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Algebra II

$$S_n = \frac{a_1 - a_1(r)^n}{1-r}$$

Modeling Series

1. Your parents want you to do some work around the house. You get them to agree to pay you \$.01 on the first day, \$.02 on the second day, \$.04 on the third day, and so on. $a_1 = .01$
Write a geometric series formula, S_n , for your total earnings over n days. $r = 2$

$$S_n = \frac{a_1 - a_1(r)^n}{1-r}$$

$$S_n = \frac{.01 - .01(2)^n}{1-2}$$

At the end of the 30-day month, how much money will your parents have paid you, to the nearest cent?

$$S_{30} = \frac{.01 - .01(2)^{30}}{1-2}$$

$$S_{30} = 10,737,418.23$$

2. This year, public parks in New York State will receive funds of \$2.4 million. Every year afterward, New York State park funding will be improved by 3%. Write a geometric series formula to represent how much funding New York State parks will receive in n years. Use your expression to determine the total amount of money, to the nearest million dollars, New York State parks will receive in funding for the first eight years.

$$a_1 = 2.4$$

$$r = 1.03$$

$$S_n = \frac{a_1 - a_1(r)^n}{1-r}$$

$$S_8 = \frac{2.4 - 2.4(1.03)^8}{1-1.03}$$

$$S_n = \frac{2.4 - 2.4(1.03)^n}{1-1.03}$$

$$S_8 = 21 \text{ million dollars}$$

3. The men's U.S. Open tennis tournament is held annually in Flushing Meadow in NYC. In the first round of the tournament, 64 matches are played. In each successive round, the number of matches played decreases by one half until the final match is played. If there are seven rounds in the tournament, how many total matches will be played?

$$\rightarrow 1 - \frac{1}{2} = \frac{1}{2}$$

$$S_n = \frac{a_1 - a_1(r)^n}{1-r}$$

$$a_1 = 64$$

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

$$n = 7$$

$$S_7 = \frac{64 - 64(\frac{1}{2})^7}{1 - \frac{1}{2}}$$

$$S_7 = 127$$

~~$$S_7 = 127$$~~

4. Alexa earns $\$33,000$ in her first year of teaching and earns a 4% increase in each successive year. Write a geometric series formula, S_n , for Alexa's total earnings over n years. Use this formula to find Alexa's total earnings for her first 15 years of teaching, to the nearest cent.

$$S_n = \frac{a_1 - a_1(r)^n}{1-r}$$

$$S_{15} = \frac{33,000 - 33,000(1.04)^{15}}{1-1.04} \quad \begin{array}{l} a_1 = 33,000 \\ r = 1.04 \end{array}$$

$$S_n = \frac{33,000 - 33,000(1.04)^n}{1-1.04}$$

$$S_{15} = 660,778.39$$

5. Ross has a hobby of collecting comic books. He currently has 50 comic books and each year, he will increase his collection by 15%. Write a geometric series formula for the amount of comic books Ross will have after n years. Use this formula to approximate how many comic books Ross will have 12 years from now.

$$S_n = \frac{a_1 - a_1(r)^n}{1-r}$$

$$S_{12} = \frac{50 - 50(1.15)^{12}}{1-1.15} \quad \begin{array}{l} a_1 = 50 \\ r = 1.15 \end{array}$$

$$S_n = \frac{50 - 50(1.15)^n}{1-1.15}$$

$$S_{12} \approx 1450$$

6. Dee is planning on decreasing the amount of time she eats fast food per month. After the first month, she ate fast food 42 times. Each month, she eats at fast food restaurants 10% less than the previous month. How many times does she eat fast food in the first four months? Round your answer to the nearest integer.

$$S_n = \frac{a_1 - a_1(r)^n}{1-r}$$

$$a_1 = 42$$

$$r = 0.9$$

$$n = 4$$

$$S_4 = \frac{42 - 42(0.9)^4}{1-0.9}$$

$$S_4 \approx 144$$

$$1 - .08 = .92$$

a_1

7. A fisherman harvests 350 kilograms of crab on Monday. From Monday to Friday, the fisherman harvests 8% less kilograms of crab per day. To the nearest tenth of a kilogram, what is the total amount of crab harvested between Monday and Friday?

$$S_n = \frac{a_1 - a_1(r)^n}{1-r}$$

$$S_5 = \frac{350 - 350(.92)^5}{1 - .92}$$

$$a_1 = 350$$

$$r = .92$$

$$n = 5$$

$$S_5 = 1491.5$$

a_1

$$1 + .025$$

$$1.025$$

8. Kina earns a \$27,000 salary for the first year of work at her job. She earns annual increases of 2.5%. What is the total amount, to the nearest cent, that Kina will earn for the first eight years at this job?

$$S_n = \frac{a_1 - a_1(r)^n}{1-r}$$

$$a_1 = 27,000$$

$$r = 1.025$$

$$n = 8$$

$$S_8 = \frac{27,000 - 27,000(1.025)^8}{1 - 1.025}$$

$$S_8 = 235,875.13$$

$$1 + .1 = 1.1$$

9. Kristin wants to increase her running endurance. According to experts, a gradual mileage increase of 10% per week can reduce the risk of injury. If Kristin runs 8 miles in week one, which expression can help her find the total number of miles she will have run over the course of her 6-week training program?

1) $\sum_{x=1}^6 8(1.10)^{x-1}$

2) $\sum_{x=1}^6 8(1.10)^x$

3) $\frac{8 - 8(1.10)^6}{0.90}$

4) $\frac{8 - 8(0.10)^x}{1.10}$

$$\sum_{n=1}^6 a_1(r)^{n-1}$$

$$\sum_{n=1}^6 8(1.1)^{n-1}$$

$$S_n = \frac{a_1 - a_1(r)^n}{1-r}$$

$$a_1 = 8$$

$$r = 1.1$$

$$n = 6$$

$$S_6 = \frac{8 - 8(1.1)^6}{1 - 1.1}$$

$$a_1 = 8$$

$$1 + .25$$

$$1.25$$

10. In his first year running track, Usain earned 8 medals. He increases his amount of medals by 25% each year. Which of the following expressions cannot be used to determine how many medals Usain will have after four years of high school?

1) $\frac{8 - 8(1.25)^4}{-.25}$ ✓

$$n = 4$$

3) $\sum_{n=1}^4 8(1.25)^{n-1}$ ✓

2) $8(1.25)^0 + 8(1.25)^1 + 8(1.25)^2 + 8(1.25)^3$ ✓

4) $\frac{8 - 8(.25)^4}{1 - .25}$ ✗

$$\sum_{n=1}^4 a_1(r)^{n-1}$$

$$a_1 = 8$$

$$r = 1.25$$

$$n = 4$$

$$\sum_{n=1}^4 8(1.25)^{n-1}$$

$$S_n = \frac{a_1 - a_1(r)^n}{1-r}$$

$$S_4 = \frac{8 - 8(1.25)^4}{1 - 1.25}$$

11. Jake wants to buy a car and hopes to save at least \$5000 for a down payment. The table below summarizes the amount of money he plans to save each week.

Week	1	2	3	4	5
Money Saved, in Dollars	2	5	12.5	31.25	...

Based on this plan, which expression should he use to determine how much he has saved in n weeks?

$a_1 = 2$
 $r = 2.5$
① $\frac{2 - 2(2.5)^n}{1 - 2.5}$

$$S_n = \frac{a_1 - a_1(r)^n}{1 - r}$$

3) $\frac{1 - 2.5^n}{1 - 2.5}$

$\frac{5}{2} = 2.5$
 $r = 2.5$

2) $\frac{2 - 2(2.5^{n-1})}{1 - 2.5}$

$$S_n = \frac{2 - 2(2.5)^n}{1 - 2.5}$$

4) $\frac{1 - 2.5^{n-1}}{1 - 2.5}$

$\frac{12.5}{5} = 2.5$

$a_1 = .01$

12. Brian deposited 1 cent into an empty non-interest bearing bank account on the first day of the month. He then additionally deposited 3 cents on the second day, 9 cents on the third day, and 27 cents on the fourth day. What would be the total amount of money in the account at the end of the 20th day if the pattern continued?

1) \$11,622,614.67

3) \$116,226,146.80

$$S_n = \frac{a_1 - a_1(r)^n}{1 - r}$$

$a_1 = .01$
 $r = 3$
 $n = 20$

② \$17,433,922.00

4) \$1,743,392,200.00

$$S_{20} = \frac{.01 - .01(3)^{20}}{1 - 3}$$

$\frac{3}{1} = 3$
 $\frac{9}{3} = 3$
 $r = 3$

$S_{20} = 17433922.00$

13. A ball is dropped from a height of 32 feet. It bounces and rebounds 80% of the height from which it was falling. What is the total downward distance, in feet, the ball traveled up to the 12th bounce?

1) 29

3) 120

$$S_n = \frac{a_1 - a_1(r)^n}{1 - r}$$

n

2) 58

④ 149

$$S_{12} = \frac{32 - 32(.8)^{12}}{1 - .8}$$

$a_1 = 32$
 $r = .8$
 $n = 12$

$S_{12} = 149$

14. Jasmine decides to put \$100 in a savings account each month. The account pays 3% annual interest, compounded monthly. How much money, S , will Jasmine have after one year?

1) $S = 100(1.03)^{12}$

3) $S = 100(1.0025)^{12}$

2) $S = \frac{100 - 100(1.0025)^{12}}{1 - 1.0025}$

4) $S = \frac{100 - 100(1.03)^{12}}{1 - 1.03}$