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## Geometric Series: Sum to infinity example

The 2<sup>nd</sup> term of a geometric series is 5 and its sum to infinity is 20.  
Find the common ratio 'r' and the first term 'a'.

$$ar = 5 \quad \textcircled{1}$$

$$\frac{a}{1-r} = 20$$

$$\therefore a = 20(1-r) \quad \textcircled{2}$$

Sub.  $\textcircled{2}$  into  $\textcircled{1}$

$$\therefore 20r(1-r) = 5$$

$$\therefore 4r(1-r) = 1$$

$$\therefore 4r - 4r^2 = 1$$

$$\therefore 4r^2 - 4r + 1 = 0$$

$$\therefore (2r-1)(2r-1) = 0$$

$$\therefore 2r-1 = 0$$

$$\therefore r = \frac{1}{2}$$

Sub. in  $\textcircled{2}$

$$a = 20\left(\frac{1}{2}\right)$$

$$\therefore a = 10$$

$$n^{\text{th}} \text{ term} = ar^{n-1}$$

$$S_{\infty} = \frac{a}{1-r}$$

$$10 + 5 + \frac{5}{2} + \frac{5}{4} + \frac{5}{8} + \frac{5}{16} + \frac{5}{32}$$

$$= 19.84375$$

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