-n} n^{-2}$

a. None
b. 1
c. 2
d. 3
e. 1, 2
f. 1, 3
g. 2, 3
h. 1, 2, 3

____ 88. Which of the following series are convergent, but not absolutely convergent?

1) $\sum_{n=1}^{\infty} \dfrac{(-1)^n}{\sqrt[3]{n}}$ 2) $\sum_{n=1}^{\infty} \dfrac{(-1)^{n-1}}{\sqrt{n}\ln n}$ 3) $\sum_{n=1}^{\infty} \dfrac{\cos n}{2^n}$

a. None
b. 1
c. 2
d. 3
e. 1, 2
f. 1, 3
g. 2, 3
h. 1, 2, 3

____ 89. Which of the following series are convergent, but not absolutely convergent?

1) $\sum_{n=1}^{\infty} (-1)^{n+1} \dfrac{n+2}{n^2+1}$ 2) $\sum_{n=1}^{\infty} \dfrac{(-1)^n}{n^4}$ 3) $\sum_{n=1}^{\infty} \dfrac{(-1)^n n}{n+1}$

a. None
b. 1
c. 2
d. 3
e. 1, 2
f. 1, 3
g. 2, 3
h. 1, 2, 3

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____ 90. Which one of the following series diverge?

a. $\sum_{n=1}^{\infty} \frac{1}{n(2n+1)}$

b. $\sum_{n=1}^{\infty} \frac{2n}{n+1}$

c. $\sum_{n=1}^{\infty} \frac{1}{(n+1)(n+3)}$

d. $\sum_{n=1}^{\infty} \frac{1}{3^n}$

e. $\sum_{n=1}^{\infty} \frac{n-2}{n\ 2^n}$

f. $\sum_{n=1}^{\infty} \frac{2n}{n!}$

g. $\sum_{n=1}^{\infty} \frac{n^{100}}{n!}$

h. $\sum_{n=1}^{\infty} \frac{n^{100}}{2^n}$

____ 91. Which of the following series converges?

1) $\sum_{n=1}^{\infty} \sin\left(\frac{1}{n^2}\right)$ 2) $\sum_{n=1}^{\infty} \frac{(-1)^n}{\sqrt[3]{n}}$ 3) $\sum_{n=1}^{\infty} \left(\frac{3n+1}{2n+1}\right)^n$

a. None
b. 1
c. 2
d. 3
e. 1, 2
f. 1, 3
g. 2, 3
h. 1, 2, 3

____ 92. Which of the following series converges?

1) $\sum_{n=1}^{\infty} \frac{4^n}{3^n+2^n}$ 2) $\sum_{n=1}^{\infty} \frac{3^n}{n+5^n}$ 3) $\sum_{n=1}^{\infty} \frac{n}{1+4n}$

a. None
b. 1
c. 2
d. 3
e. 1, 2
f. 1, 3
g. 2, 3
h. 1, 2, 3

____ 93. Which of the following series can be shown to be convergent using the Ratio Test?

1) $\sum_{n=1}^{\infty} \frac{1}{n^2}$ 2) $\sum_{n=1}^{\infty} \frac{n}{3^n}$ 3) $\sum_{n=1}^{\infty} \frac{2^n}{n!}$

a. None
b. 1
c. 2
d. 3
e. 1, 2
f. 1, 3
g. 2, 3
h. 1, 2, 3

____ 94. Use the Ratio Test to examine the two series below, stating: absolute convergence (A), divergence (D), or Ratio Test inconclusive (I).

1) $\sum_{n=1}^{\infty} n^{-100}$ 2) $\sum_{n=1}^{\infty} 100^{-n}$

a. 1A, 2A
b. 1A, 2D
c. 1A, 2I
d. 1D, 2A
e. 1D, 2D
f. 1D, 2I
g. 1I, 2A
h. 1I, 2D

____ 95. Use the Ratio Test to examine the two series below, stating: absolute convergence (A), divergence (D), or Ratio Test inconclusive (I).

1) $\sum_{n=1}^{\infty} (-1)^{n-1} \frac{2^{2n+1}}{5^n}$ 2) $\sum_{n=1}^{\infty} (-1)^{n-1} \frac{5^n}{2^{2n+1}}$

a. 1A, 2A
b. 1A, 2D
c. 1A, 2I
d. 1D, 2A
e. 1D, 2D
f. 1D, 2I
g. 1I, 2A
h. 1I, 2D

____ 96. For which of the following series will the Test for Divergence establish divergence?

1) $\sum_{n=1}^{\infty} (-1)^n$ 2) $\sum_{n=1}^{\infty} n^{-1}$ 3) $\sum_{n=1}^{\infty} \frac{n+1}{2n}$

a. None
b. 1
c. 2
d. 3
e. 1, 2
f. 1, 3
g. 2, 3
h. 1, 2, 3

____ 97. For which of the following series will the Ratio Test fail to give a definite answer (i.e., be inconclusive)?

1) $\sum_{n=1}^{\infty} \left(\frac{99}{100}\right)^n$ 2) $\sum_{n=1}^{\infty} \left(\frac{100}{99}\right)^n$ 3) $\sum_{n=1}^{\infty} n^{-100}$

a. None
b. 1
c. 2
d. 3
e. 1, 2
f. 1, 3
g. 2, 3
h. 1, 2, 3

____ 98. Tell which of the following series can be compared with geometric series to establish convergence.

1) $\sum_{n=1}^{\infty} \frac{1}{2+3^n}$ 2) $\sum_{n=1}^{\infty} \frac{n}{n^3+4}$ 3) $\sum_{n=1}^{\infty} \frac{n^2}{3^n}$

a. None
b. 1
c. 2
d. 3
e. 1, 2
f. 1, 3
g. 2, 3
h. 1, 2, 3

____ 99. Tell which of the following three series cannot be found convergent by the Ratio Test but can be found convergent by comparison with a *p*-series.

1) $\sum_{n=1}^{\infty} \frac{1}{2+3^n}$ 2) $\sum_{n=1}^{\infty} \frac{n}{n^3+4}$ 3) $\sum_{n=1}^{\infty} \frac{\sqrt{n}}{n^2+n}$

a. None
b. 1
c. 2
d. 3
e. 1, 2
f. 1, 3
g. 2, 3
h. 1, 2, 3

____ 100. Find the radius of convergence of $\sum_{n=0}^{\infty} 3x^n$.

a. 2
b. $\frac{1}{2}$
c. 6
d. $\frac{1}{6}$
e. 3
f. 1
g. $\frac{1}{3}$
h. 0

____ 101. Find the radius of convergence of $\sum_{n=0}^{\infty} (3x)^n$.

a. 3
b. 0
c. 2
d. $\frac{1}{6}$
e. 6
f. $\frac{1}{3}$
g. 1
h. $\frac{1}{2}$

____ 102. Find the interval of convergence of $\sum_{n=0}^{\infty} \frac{x^n}{3n+1}$.

a. $[-3,3]$
b. $(-1,1)$
c. $(-3,3)$
d. $[-1,1]$
e. $(-1,1]$
f. $(-3,3]$
g. $[-3,3)$
h. $[-1,1)$

____ 103. Find the interval of convergence of $\sum_{n=0}^{\infty} \frac{(-3x)^n}{3n+1}$.

a. $\left(-\frac{1}{3},\frac{1}{3}\right)$
b. $\left(-\frac{1}{3},\frac{1}{3}\right]$
c. $\left[-\frac{1}{3},\frac{1}{3}\right)$
d. $\left[-\frac{1}{3},\frac{1}{3}\right]$
e. $(-3,3)$
f. $(-3,3]$
g. $[-3,3)$
h. $[-3,3]$

____ 104. Find the interval of convergence of $\sum_{n=0}^{\infty} \frac{x^n}{2n^2}$.

a. $[-1,1]$
b. $(-1,1]$
c. $(-1,1)$
d. $[-1,1)$
e. $[-2,2]$
f. $(-2,2]$
g. $(-2,2)$
h. $[-2,2)$

____ 105. Find the radius of convergence of the series $\sum_{n=1}^{\infty} \frac{3^n (x+1)^n}{n^n}$.

a. 0
b. 2
c. 3
d. 4
e. $\frac{1}{2}$
f. 1
g. 5
h. ∞

____ 106. Find the radius of convergence of the series $\sum_{n=1}^{\infty} \frac{n^n (x+1)^n}{3^n}$.

a. 0
b. 2
c. 3
d. 4
e. $\frac{1}{2}$
f. 1
g. 5
h. ∞

____ 107. Find the radius of convergence of $\sum_{n=1}^{\infty} \frac{(x+2)^n}{n^2 3^n}$.

a. 0
b. 1
c. 2
d. 3
e. 4
f. 5
g. 6
h. ∞

____ 108. Find the radius of convergence of $\sum_{n=0}^{\infty} \frac{n!}{4^n} (x+3)^n$.

a. 0
b. 1
c. 2
d. 3
e. 4
f. 5
g. 6
h. ∞

____ 109. Find the interval of convergence of $\sum_{n=0}^{\infty} \frac{n}{4^n} (x+3)^n$.

a. $(-3,3)$
b. $[-3,3)$
c. $[-3,3]$
d. $(-3,3]$
e. $(-7,1)$
f. $[-7,1)$
g. $[-7,1]$
h. $(-7,1]$

____ 110. Find the radius of convergence of $\sum_{n=1}^{\infty} \frac{2 \cdot 5 \cdot 8 \cdots (3n-1)}{3 \cdot 7 \cdot 11 \cdots (4n-1)} (x+1)^n$.

a. 0
b. $\frac{4}{3}$
c. $\frac{3}{4}$
d. $\frac{3}{2}$
e. $\frac{1}{2}$
f. 2
g. $\frac{2}{3}$
h. ∞

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____ 111. Find the radius of convergence of $\sum_{n=1}^{\infty} \frac{n!\,x^n}{n^n}$.

a. 0
b. ∞
c. $1/e$
d. $\frac{1}{2}$
e. 1
f. e
g. 2
h. 3

____ 112. Find the radius of convergence of $\sum_{n=0}^{\infty} \frac{(-1)^n x^{2n+1}}{(2n+1)!}$.

a. 1
b. $\frac{1}{2}$
c. 2
d. 0
e. ∞
f. $\frac{1}{4}$
g. 4
h. 8

____ 113. Find the radius of convergence of $\sum_{n=1}^{\infty} \frac{(-1)^n (x+2)^n}{\sqrt{n}\, 3^n}$.

a. 0
b. 1
c. 2
d. 3
e. 4
f. 5
g. 6
h. ∞

____ 114. Find the interval of convergence of $\sum_{n=1}^{\infty} \frac{(-1)^n (x+2)^n}{\sqrt{n}\, 3^n}$.

a. $(-\infty, \infty)$
b. $(-5, 1]$
c. $[-5, 1)$
d. $[-5, 1]$
e. $(-4, 0]$
f. $[-4, 0)$
g. $[-4, 0]$
h. $(-3, -1)$

____ 115. Find the radius of convergence of $\sum_{n=1}^{\infty} \frac{(x-2)^n}{n 3^n}$.

a. 0
b. 1
c. 2
d. 3
e. 4
f. 5
g. 6
h. ∞

____ 116. Find the interval of convergence of $\sum_{n=1}^{\infty} \frac{(x-2)^n}{n3^n}$.

a. $(1,3)$
b. $[1,3)$
c. $(2,4]$
d. $[2,4]$
e. $(-1,5)$
f. $[-1,5)$
g. $(-2,6]$
h. $(-\infty,\infty)$

____ 117. Find the radius of convergence of $\sum_{n=0}^{\infty} \frac{(-3)^n (x-1)^n}{\sqrt{n+1}}$.

a. 0
b. $\frac{1}{3}$
c. $\frac{1}{2}$
d. 1
e. 2
f. 3
g. 4
h. ∞

____ 118. Find the radius of convergence of $\sum_{n=0}^{\infty} \frac{(-3)^n (x-1)^n}{\sqrt{n+1}}$.

a. $\left(\frac{2}{3},\frac{4}{3}\right]$
b. $\left[\frac{2}{3},\frac{4}{3}\right)$
c. $\left(\frac{1}{2},\frac{3}{2}\right)$
d. $\left[\frac{1}{2},\frac{3}{2}\right]$
e. $(0,2]$
f. $[0,2)$
g. $(-1,3)$
h. $[-2,4]$

____ 119. Which of the following is a power series?

1) $1+2x+3x^4$ 2) $\sum_{n=1}^{\infty} (5x+1)^{2n}$ 3) $\sum_{n=1}^{\infty} \frac{2^n}{x^n}$

a. None
b. 1
c. 2
d. 3
e. 1, 2
f. 1, 3
g. 2, 3
h. 1, 2, 3

____ 120. Which of the following is a power series?

1) $1+\frac{3}{x}+3x^4$ 2) $\sum_{n=1}^{\infty} 3^n x^{-n}$ 3) $\sum_{n=1}^{\infty} (-1)^{n-1}(2x+1)^n$

a. None
b. 1
c. 2
d. 3
e. 1, 2
f. 1, 3
g. 2, 3
h. 1, 2, 3

Short Answer

121. A sequence is defined by $a_n = 0.9999^n$.

(a) Calculate a_{10^3} and a_{10^5}.

(b) Determine whether a_n converges or diverges. If it converges, find the limit.

122. A sequence is defined by $b_n = 1.0001^n$.

(a) Calculate b_{10^3} and b_{10^5}.

(b) Determine whether b_n converges or diverges. If it converges, find the limit.

123. A sequence is defined by $a_n = r^n$, where r is a constant. For what values of r will the sequence converge? What is the limit?

124. Consider the recursive sequence defined by $x_1 = 1$; $x_{n+1} = \frac{x_n^2+2}{2x_n}$, $n > 1$. Evaluate the first three terms of this sequence.

125. Consider the recursive sequence defined by $x_1 = 1$; $x_{n+1} = \frac{x_n^2+2}{2x_n}$, $n > 1$. You may assume the sequence to be monotonic (after the first term) and bounded and hence convergent. Find its limit.

126. Consider the recursive sequence defined by $a_1 = 1$; $a_{n+1} = \frac{1}{2}(a_n + 4)$, $n > 1$.

(a) Evaluate the first four terms of this sequence.

(b) Show that the sequence converges.

(c) Find the limit.

127. Determine whether $a_n = \sin\left(\frac{n\pi}{2}\right)$ converges or diverges. If it converges, find the limit.

128. Determine whether $a_n = \frac{n\cos n}{n^2 + 1}$ converges or diverges. If it converges, find the limit.

129. Consider the recursive sequence defined by $a_1 = 2$; $a_{n+1} = \frac{2}{3 - a_n}$, $n > 1$.

(a) Evaluate the first four terms of this sequence.

(b) Show that the sequence converges.

(c) Find the limit.

130. Determine whether $a_n = \frac{3n + 4}{2n + 5}$ is increasing, decreasing, or not monotonic.

131. Determine whether $a_n = \frac{3 + (-1)^n}{n}$ is increasing, decreasing, or not monotonic.

132. Determine whether $a_n = \frac{\sqrt{n + 1}}{5n + 3}$ is increasing, decreasing, or not monotonic.

133. If $\frac{3n - 1}{n + 1} < x_n < \frac{3n^2 + 6n + 2}{n^2 + 2n + 1}$ for all positive integers n, then find $\lim\limits_{n \to \infty} x_n$.

134. A car purchased for \$18,000 depreciates 5% each year.

(a) If P_n is the value of the car after n years, find a formula for P_n.

(b) What does the value of the car approach as time goes on?

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135. The population of a certain colony is 1000 and is increasing by 2% each year.

(a) If P_n is the population after n years, find a formula for P_n.

(b) What does the population approach as time goes on?

136. If a sequence is bounded, does the sequence necessarily have a limit? Explain.

137. Consider the sequence defined by $a_n = \left(\frac{2}{3}\right)^n$. ($n$ starts at 1)

(a) Write the first five terms of the sequence.

(b) Determine the limit of the sequence.

(c) Let $b_n = \frac{a_{n+1}}{a_n}$. Write the first five terms of this sequence.

(d) Determine the limit of b_n.

138. Consider the sequence defined by $a_n = \left(-\frac{3}{4}\right)^n$. ($n$ starts at 1)

(a) Write the first five terms of the sequence.

(b) Determine the limit of the sequence.

(c) Let $b_n = \frac{a_{n+1}}{a_n}$. Write the first five terms of this sequence.

(d) Determine the limit of b_n.

139. Consider the sequence defined by $a_n = \left(\frac{3}{2}\right)^n$. ($n$ starts at 1)

(a) Write the first five terms of the sequence.

(b) Determine the limit of the sequence.

(c) Let $b_n = \frac{a_{n+1}}{a_n}$. Write the first five terms of this sequence.

(d) Determine the limit of b_n.

140. Consider the sequence defined by $a_n = (-1)^n$. (n starts at 1)

(a) Write the first five terms of the sequence.

(b) Determine the limit of the sequence.

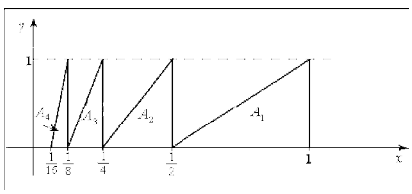
(c) Let $b_n = \dfrac{a_{n+1}}{a_n}$. Write the first five terms of this sequence.

(d) Determine the limit of b_n.

(e) Let $c_n = \sum_{k=1}^{n} a_k$. Write the first five terms of this sequence.

(f) Determine the limit of c_n.

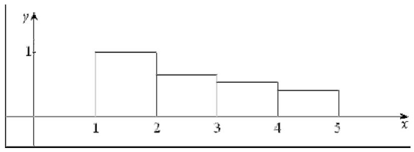
141. A sequence of right triangles, A_1, A_2, A_3, ... is given in the figure below:



(a) Let a_n = area (A_n). Determine an expression for a_n and find the limit of a_n.

(b) Let $b_n = \sum_{k=1}^{n} a_k$. Use geometric reasoning to determine the limit of b_n.

142. Consider a sequence of rectangles, $R_1, R_2, R_3, \ldots$ illustrated in the figure below:



(a) The height L_n of R_n is given by $L_n = f(n)$ where $f(x) = \dfrac{1}{x}$. Write down the first five terms of $\{L_n\}$ and determine the limit of $\{L_n\}$.

(b) Let $b_n = \sum_{k=1}^{n} L_k$. Compare b_n to $\int_n^{n+1} (1/x)\, dx$.

(c) Determine whether $\{b_n\}$ converges or diverges. Justify your answer.

143. Suppose that $1,000 is deposited in a bank at 3% interest, compounded annually. Let $B(n)$ denote the balance after the nth year. Find an expression for the sequence $B(n)$.

144. Suppose a 600 milligram dose of a drug is injected into a patient and that the patient's kidneys remove 20% of the drug from the bloodstream every hour. Let $D(n)$ denote the amount of the drug left in the patient's body after n hours.

(a) Find an expression for $D(n)$.

(b) How long will it take for the drug level to drop below 200 milligrams?

(c) How long will it take to bring the drug level below 10% of the original dosage?

145. Consider the sequence defined by $a_n = \dfrac{n!}{2 \cdot 5 \cdot 8 \cdot \cdots \cdot (3n-1)}$, $n \ge 1$

(a) Evaluate the first three terms of this sequence.

(b) Find the limit.

146. Evaluate $\lim_{n \to \infty} \left(1 - \dfrac{2}{n}\right)^n$.

147. Find the value of $\dfrac{2}{9} - \dfrac{4}{27} + \cdots + \dfrac{(-1)^{n+1} \cdot 2^n}{3^{n+1}} + \cdots$.

148. Determine whether the series $\sum_{n=1}^{\infty} \frac{n-1}{5n+1}$ is convergent or divergent. If it is convergent, find the sum.

149. Determine whether the series $\sum_{n=1}^{\infty} \cos\left(\frac{\pi}{2n^2-1}\right)$ is convergent or divergent. If it is convergent, find the sum.

150. Find the value of $\sum_{n=2}^{\infty} \frac{3^n+5^n}{15^n}$.

151. Determine whether the series $\sum_{n=1}^{\infty} \frac{n}{\sqrt{3n+2}}$ is convergent or divergent. If it is convergent, find the sum.

152. Determine whether the series $1-\frac{1}{2}+\frac{1}{4}-\frac{1}{8}+\cdots$ is convergent or divergent. If it is convergent, find its sum.

153. Determine whether the series $\sum_{n=1}^{\infty} \frac{n}{(n+1)!}$ is convergent or divergent. If it is convergent, find the sum.

154. Determine whether the series $\sum_{n=1}^{\infty} \ln\left(\frac{2n-1}{2n+1}\right)$ is convergent or divergent. If it is convergent, find the sum.

155. Determine whether the series $\sum_{n=1}^{\infty} \frac{1}{(3n-1)(3n+2)}$ is convergent or divergent. If it is convergent, find the sum.

156. Determine whether the series $-\frac{81}{100}+\frac{9}{10}-1+\frac{10}{9}-\cdots$ is convergent or divergent. If it is convergent, find its sum.

157. Determine whether the series $\sum_{n=2}^{\infty} \ln\frac{n^2}{(n+1)(n-1)}$ is convergent or divergent. If it is convergent, find the sum.

158. Determine whether the series $\sum_{n=1}^{\infty} \frac{3+(-1)^n}{3^n}$ is convergent or divergent. If it is convergent, find the sum.

159. Show that if $\sum_{n=1}^{\infty} a_n$ converges, then $\sum_{n=1}^{\infty} \cos(a_n)$ diverges.

160. Determine whether the series $\sum_{n=1}^{\infty}(0.9999)^n$ is convergent or divergent. If it is convergent, find the sum.

161. Determine whether the series $\sum_{n=1}^{\infty}(1.0001)^n$ is convergent or divergent. If it is convergent, find the sum.

162. Determine whether the series $\sum_{n=1}^{\infty}\frac{n^2}{3(n+1)(n+2)}$ is convergent or divergent. If it is convergent, find its sum.

163. If $\sum_{n=2}^{\infty}\left(\frac{a}{1+a}\right)^n = 3$ and $a > 0$, determine the value of a.

164. Determine whether the series $\sum_{n=1}^{\infty}(-1)^{n-1}\frac{3^{2n}}{2^{3n+1}}$ is convergent or divergent. If it is convergent, find its sum.

165. Let $\sum a_n$ and $\sum b_n$ be two series. Determine whether each of the following statements is true or false. Justify your answer.

(a) If $\sum a_n$ converges, then $a_n \to 0$.

(b) If $a_n \to 0$, then $\sum a_n$ converges.

(c) If $\sum a_n$ converges, and $\sum b_n$ diverges, then $\sum (a_n + b_n)$ diverges.

(d) If $\sum a_n$ diverges, and $\sum b_n$ diverges, then $\sum (a_n + b_n)$ diverges.

(e) If $\sum a_n$ converges, and $\lim_{n\to\infty} b_n = 0$ then $\sum (a_n + b_n)$ converges.

166. A series $\sum_{k=1}^{\infty} a_k$ has partial sums, s_n, given by $s_n = \dfrac{7n-2}{n}$

(a) Is $\sum_{k=1}^{\infty} a_k$ convergent? If it is, find the sum.

(b) Find $\lim_{n\to\infty} a_k$.

(c) Find $\sum_{k=1}^{200} a_k$

167. Let $a_n = \dfrac{1+3^n}{1+4\cdot 3^n}$.

(a) Find $\lim_{n\to\infty} a_n$.

(b) Is $\sum a_n$ convergent? Justify your answer.

168. Express the number $0.\overline{307}$ as a ratio of integers.

169. Express the number $0.2\overline{15}$ as a ratio of integers.

170. A superball is dropped from a height of 8 ft. Each time it strikes the ground after falling from a height of t ft. it rebounds to a height of $\dfrac{3}{4}t$ feet. Find the total distance traveled by the ball.

171. A superball is dropped from a height of 8 ft. Each time it strikes the ground after falling from a height of t ft. it rebounds to a height of $\dfrac{3}{4}t$ feet. How long does it take for the ball to come to rest? (Use $g = 32\ \text{ft}/\text{s}^2$.)

172. Find $\sum_{n=2}^{\infty}\left(\sum_{m=2}^{\infty}\dfrac{1}{n^m}\right)$.

173. Determine whether each of the following series is convergent or divergent.

(a) $\displaystyle\sum_{n=1}^{\infty} \frac{1}{2+3^{-n}}$

(b) $\displaystyle\sum_{n=0}^{\infty} \frac{\pi^n}{3^n}$

(c) $\displaystyle\sum_{n=1}^{\infty} \frac{e^n}{3^n}$

174. Determine whether each of the following series is convergent or divergent.

(a) $\displaystyle\sum_{n=1}^{\infty} \frac{1}{n}$

(b) $\displaystyle\sum_{n=0}^{\infty} n \sin\left(\frac{1}{n}\right)$

(c) $\displaystyle\sum_{n=0}^{\infty} (-1)^n \frac{3^n}{5^n}$

175. Here is a two-player game: Two players take turns flipping a fair coin. The first player to get a head wins the game. What is the probability that the person who starts first wins the game?

176. Here is a two-player game: Two players take turns tossing a fair die. The first player to get a 5 wins the game. What is the probability that the player who starts first wins the game?

177. Let $X = \{1, 2, 3, \ldots, n, \ldots\}$ be a discrete random variable with probability density function $f(n) = r(1-r)^{n-1}$, where $0 < r < 1$.

(a) Show that $\displaystyle\sum_{n=1}^{\infty} f(n) = 1$. Explain the significance of the value 1.

(b) The expected value of the random variable X is defined by $E(X) = \displaystyle\sum_{n=1}^{\infty} n f(n)$. Show that $E(X) = \dfrac{1}{r}$. The distribution of X is known as the *geometric distribution*.

178. Let $X = \{0, 1, 2, 3, \ldots, n, \ldots\}$ be a discrete random variable with probability density function $f(n) = e^{-\mu}\dfrac{\mu^n}{n!}$, where $0 < \mu$.

(a) Show that $\displaystyle\sum_{n=0}^{\infty} f(n) = 1$. Explain the significance of the value 1.

(b) The expected value of the random variable X is defined by $E(X) = \displaystyle\sum_{n=0}^{\infty} n f(n)$. Show that $E(X) = \mu$. The distribution of X is known as the *Poisson distribution*.

179. Use the Integral Test to determine if the following series converges or diverges: $\displaystyle\sum_{n=1}^{\infty} \frac{n}{(n^2+1)^2}$.

180. Determine whether or not $\displaystyle\sum_{k=2}^{\infty} \frac{1}{k(\ln k)^2}$ converges.

181. Determine whether $\displaystyle\sum_{n=1}^{\infty} 3ne^{-n^2}$ converges or diverges.

182. Use the integral test to show that the series $\displaystyle\sum_{k=2}^{\infty} \frac{1}{k(\ln k)^p}$ converges if $p > 1$ and diverges if $p \le 1$.
Hint: Consider the two cases $p = 1$ and $p \ne 1$.

183. Determine whether $\displaystyle\sum_{n=1}^{\infty} \frac{\cos n + 3^n}{n^2 + 5^n}$ is convergent or divergent.

184. Determine whether the series $\displaystyle\sum_{n=0}^{\infty} \frac{1+\sin^2 n}{5^n}$ converges.

185. Determine whether the given series is convergent or divergent. Indicate the test you use and show any necessary computation.

(a) $\sum_{n=1}^{\infty} \frac{2n^2+1}{5n^3-n+4}$

(b) $\sum_{n=1}^{\infty} \left(\frac{1+\sin n}{n}\right)^2$

(c) $\sum_{n=1}^{\infty} n \cdot \sin\left(\frac{1}{n}\right)$

(d) $\sum_{n=1}^{\infty} \left(\frac{2}{n\sqrt{n}} + \frac{3}{n^3}\right)$

(e) $\sum_{n=1}^{\infty} \tan^{-1} n$

(f) $\sum_{n=1}^{\infty} \frac{1}{n\sqrt{1+\ln n}}$

(g) $\sum_{n=1}^{\infty} \frac{\ln n}{(n+1)^3}$

(h) $\sum_{n=1}^{\infty} \frac{\ln n}{n}$

(i) $\sum_{n=1}^{\infty} \frac{4^n}{2^n+3^n}$

(j) $\sum_{n=1}^{\infty} \ln\left(1+\frac{1}{n}\right)$

(k) $\sum_{n=1}^{\infty} n \cdot e^{-n^2}$

186. Consider the two series: (a) $\sum_{k=2}^{\infty} \frac{\ln k}{k}$ and (b) $\sum_{k=2}^{\infty} \frac{1}{k \ln k}$. Suppose you compare (a) and (b) to the series $\sum_{k=1}^{\infty} \frac{1}{k}$. What (if anything) can you conclude about the convergence or divergence of (a) and (b) using *only* the Comparison Test?

187. For the series $\sum_{n=2}^{\infty} \frac{n^{1/2}}{\ln n}$, tell whether or not it converges, and indicate what test you used. If the test involves a limit, give the limit. If the test involves a comparison, give the comparison.

188. Given $\sum_{n=1}^{\infty} \frac{1}{n^3}$.

(a) Approximate the sum of the series $\sum_{n=1}^{\infty} \frac{1}{n^3}$ by using the sum of the first 4 terms.

(b) Estimate the error involved in the approximation in part (a).

(c) How many terms are required to ensure that the sum is accurate to within 0:001?

189. Given $\sum_{n=1}^{\infty} \frac{1}{n^4}$.

(a) Approximate the sum of the series $\sum_{n=1}^{\infty} \frac{1}{n^4}$ by using the sum of the first 4 terms.

(b) Estimate the error involved in the approximation in part (a).

(c) How many terms are required to ensure that the sum is accurate to within 0:001?

190. Given $\sum_{n=1}^{\infty} \frac{1}{n^5}$.

(a) Approximate the sum of the series $\sum_{n=1}^{\infty} \frac{1}{n^5}$ by using the sum of the first 4 terms.

(b) Estimate the error involved in the approximation in part (a).

(c) How many terms are required to ensure that the sum is accurate to within 0.001?

191. Use the sum of the first 10 terms to approximate the sum of the series $\sum_{n=1}^{\infty} \frac{1}{n^4+1}$. Estimate the error involved in this approximation.

192. Estimate $\sum_{n=1}^{\infty} \frac{1}{n^4+1}$ to within 0.01.

193. Use the sum of the first 10 terms to approximate the sum of the series $\sum_{n=1}^{\infty} \frac{1}{n(\ln(2n))^4+1}$. Estimate the error involved in this approximation.

194. Test the following series for convergence or divergence: $5-\frac{5}{2}+\frac{5}{5}-\frac{5}{8}+\frac{5}{11}-\frac{5}{14}+\cdots$.

195. Test the following series for convergence or divergence: $\frac{1}{\ln 2}-\frac{1}{\ln 3}+\frac{1}{\ln 4}-\frac{1}{\ln 5}+\frac{1}{\ln 6}-\cdots$.

196. Test the following series for convergence or divergence: $\sum_{n=1}^{\infty} \frac{(-1)^n}{\sqrt{n+3}}$.

197. Test the following series for convergence or divergence: $\sum_{n=2}^{\infty} \frac{(-1)^{n-1}}{n \ln n}$.

198. Test the following series for convergence or divergence: $\sum_{n=1}^{\infty} (-1)^n \frac{n^2}{n^2+1}$.

199. Test the following series for convergence or divergence: $\sum_{n=1}^{\infty} (-1)^{n-1} \frac{(n+9)(n+10)}{n(n+1)}$.

200. Test the following series for convergence or divergence: $\sum_{n=1}^{\infty} (-1)^n \cos\left(\frac{\pi}{n}\right)$.

201. Which of the following series is convergent, but not absolutely convergent?

(a) $\sum_{n=1}^{\infty} \frac{1}{n}$ (b) $\sum_{n=1}^{\infty} \frac{\sin n}{n^2}$ (c) $\sum_{n=1}^{\infty} \frac{(-1)^n}{\sqrt{n}}$ (d) $\sum_{n=1}^{\infty} \frac{3^n}{2^n+\sqrt{n}}$ (e) $\sum_{n=1}^{\infty} \frac{1-2n}{n+1}$

202. Determine whether the given series is convergent (but not absolutely convergent), absolutely convergent, or divergent.

$$\sum_{k=2}^{\infty} \frac{(-1)^{k+1}}{\ln k}$$

203. Determine whether the given series is convergent (but not absolutely convergent), absolutely convergent, or divergent.

$$\sum_{n=1}^{\infty} \frac{(-1)^{n+1} n}{n^2+1}$$

204. Consider the series $\sum_{n=0}^{\infty} (-1)^n \frac{1}{(4n)!}$.

(a) Show that $\sum_{n=0}^{\infty} (-1)^n \frac{1}{(4n)!}$ is absolutely convergent.

(b) Calculate the sum of the first 3 terms to approximate the sum of the series.

(c) Estimate the error involved in the approximation from part (b).

205. Consider the series $\sum_{n=1}^{\infty} (-1)^{n-1} \frac{n}{4^n}$.

(a) Show that the series is absolutely convergent.

(b) Calculate the sum of the first 3 terms to approximate the sum of the series.

(c) Is the approximation in part (b) an overestimate or an underestimate?

(d) Estimate the error involved in the approximation from part (b).

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

(a) Show that the series is convergent, but not absolutely convergent.

(b) Calculate the sum of the first 8 terms to approximate the sum of the series.

(c) Is the approximation in part (b) an overestimate or an underestimate?

(d) Estimate the error involved in the approximation from part (b).

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

(a) Show that the series is convergent, but not absolutely convergent.

(b) Calculate the sum of the first 9 terms to approximate the sum of the series.

(c) Is the approximation in part (b) an overestimate or an underestimate?

(d) Estimate the error involved in the approximation from part (b).

208. Consider the series $\sum_{n=1}^{\infty} (-1)^{n-1} \frac{1}{n^4}$.

(a) Show that the series is absolutely convergent.

(b) How many terms of the series do we need to add in order to find the sum to within 0.001?

(c) What is the approximation sum in part (b)?

209. Consider the series $\sum_{n=1}^{\infty} (-1)^n \frac{n}{4^n}$.

(a) Show that the series is absolutely convergent.

(b) How many terms of the series do we need to add in order to find the sum to within 0.002?

(c) What is the approximation sum in part (b)?

210. Consider the series $\sum_{n=1}^{\infty} (-1)^{n-1} \frac{1}{n^4+1}$.

(a) Show that the series is absolutely convergent.

(b) How many terms of the series do we need to add in order to find the sum to within 0.01?

(c) What is the approximation sum in part (b)?

211. Consider the series $\sum_{n=0}^{\infty} \frac{(-1)^n}{(2n)!}$.

(a) Show that the series is absolutely convergent.

(b) How many terms of the series do we need to add in order to find the sum to within 0.0001?

(c) What is the approximation sum in part (b)?

212. Show that the series $\sum_{n=1}^{\infty} \frac{(-1)^{n-1}}{3n+1}$ is convergent. How many terms of the series do we need to add to find the sum to within 0.01?

213. Show that the series $\sum_{n=1}^{\infty} \frac{(-1)^{n-1}}{4n}$ is convergent. How many terms of the series do we need to add to find the sum to within 0.01?

214. Determine if the series $\sum_{n=1}^{\infty} \frac{6^n}{n!}$ converges or diverges by the Ratio Test or Root Test.

215. Determine if the series $\sum_{n=1}^{\infty} \frac{6^n}{n^{100}}$ converges or diverges by the Ratio Test or Root Test.

216. Determine if the series $\sum_{n=1}^{\infty} \frac{n^n}{n!}$ converges or diverges by the Ratio Test or Root Test.

217. Determine if the series $\sum_{n=1}^{\infty} \frac{2 \cdot 5 \cdot 8 \cdot \ldots \cdot (3n-1)}{6^n n!}$ converges or diverges by the Ratio Test or Root Test.

218. Determine if the series $\sum_{n=1}^{\infty} \frac{2 \cdot 5 \cdot 8 \cdot \ldots \cdot (3n-1)}{2^n n!}$ converges or diverges by the Ratio Test or Root Test.

219. Determine if the series $\sum_{n=1}^{\infty} \left(\frac{3n-1}{4n+1}\right)^n$ converges or diverges by the Ratio Test or Root Test.

220. Determine if the series $\sum_{n=2}^{\infty} \left(\frac{n}{\ln n}\right)^n$ converges or diverges by the Ratio Test or Root Test.

221. Determine whether each of the following series converges. Justify your answer by specifying which test you are using and showing any necessary computation.

(a) $\sum_{n=1}^{\infty} \frac{2+(-1)^n}{2^n}$ (b) $\sum_{n=1}^{\infty} \frac{n^2+1}{3n^3-n+2}$ (c) $\sum_{n=1}^{\infty} \left(\frac{1+\sin n}{n}\right)^2$

(d) $\sum_{n=1}^{\infty} \frac{n!}{1 \cdot 3 \cdot 5 \cdot \cdots \cdot (2n-1)}$ (e) $\sum_{n=1}^{\infty} \frac{n!}{n^n}$ (f) $\sum_{n=1}^{\infty} \left(\frac{\ln n}{n}\right)^n$

(g) $\sum_{n=1}^{\infty} \frac{1}{n\sqrt{1+\ln n}}$ (h) $\sum_{n=1}^{\infty} \frac{\ln n}{(n+1)^3}$ (i) $\sum_{n=1}^{\infty} 3^n \sin\left(\frac{\pi}{4^n}\right)$

(j) $\sum_{n=1}^{\infty} \tan^{-1} n$ (k) $\sum_{n=1}^{\infty} (-1)^n \frac{\ln n}{n}$ (l) $\sum_{n=1}^{\infty} \ln\left(1+\frac{1}{n}\right)$

(m) $\sum_{n=1}^{\infty} \frac{2^n n!}{2 \cdot 5 \cdot 8 \cdot \ldots \cdot (3n-1)}$ (n) $\sum_{n=1}^{\infty} \frac{\sqrt{n+1}-\sqrt{n}}{n}$

222. Find the interval of convergence for $\sum_{n=1}^{\infty} \frac{x^n}{4n^2}$.

223. Find the interval of convergence for $\sum_{n=1}^{\infty} \frac{x^n}{n2^n}$.

224. Find the interval of convergence of the power series $\sum_{n=1}^{\infty} \frac{(-1)^n (x-2)^n}{\sqrt[3]{n}}$.

225. Consider the power series $\sum_{k=1}^{\infty} \frac{(-1)^k}{k} x^k$.

(a) Find the radius of convergence.

(b) Determine what happens at the end points (absolute or conditional convergence, or divergence).

226. Find the interval of convergence for $\sum_{k=0}^{\infty} \left(\frac{e^k}{k+1} \right) x^k$.

227. Find the interval of convergence for $\sum_{k=1}^{\infty} \frac{(-1)^k (x-3)^k}{5^k (k+1)}$.

228. If $\sum_{n=1}^{\infty} c_n x^n$ is convergent at $x = 3$, what can be said about the convergence or divergence of the following series?

(a) $\sum_{n=1}^{\infty} c_n 4^n$

(b) $\sum_{n=1}^{\infty} c_n (-2)^n$

(c) $\sum_{n=1}^{\infty} c_n (-3)^n$

229. If $\sum_{n=1}^{\infty} c_n(x-n)^n$ is convergent at $x = 5$, what can be said about the convergence or divergence of the following series?

(a) $\sum_{n=1}^{\infty} c_n$

(b) $\sum_{n=1}^{\infty} c_n(-2)^n$

(c) $\sum_{n=1}^{\infty} c_n 4^n$

230. The power series $\sum_{n=1}^{\infty} a_n(x-2)^n$ and $\sum_{n=1}^{\infty} b_n(x-3)^n$ both converge at $x = 6$. Find the largest interval over which both series must converge.

231. Find the radius of convergence of the series $\sum_{n=1}^{\infty} \frac{3^n(x-2)^{2n+1}}{n!}$.

232. Find the radius of convergence of $\sum_{n=1}^{\infty} \frac{2 \cdot 5 \cdot 8 \cdot \cdots \cdot (3n-1)}{n!} x^n$.

233. Find the radius of convergence of $\sum_{n=1}^{\infty} \frac{n}{2 \cdot 5 \cdot 8 \cdot \cdots \cdot (3n-1)} x^n$.

234. Find the radius of convergence of $\sum_{n=1}^{\infty} \frac{2 \cdot 5 \cdot 8 \cdot \cdots \cdot (3n-1)}{n} x^n$.

235. Construct an example of a power series that has $\left[-3,5\right]$ as its interval of convergence.

236. Construct an example of a power series that has $\left[-3,5\right)$ as its interval of convergence.

237. Construct an example of a power series that has $\left(-3,5\right)$ as its interval of convergence.

238. Construct an example of power series that has $\left(-3,5\right]$ as its interval of convergence.

239. Construct an example of power series that has $[3,5]$ as its interval of convergence.

240. Construct an example of power series that has $[3,5)$ as its interval of convergence.

241. Construct an example of power series that has $(3,5)$ as its interval of convergence.

242. Construct an example of power series that has $(3,5]$ as its interval of convergence.

104 Chapter 12 Practice Problems
Answer Section

MULTIPLE CHOICE

1.	ANS: F	PTS:	1
2.	ANS: G	PTS:	1
3.	ANS: C	PTS:	1
4.	ANS: G	PTS:	1
5.	ANS: A	PTS:	1
6.	ANS: E	PTS:	1
7.	ANS: E	PTS:	1
8.	ANS: H	PTS:	1
9.	ANS: B	PTS:	1
10.	ANS: H	PTS:	1
11.	ANS: H	PTS:	1
12.	ANS: C	PTS:	1
13.	ANS: E	PTS:	1
14.	ANS: D	PTS:	1
15.	ANS: G	PTS:	1
16.	ANS: B	PTS:	1
17.	ANS: H	PTS:	1
18.	ANS: A	PTS:	1
19.	ANS: D	PTS:	1
20.	ANS: A	PTS:	1
21.	ANS: F	PTS:	1
22.	ANS: A	PTS:	1
23.	ANS: H	PTS:	1
24.	ANS: A	PTS:	1
25.	ANS: B	PTS:	1
26.	ANS: F	PTS:	1
27.	ANS: G	PTS:	1
28.	ANS: D	PTS:	1
29.	ANS: C	PTS:	1
30.	ANS: G	PTS:	1
31.	ANS: F	PTS:	1
32.	ANS: B	PTS:	1
33.	ANS: A	PTS:	1
34.	ANS: H	PTS:	1
35.	ANS: D	PTS:	1
36.	ANS: F	PTS:	1
37.	ANS: A	PTS:	1
38.	ANS: H	PTS:	1
39.	ANS: H	PTS:	1

40. ANS: H PTS: 1
41. ANS: H PTS: 1
42. ANS: C PTS: 1
43. ANS: G PTS: 1
44. ANS: E PTS: 1
45. ANS: D PTS: 1
46. ANS: F PTS: 1
47. ANS: E PTS: 1
48. ANS: E PTS: 1
49. ANS: D PTS: 1
50. ANS: E PTS: 1
51. ANS: E PTS: 1
52. ANS: C PTS: 1
53. ANS: C PTS: 1
54. ANS: E PTS: 1
55. ANS: E PTS: 1
56. ANS: A PTS: 1
57. ANS: H PTS: 1
58. ANS: C PTS: 1
59. ANS: D PTS: 1
60. ANS: G PTS: 1
61. ANS: E PTS: 1
62. ANS: E PTS: 1
63. ANS: A PTS: 1
64. ANS: E PTS: 1
65. ANS: C PTS: 1
66. ANS: D PTS: 1
67. ANS: C PTS: 1
68. ANS: G PTS: 1
69. ANS: F PTS: 1
70. ANS: B PTS: 1
71. ANS: G PTS: 1
72. ANS: D PTS: 1
73. ANS: F PTS: 1
74. ANS: H PTS: 1
75. ANS: D PTS: 1
76. ANS: D PTS: 1
77. ANS: F PTS: 1
78. ANS: G PTS: 1
79. ANS: F PTS: 1
80. ANS: B PTS: 1
81. ANS: H PTS: 1
82. ANS: D PTS: 1
83. ANS: C PTS: 1
84. ANS: E PTS: 1

85. ANS: H PTS: 1
86. ANS: C PTS: 1
87. ANS: C PTS: 1
88. ANS: E PTS: 1
89. ANS: B PTS: 1
90. ANS: B PTS: 1
91. ANS: E PTS: 1
92. ANS: C PTS: 1
93. ANS: G PTS: 1
94. ANS: G PTS: 1
95. ANS: B PTS: 1
96. ANS: F PTS: 1
97. ANS: D PTS: 1
98. ANS: F PTS: 1
99. ANS: G PTS: 1
100. ANS: F PTS: 1
101. ANS: F PTS: 1
102. ANS: H PTS: 1
103. ANS: B PTS: 1
104. ANS: A PTS: 1
105. ANS: H PTS: 1
106. ANS: A PTS: 1
107. ANS: D PTS: 1
108. ANS: A PTS: 1
109. ANS: E PTS: 1
110. ANS: B PTS: 1
111. ANS: F PTS: 1
112. ANS: E PTS: 1
113. ANS: D PTS: 1
114. ANS: B PTS: 1
115. ANS: D PTS: 1
116. ANS: F PTS: 1
117. ANS: B PTS: 1
118. ANS: A PTS: 1
119. ANS: E PTS: 1
120. ANS: D PTS: 1

SHORT ANSWER

121. ANS:
(a) $a_{10^3} \approx 0.905, a_{10^5} \approx 4.5 \times 10^{-5}$
(b) Converges to 0

PTS: 1

122. ANS:
(a) $b_{10^3} \approx 1.105, b_{10^5} \approx 22015$
(b) Diverges

PTS: 1
123. ANS:
For $|r| < 1$, $\lim_{n \to \infty} r^n = 0$

PTS: 1
124. ANS:
$x_1 = 1; x_2 = \frac{3}{2}; x_3 = \frac{17}{12}$

PTS: 1
125. ANS:
$L = \sqrt{2}$

PTS: 1
126. ANS:
(a) $a_1 = 1, a_2 = \frac{5}{2}, a_3 = \frac{13}{4}, a_4 = \frac{29}{8}$
(b) Use mathematical induction to show that the sequence is decreasing and bounded.
(c) 4

PTS: 1
127. ANS:
Diverges

PTS: 1
128. ANS:
Converges to 0

PTS: 1
129. ANS:
(a) $a_1 = 2, a_2 = 2, a_3 = 2, a_4 = 2$
(b) $a_n = 2$ for all $n \geq 1$.
(c) 2

PTS: 1
130. ANS:
Increasing

PTS: 1

131. ANS:
Not monotonic

PTS: 1

132. ANS:
Decreasing

PTS: 1

133. ANS:
$\lim_{n \to \infty} x_n = 3$

PTS: 1

134. ANS:
(a) $P_n = 18,000 * (0.95)^n$
(b) 0

PTS: 1

135. ANS:
(a) $P_n = 1000 * (1.02)^n$
(b) ∞

PTS: 1

136. ANS:
Boundedness does not imply the existence of the limit, for example: $a_n = (-1)^n$ is bounded, but the limit does not exist.

PTS: 1

137. ANS:
(a) $\frac{2}{3}, \frac{4}{9}, \frac{8}{27}, \frac{16}{81}, \frac{32}{243}$
(b) Converges to 0
(c) $\frac{2}{3}, \frac{2}{3}, \frac{2}{3}, \frac{2}{3}, \frac{2}{3}$
(d) Converges to $\frac{2}{3}$

PTS: 1

138. ANS:

(a) $-\frac{3}{4}, \frac{9}{16}, -\frac{27}{64}, \frac{81}{256}, -\frac{243}{1024}$

(b) Converges to 0

(c) $-\frac{3}{4}, -\frac{3}{4}, -\frac{3}{4}, -\frac{3}{4}, -\frac{3}{4}$

(d) Converges to $-\frac{3}{4}$

PTS: 1

139. ANS:

(a) $\frac{3}{2}, \frac{9}{4}, \frac{27}{8}, \frac{81}{16}, \frac{243}{32}$

(b) Diverges to ∞

(c) $\frac{3}{2}, \frac{3}{2}, \frac{3}{2}, \frac{3}{2}, \frac{3}{2}$

(d) Converges to $\frac{3}{2}$

PTS: 1

140. ANS:

(a) –1, 1, –1, 1, –1

(b) Does not exist

(c) –1, –1, –1, –1, –1

(d) Converges to –1

(e) –1, 0, –1, 0, –1

(f) Diverges

PTS: 1

141. ANS:

(a) $\left\{a_n = \frac{1}{2^n}\right\}_{n=2}^{\infty} \quad a_n \to 0$

(b) Converges to $\frac{1}{2}$

PTS: 1

142. ANS:
(a) $1, \frac{1}{2}, \frac{1}{3}, \frac{1}{4}, \frac{1}{5}$; $L_n = \frac{1}{n} \to 0$

(b) For any n, the region whose area is given by $\int_1^{n+1} (1/x)\,dx$ is completely contained in the union of rectangles whose area is given by b_n. So $b_n > \int_1^{n+1} (1/x)\,dx$.

(c) Since $\int_1^{\infty} (1/x)\,dx$ diverges, $\{b_n\}$ also diverges.

PTS: 1

143. ANS:
$B(n) = 1000\left(1 + \frac{3}{1000}\right)^n$

PTS: 1

144. ANS:
(a) $D(n) = 600\,(0.8)^n$
(b) About 4.9 hours
(c) About 10.3 hours

PTS: 1

145. ANS:
(a) $a_1 = \frac{1}{2}, a_2 = \frac{1}{5}, a_3 = \frac{3}{40}$
(b) 0

PTS: 1

146. ANS:
$\frac{1}{e^2}$

PTS: 1

147. ANS:
$\frac{2}{15}$

PTS: 1

148. ANS:
Diverges

PTS: 1

149. ANS:
Diverges

PTS: 1

150. ANS:
$S = \frac{13}{60}$

PTS: 1

151. ANS:
Diverges

PTS: 1

152. ANS:
Converges with sum $\frac{2}{3}$

PTS: 1

153. ANS:
The series converges and $\sum_{n=1}^{\infty} \frac{n}{(n+1)!} = \sum_{n=1}^{\infty} \left(\frac{1}{n!} - \frac{1}{(n+1)!} \right) = 1.$

PTS: 1

154. ANS:
Diverges

PTS: 1

155. ANS:
Converges with sum $\frac{1}{6}$

PTS: 1

156. ANS:
Diverges

PTS: 1

157. ANS:
Converges to ln 2

PTS: 1

158. ANS:
Converges to $\frac{5}{4}$

PTS: 1

159. ANS:

Since $\sum_{n=1}^{\infty} a_n$ converges, $\lim_{n \to \infty} a_n = 0 \Rightarrow \lim_{n \to \infty} \cos(a_n) = 1 \neq 0$. Thus by the Test for Divergence, $\sum_{n=1}^{\infty} \cos(a_n)$ diverges.

PTS: 1

160. ANS:
Converges to 9999

PTS: 1

161. ANS:
Diverges

PTS: 1

162. ANS:
Diverges by the Test for Divergence

PTS: 1

163. ANS:
$a = \dfrac{3 + \sqrt{21}}{2}$

PTS: 1

164. ANS:
Diverges

PTS: 1

165. ANS:
(a) True
(b) False. For example, $\frac{1}{n} \to 0$, but $\sum \frac{1}{n}$, diverges.
(c) True
(d) False. For example, $\sum_{n=0}^{\infty} (-1)^n$ and $\sum_{n=0}^{\infty} (-1)^{n+1}$ both diverge, but $\sum \left[(-1)^n + (-1)^{n+1} \right] = 0$, which is convergent.
(e) False. For example, $\sum \frac{1}{2^n}$ converges and $\frac{1}{n} \to 0$, but $\sum \left(\frac{1}{2^n} + \frac{1}{n} \right)$ diverges by part (c).

PTS: 1

166. ANS:

(a) $s_n \to 7$, which is the sum of $\sum_{k=1}^{\infty} a_k$.

(b) Since $\sum_{k=1}^{\infty} a_k$ converges, $a_k \to 0$.

(c) $\frac{699}{100}$

PTS: 1

167. ANS:

(a) $a_n \to \frac{1}{4}$

(b) $\sum a_n$ diverges by the Test for Divergence.

PTS: 1

168. ANS:

$\frac{307}{999}$

PTS: 1

169. ANS:

$\frac{213}{990}$

PTS: 1

170. ANS:

56 ft

PTS: 1

171. ANS:

About 9.849 s

PTS: 1

172. ANS:

1

PTS: 1

173. ANS:

(a) Divergent
(b) Divergent
(c) Convergent

PTS: 1

174. ANS:
(a) Divergent
(b) Divergent
(c) Convergent

PTS: 1

175. ANS:
$\frac{2}{3}$

PTS: 1

176. ANS:
$\frac{6}{11}$

PTS: 1

177. ANS:
Answers will vary.

PTS: 1

178. ANS:
Answers will vary.

PTS: 1

179. ANS:
The integral has a value of $\frac{1}{4}$. Since it is finite, the series converges.

PTS: 1

180. ANS:
Converges

PTS: 1

181. ANS:
Converges

PTS: 1

182. ANS:

Suppose that $p = 1$. Using the integral test with $\int_2^\infty \frac{dx}{x \ln k}$ gives $\lim_{l \to +\infty} (\ln(\ln x))_2^l = \infty$ and the series diverges.

If $p \neq 1$, then using the integral test with $\int_2^\infty \frac{dx}{x(\ln x)^p}$ gives $\lim_{l \to \infty} \left[\frac{(\ln x)^{1-p}}{1-p} \right]_2^l$. Since $\ln x \to \infty$ as $x \to \infty$, the convergence of the series depends on whether $\ln x$ is in the numerator or denominator of the limit above. If $p > 1$, the $\ln x$ is in the denominator and the series converges. If $p \leq 1$, the $\ln x$ is in the numerator and the series diverges. So we have convergence if $p > 1$ and divergence if $p \leq 1$.

PTS: 1

183. ANS:
Convergent

PTS: 1

184. ANS:
Converges

PTS: 1

185. ANS:
(a) Diverges
(b) Converges
(c) Diverges
(d) Converges
(e) Diverges
(f) Diverges
(g) Converges
(h) Diverges
(i) Diverges
(j) Diverges
(k) Converges

PTS: 1

186. ANS:

$\sum_{k=1}^{\infty} \frac{1}{k}$ diverges to ∞. Since $\ln k > 1$ for $k \geq 3$, we have (a) $\frac{\ln k}{k} > \frac{1}{k}$ and (b) $\frac{1}{k \ln k} < \frac{1}{k}$. From (a) we conclude that $\sum_{k=2}^{\infty} \frac{\ln k}{k}$ also diverges to ∞. However, nothing can be concluded from (b). The comparison test yields no useful information about the series $\sum_{k=2}^{\infty} \frac{1}{k \ln k}$.

PTS: 1

187. ANS:

It diverges by the Comparison Test: Because $\sum_{n=2}^{\infty} \frac{1}{n}$ diverges and $\frac{n^{1/n}}{\ln n} > \frac{1}{n}$ for all $n > 1$, the given series also diverges.

PTS: 1

188. ANS:

(a) $1 + \frac{1}{2^3} + \frac{1}{3^3} + \frac{1}{4^3} \approx 1.178$

(b) $R_4 \le \int_4^{\infty} \frac{1}{x^3}\, dx = \frac{1}{2(4)^2} = \frac{1}{32} < 0.032$

(c) Solve $\frac{1}{2(n)^2} < \frac{1}{1000} \Rightarrow n > 23.$

PTS: 1

189. ANS:

(a) $1 + \frac{1}{2^4} + \frac{1}{3^4} + \frac{1}{4^4} \approx 1.079$

(b) $R_4 \le \int_4^{\infty} \frac{1}{x^4}\, dx = \frac{1}{3(4)^3} = \frac{1}{192} < 0.00521$

(c) Solve $\frac{1}{3(n)^3} < \frac{1}{1000} \Rightarrow n > 7.$

PTS: 1

190. ANS:

(a) $1 + \frac{1}{2^5} + \frac{1}{3^5} + \frac{1}{4^5} \approx 1.0363$

(b) $R_4 \le \int_4^{\infty} \frac{1}{x^5}\, dx = \frac{1}{4(4)^4} = \frac{1}{1024} < 0.001$

(c) $n > 4.$

PTS: 1

191. ANS:

$S_{10} \approx 0.57819; R_{10} \le \frac{1}{3000} \approx 0.00034$. (Answers for R_{10} may vary.)

PTS: 1

192. ANS:

$\frac{1}{1^4+1} + \frac{1}{2^4+1} + \frac{1}{3^4+1} + \frac{1}{4^4+1} \approx 0.575$

PTS: 1

193. ANS:
$S_{10} \approx 0.99551; R_{10} \le \dfrac{1}{3(\ln 20)^3} \approx 0.0124$

PTS: 1

194. ANS:
Converges by the Alternating Series Test

PTS: 1

195. ANS:
Converges by the Alternating Series Test

PTS: 1

196. ANS:
Converges by the Alternating Series Test

PTS: 1

197. ANS:
Converges by the Alternating Series Test

PTS: 1

198. ANS:
Diverges by the Divergence Test

PTS: 1

199. ANS:
Diverges

PTS: 1

200. ANS:
Diverges

PTS: 1

201. ANS:

(c) is convergent by the Alternating Series Test, but not absolutely convergent since $\displaystyle\sum_{0}^{\infty}\left|\frac{(-1)^n}{\sqrt{n}}\right| = \sum_{n=1}^{\infty}\frac{1}{n^{1/2}}$ is a divergent *p*-series.

PTS: 1

202. ANS:
Convergent, but not absolutely convergent

PTS: 1

203. ANS:
Convergent, but not absolutely convergent

PTS: 1

204. ANS:
(b) About 0.958358
(c) $R_3 \le \frac{1}{12!} \approx 2\times 10^{-9}$

PTS: 1
205. ANS:
(b) About 0.17
(c) Overestimate
(d) $R_3 \le \frac{1}{64} \approx 0.016$

PTS: 1
206. ANS:
(b) About 0.21
(c) Underestimate
(d) $R_8 \le \frac{9}{82} \approx 0.11$

PTS: 1
207. ANS:
(b) About 0.81
(c) Overestimation
(d) $R_9 \le \frac{1}{19} \approx 0.053$

PTS: 1
208. ANS:
(b) $\frac{1}{n^4} < \frac{1}{1000} \Rightarrow n \ge 6 \Rightarrow$ At least 5 terms.
(c) $\sum_{n=1}^{\infty} (-1)^{n-1} \frac{1}{n^4} \approx 1 - \frac{1}{2^4} + \frac{1}{3^4} - \frac{1}{4^4} + \frac{1}{5^4} \approx 0.948$

PTS: 1
209. ANS:
(b) $\frac{n}{4^n} < \frac{2}{1000} = \frac{1}{500} \Rightarrow n \ge 6 \Rightarrow$ At least 5 terms.
(c) $\sum_{n=1}^{\infty} (-1)^{n} \frac{n}{4^n} \approx -\frac{1}{4} + \frac{2}{4^2} - \frac{3}{4^3} + \frac{4}{4^4} - \frac{5}{4^5} \approx -0.161$

PTS: 1

210. ANS:

(b) $\frac{1}{n^4+1} < \frac{1}{100} \Rightarrow n \geq 4 \Rightarrow$ At least 3 terms.

(c) $\sum_{n=1}^{\infty} (-1)^{n-1} \frac{1}{n^4+1} \approx \frac{1}{2} - \frac{1}{17} + \frac{1}{82} \approx 0.453$

PTS: 1

211. ANS:

(b) $\frac{1}{(2n)!} < \frac{1}{10000} \Rightarrow n \geq 4 \Rightarrow$ At least 4 terms.

(c) $\sum_{n=0}^{\infty} \frac{(-1)^n}{(2n)!} \approx 1 - \frac{1}{2} + \frac{1}{24} + \frac{1}{720} \approx 0.54028$

PTS: 1

212. ANS:

$n \geq 32$

PTS: 1

213. ANS:

$n \geq 24$

PTS: 1

214. ANS:

$\frac{a_{n+1}}{a_n} = \frac{6^{n+1}}{(n+1)!} \frac{n!}{6^n} = \frac{6}{(n+1)} \rightarrow 0 \therefore$ The series converges.

PTS: 1

215. ANS:

$\frac{a_{n+1}}{a_n} = \frac{6^{n+1}}{(n+1)^{100}} \frac{n^{100}}{6^n} = \frac{6n^{100}}{(n+1)^{100}} = 6\left(\frac{n}{n+1}\right)^{100} \rightarrow 6 \therefore$ The series diverges.

PTS: 1

216. ANS:

$\frac{a_{n+1}}{a_n} = \frac{(n+1)^{n+1}}{(n+1)!} \frac{n!}{n^n} = \left(\frac{n+1}{n}\right)^n \rightarrow e > 1 \therefore$ The series diverges.

PTS: 1

217. ANS:

$\frac{a_{n+1}}{a_n} = \frac{2 \cdot 5 \cdot 8 \cdot \ldots \cdot (3n-1)(3n+2)}{6^{n+1}(n+1)!} \frac{6^n n!}{2 \cdot 5 \cdot 8 \cdot \ldots \cdot (3n-1)} = \frac{3n+2}{6(n+1)} \rightarrow \frac{1}{2} \therefore$ The series converges

PTS: 1

218. ANS:
$$\frac{a_{n+1}}{a_n} = \frac{2\cdot 5\cdot 8\cdot\ldots\cdot(3n-1)(3n+2)}{2^{n+1}(n+1)!}\,\frac{2^n n!}{2\cdot 5\cdot 8\cdot\ldots\cdot(3n-1)} = \frac{3n+2}{2(n+1)} \to \frac{3}{2}$$ ∴ The series diverges.

PTS: 1

219. ANS:
$$\sqrt[n]{a_n} = \frac{3n-1}{4n+1} \to \frac{3}{4} < 1$$ ∴ The series converges.

PTS: 1

220. ANS:
$$\sqrt[n]{a_n} = \frac{n}{\ln n} \to \infty$$ ∴ The series diverges.

PTS: 1

221. ANS:
(a) Converges (b) Diverges (c) Converges (d) Converges (e) Converges

(f) Converges (g) Diverges (h) Converges (i) Converges (j) Diverges

(k) Converges (l) Diverges (m) Converges (n) Converges

PTS: 1

222. ANS:
$[-1,1]$

PTS: 1

223. ANS:
$[-2,2)$

PTS: 1

224. ANS:
$(1,3]$

PTS: 1

225. ANS:
(a) $r = 1$
(b) for $x = 1$, converges conditionally; for $x = -1$, diverges

PTS: 1

226. ANS:
$$\frac{-1}{e} \le x < \frac{1}{e}$$

PTS: 1

227. ANS:
$(-2,8]$

PTS: 1

228. ANS:
(a) Inconclusive
(b) Convergent
(c) Inconclusive

PTS: 1

229. ANS:
(a) Convergent
(b) Convergent
(c) Inconclusive

PTS: 1

230. ANS:
$0 < x \leq 6$

PTS: 1

231. ANS:
$r = \infty$; that is, the series converges for all real x.

PTS: 1

232. ANS:
$\frac{1}{3}$

PTS: 1

233. ANS:
∞

PTS: 1

234. ANS:
0

PTS: 1

235. ANS:
There are many such series. One is $\sum_{n=1}^{\infty} \frac{(x-1)^n}{4^n n^2}$.

PTS: 1

236. ANS:

There are many such series. One is $\sum_{n=1}^{\infty} \frac{(x-1)^n}{4^n n}$.

PTS: 1

237. ANS:

There are many such series. One is $\sum_{n=1}^{\infty} \frac{n(x-1)^n}{4^n}$.

PTS: 1

238. ANS:

There are many such series. One is $\sum_{n=1}^{\infty} \frac{(-1)^n (x-1)^n}{4^n n}$.

PTS: 1

239. ANS:

There are many such series. One is $\sum_{n=1}^{\infty} \frac{(x-4)^n}{n^2}$

PTS: 1

240. ANS:

There are many such series. One is $\sum_{n=1}^{\infty} \frac{(x-4)^n}{n}$

PTS: 1

241. ANS:

There are many such series. One is $\sum_{n=1}^{\infty} (x-4)^n$

PTS: 1

242. ANS:

There are many such series. One is $\sum_{n=1}^{\infty} \frac{(-1)^n (x-4)^n}{n}$.

PTS: 1