9.1 Power Series

Infinite Series $\sum_{k=1}^{\infty} a_k$

to find the sum of an infinite series - we look at the partial sums

Partial Sums

$S_1 = a_1$

$S_2 = a_1 + a_2$

$S_3 = a_1 + a_2 + a_3$

$S_n = \sum_{k=1}^{n} a_k$

what if the partial sums have a finite limit?

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Does the series converge or diverge?

$1 + 1.1 + 1.11 + 1.111 + \ldots$

$5 + .5 + .05 + .005 + \ldots$

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Infinite Geometric Series

$$\sum_{n=1}^{\infty} ar^{n-1} = a + ar + ar^2 + ar^3 + ...$$

When do geometric series converge?

What is the interval of convergence?

What is the sum?

$$\sum_{n=1}^{\infty} ar^{n-1} = a + ar + ar^2 + ar^3 + ... =$$

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Tell whether each series converges or diverges. If it converges, give its sum.

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

$$1 - \frac{1}{2} + \frac{1}{4} - \frac{1}{8} + ...$$

$$\sum_{k=0}^{\infty} \left(\frac{3}{5}\right)^{k}$$

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

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Test for Divergence:

If $\lim_{n\to\infty} a_n \neq 0$ or DNE then the series diverges.

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

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

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Find the function that is equal to (models) the series. Support graphically.

$$1 + x + x^2 + x^3 + ... + x^n + ...$$

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Power Series: series equivalent to a known function on a given interval

centered at $x = 0$: $\sum_{n=0}^{\infty} c_n x^n$

centered at $x = a$: $\sum_{n=0}^{\infty} c_n (x-a)^n$

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Find the power series for the following functions:

$$f(x) = \frac{1}{1+x}$$

$$f(x) = \frac{1}{x}$$

hint: $\frac{1}{x} = \frac{1}{1+(x-1)}$

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Differentiate the power series for $\frac{1}{1-x}$

What function equals this new power series?

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Use the power series for $\frac{1}{1+x}$ to find a power series for $\ln(1+x)$

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Find a power series for $\frac{1}{1+x^2}$ and use it to find a series for

$\tan^{-1} x$

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