

Series Sum Sprint

Find finite geometric sums with a formula you can derive.

HIGH SCHOOL • HSA-SSE.B.4

CCSS.Math.Content.HSA-SSE.B.4 "Derive the formula for the sum of a finite geometric series (when the common ratio is not 1), and use the formula to solve problems. For example, calculate mortgage payments. *"

NAME _____

DATE _____

THE BIG IDEA

For a finite geometric series with first term a and common ratio r , where r is not 1, use $S_n = a(1 - r^n)/(1 - r)$. You can derive this rule by multiplying the sum by r and subtracting, which makes the middle terms cancel. Then use the first term, ratio, and number of terms to find the total.

WORKED EXAMPLE

Find the sum: $8 + 40 + 200$

1. The first term is $a = 8$, the ratio is $r = 5$, and there are $n = 3$ terms.
2. $S_3 = 8(1 - 5^3)/(1 - 5)$
3. $S_3 = 8(-124)/(-4) = 248$

Answer: 248

PRACTICE 6 problems

1 Find the sum: $6 + 12 + 24 + 48 + 96 + 192$

ANSWER _____

2 Find the sum: $15 + 30 + 60 + 120 + 240 + 480$

ANSWER _____

3 Find the sum: $216 + 36 + 6$

ANSWER _____

4 Find the sum: $17 - 34 + 68 - 136 + 272 - 544$

ANSWER _____

5 Find the sum of the first six terms of the geometric sequence 13, 26, 52, ...

ANSWER _____

6 Find the sum of the first six terms of a geometric sequence with $a = 2048$ and $r = 1/2$.

ANSWER _____

APPLY IT Show your work

- 1** A band's new video gets 9 comments in its first hour. For each of the next five hours, it gets twice as many comments as in the hour before. How many comments does it get during all six hours?

WORK SPACE

ANSWER _____

- 2** In a puzzle game, a bonus chest gives 672 coins on the first level. Each next level gives half as many coins as the level before. How many coins are in the first six chests?

WORK SPACE

ANSWER _____

CHALLENGE One step up

CHALLENGE

For $S_n = a + ar + ar^2 + \dots + ar^{(n-1)}$, explain in exactly two sentences how subtracting rS_n from S_n leads to the formula for S_n when $r \neq 1$.

PART 1 • PRACTICE

#	PROBLEM	ANSWER
1	Find the sum: $6 + 12 + 24 + 48 + 96 + 192$	378
2	Find the sum: $15 + 30 + 60 + 120 + 240 + 480$	945
3	Find the sum: $216 + 36 + 6$	258
4	Find the sum: $17 - 34 + 68 - 136 + 272 - 544$	-357
5	Find the sum of the first six terms of the geometric sequence 13, 26, 52, ...	819
6	Find the sum of the first six terms of a geometric sequence with $a = 2048$ and $r = 1/2$.	4032

PART 2 • APPLY IT

1. **567 comments** Use $a = 9$, $r = 2$, and $n = 6$. The total is $9(1 - 2^6)/(1 - 2) = 567$.
2. **1323 coins** Use $a = 672$, $r = 1/2$, and $n = 6$. Adding the six geometric terms gives 1323.

CHALLENGE

After subtracting, all middle terms cancel, so $S_n - rS_n = a - ar^n$. Factoring gives $S_n(1 - r) = a(1 - r^n)$, so $S_n = a(1 - r^n)/(1 - r)$.

Accept the equivalent formula $S_n = a(r^n - 1)/(r - 1)$. Accept correct simplified fractions or decimals when they represent the same sum.