Geometric Series - Past Edexcel Exam Questions

1. The second and fourth terms of a geometric series are 7.2 and 5.832 respectively.
   The common ratio of the series is positive.
   For this series, find

   (a) the common ratio, [2]

   (b) the first term, [2]

   (c) the sum of the first 50 terms, giving your answer to 3 decimal places, [2]

   (d) the difference between the sum to infinity and the sum of first 50 terms, giving your answer to 3 decimal places. [2]

Question 6 - Jan 2005

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2. (a) A geometric series has first term a and common ratio r. Prove that the sum of the first n terms of the series is

$$\frac{a\left(1-r^n\right)}{1-r}$$

[4]

Mr King will be paid a salary of £35,000 in the year 2005. Mr King's contract promises a 4% increase in salary every year, the first increase being given in 2006, so that his annual salaries form a geometric sequence.

(b) Find, to the nearest £100, Mr King's salary in the year 2008. [2]

Mr King will receive a salary each year from 2005 until he retires at the end of 2024.

(c) Find, to the nearest £1000, the total amount of salary he will receive in the period from 2005 until he retires at the end of 2024. [4]

Question 9 - Jun 2005

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3. The first term of a geometric series is 120. The sum to infinity of the series is 480.

   (a) Show that the common ratio, r, is $\frac{3}{4}$. [3]

(b) Find, to 2 decimal places, the difference between the 5th and 6th terms. [2]

(c) Calculate the sum of the first 7 terms. [2]

The sum of the first n terms is greater than 300.

(d) Calculate the smallest possible value of n. [4]

Question 4 - Jan 2006

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4. A geometric series has first term a and common ratio r. The second term of the series is 4 and the sum to infinity of the series is 25.

(a) Show that $25r^2 - 25r + 4 = 0$. [4]

(b) Find the two possible values of r. [2]

(c) Find the corresponding two possible values of a. [2]

(d) Show that the sum, S_n, of the first n terms of the series is given by

$$S_n = 25\left(1 - r^n\right)$$

[1]

Given that r takes the larger of its two possible values,

(e) find the smallest value of n for which S_n exceeds 24. [2]

Question 9 - May 2006

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5. A geometric series is $a + ar + ar^2 + ...$

(a) Prove that the sum of the first n terms of this series is given by

$$S_n = \frac{a\left(1 - r^n\right)}{1 - r}$$

[4]

(b) Find

$$\sum_{k=1}^{10} 100\left(2^k\right).$$

[3]

(c) Find the sum to infinity of the geometric series

$$\frac{5}{6} + \frac{5}{18} + \frac{5}{54} + ...$$

[3]

(d) State the condition for an infinite geometric series with common ratio r to be convergent. [1]

Question 10 - Jan 2007

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6. A trading company made a profit of £50,000 in 2006 (Year 1).

A model for future trading predicts that profits will increase year by year in a geometric sequence with common ratio r, $r > 1$.

The model therefore predicts that in 2007 (Year 2) a profit of £50000r will be made.

(a) Write down an expression for the predicted profit in Year n. [1]

The model predicts that in Year n, the profit made will exceed £200,000.

(b) Show that $n > \frac{\log 4}{\log r} + 1$. [3]

Using the model with $r = 1.09$,

(c) find the year in which the profit made will exceed £200,000. [2]

(d) find the total of the profits that will be made by the company over the 10 years from 2006 to 2015 inclusive, giving your answer to the nearest £10,000. [3]

Question 8 - May 2007

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7. The fourth term of a geometric series is 10 and the seventh term of the series is 80. For this series, find

(a) the common ratio, [2]

(b) the first term, [2]

(c) the sum of the first 20 terms, giving your answer to the nearest whole number.
. [2]

Question 2 - Jan 2008

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8. A geometric series has first term 5 and common ratio $\frac{4}{5}$.

   Calculate

   (a) the 20th term of the series, to 3 decimal places, [2]

   (b) the sum to infinity of the series. [2]

   Given that the sum to k terms of the series is greater than 24.95,

   (c) show that $k > \frac{\log 0.002}{\log 0.8}$, [4]

   (d) find the smallest possible value of k. [1]

Question 6 - Jun 2008

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9. The first three terms of a geometric series are $(k + 4)$, k and $(2k - 15)$, where k is a positive constant.

   (a) Show that $k^2 - 7k - 60 = 0$. [4]

   (b) Hence show that $k = 12$. [2]

   (c) Find the common ratio of this series. [2]

   (d) Find the sum to infinity of this series. [2]

Question 9 - Jan 2009

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10. The third term of a geometric sequence is 324 and the sixth term is 96.

    (a) Show that the common ratio of the sequence is $\frac{2}{3}$. [2]

    (b) Find the first term of the sequence. [2]

    (c) Find the sum of the first 15 terms of the sequence. [3]

    (d) Find the sum to infinity of the sequence. [2]

Question 5 - Jun 2009

11. A car was purchased for £18,000 on 1st January.

    On 1st January each following year, the value of the car is 80% of its value on 1st January in the previous year.

    (a) Show that the value of the car exactly 3 years after it was purchased is £9216. . [1]

    The value of the car falls below £1000 for the first time n years after it was purchased.

    (b) Find the value of n. [3]

    An insurance company has a scheme to cover the cost of maintenance of the car. The cost is £200 for the first year, and for every following year the cost increases by 12% so that for the third year the cost of the scheme is £250.88.

    (c) Find the cost of the scheme for the 5th year, giving your answer to the nearest penny. [2]

    (d) Find the total cost of the insurance scheme for the first 15 years. [3]

Question 6 - Jan 2010

12. The adult population of a town is 25,000 at the end of Year 1.

    A model predicts that the adult population of the town will increase by 3% each year, forming a geometric sequence.

    (a) Show that the predicted adult population at the end of Year 2 is 25,750. [1]

    (b) Write down the common ratio of the geometric sequence. [1]

    The model predicts that Year N will be the first year in which the adult population of the town exceeds 40,000.

    (c) Show that

$$(N-1)\log 1.03 > \log 1.6$$

[3]

(d) Find the value of N. [2]

At the end of each year, each member of the adult population of the town will give £1 to a charity fund.

Assuming the population model,

(e) find the total amount that will be given to the charity fund for the 10 years from the end of Year 1 to the end of Year 10, giving your answer to the nearest £1000.
. [3]

Question 9 - Jun 2010

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13. The second and fifth term of a geometric series are 750 and -6 respectively.

Find

(a) the common ratio, [3]

(b) the first term of the series, [2]

(c) the sum to infinity of the series. [2]

Question 3 - Jan 2011

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14. The second and third terms of a geometric series are 192 and 144 respectively.

For this series, find

(a) the common ratio, [2]

(b) the first term, [2]

(c) the sum to infinity, [2]

(d) the smallest value of n for which the sum of the first n terms of the series exceeds 1000. [4]

Question 6 - May 2011

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15. A geometric series has first term $a = 360$ and common ratio $r = \frac{7}{8}$.

Giving your answers to 3 significant figures where appropriate, find

(a) the 20th term of the series, [2]

(b) the sum of the first 20 terms of the series, [2]

(c) the sum to infinity of the series. [2]

Question 1 - Jan 2012

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16. A geometric series is $a + ar + ar^2 + ...$

(a) Prove that the sum of the first n terms of this series is given by

$$S_n = \frac{a\left(1 - r^n\right)}{1 - r}$$

[4]

The third and fifth terms of a geometric series are 5.4 and 1.944 respectively and all the terms in the series are positive.

For this series find,

(b) the common ratio, [2]

(c) the first term, [2]

(d) the sum to infinity. [3]

Question 9 - May 2012

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17. A company predicts a yearly profit of £120,000 in the year 2013. The company predicts that the yearly profit will rise each year by 5%. The predicted yearly profit forms a geometric sequence with common ratio 1.05.

(a) Show that the predicted profit in the year 2016 is £138,915. [1]

(b) Find the first year in which the yearly predicted profit exceeds £200,000. [5]

(c) Find the total predicted profit for the years 2013 to 2023 inclusive, giving your answer to the nearest pound. [3]

Question 3 - Jan 2013

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18. The first three terms of a geometric series are $4p$, $(3p + 15)$ and $(5p + 20)$ respectively, where p is a **positive** constant.

    (a) Show that $11p^2 - 10p - 225 = 0$. [4]

    (b) Hence show that $p = 5$. [2]

    (c) Find the common ratio of this series. [2]

    (d) Find the sum of the first ten terms of the series, giving your answer to the nearest integer. [3]

Question 5 - Jun 2013

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19. The first term of a geometric series is 20 and the common ratio is $\frac{7}{8}$.

    The sum to infinity of the series is S_∞

    (a) Find the value of S_∞. [2]

    The sum to N terms of the series is S_N.

    (b) Find, to 1 decimal place, the value of S_{12}. [2]

    (c) Find the smallest value of N, for which

$$S_\infty - S_N < 0.5$$

[4]

. **Question 6 - Jun 2014**

Solutions

1. (a) $r = \frac{9}{10}$
   (b) $a = 8$
   (c) $S_{50} = 79.588$
   (d) 0.412
2. (a) -
   (b) £39,400
   (c) $S_{20} = £1,042,000$
3. (a) -
   (b) 9.49
   (c) $S_7 = 415.93$
   (d) $n = 4$
4. (a) -
   (b) $r = \frac{1}{5}$, $r = \frac{4}{5}$
   (c) $a = 20$, $a = 5$
   (d) -
   (e) $n = 15$
5. (a) -
   (b) $S_{10} = 204,600$
   (c) $S_\infty = \frac{5}{4}$
   (d) $|r| < 1$
6. (a) $U_n = 50000r^{n-1}$
   (b) -
   (c) 2023
   (d) $£760,000$
7. (a) $r = 2$
   (b) $a = \frac{5}{4}$
   (c) $S_{20} = 1,310,719$

8. (a) $U_{20} = 0.072$
   (b) $S_\infty = 25$
   (c) -
   (d) $k = 28$
9. (a) -
   (b) -
   (c) $r = \frac{3}{4}$
   (d) $S_\infty = 64$
10. (a) -
    (b) $a = 729$
    (c) $S_{15} = 2179.51$
    (d) $S_\infty = 2187$
11. (a) -
    (b) $n = 13$
    (c) £314.70
    (d) £7455.94
12. (a) -
    (b) $r = 1.03$
    (c) -
    (d) $N = 17$
    (e) $S_{10} = £287,000$
13. (a) $r = -\frac{1}{5}$
    (b) $a = -3750$
    (c) $S_\infty = -3125$
14. (a) $r = \frac{3}{4}$
    (b) $a = 256$
    (c) $S_\infty = 1024$
    (d) $n = 14$
15. (a) $U_{20} = 28.5$

(b) $S_{20} = 2680$

(c) $S_\infty = 2880$

16. (a) -

(b) $r = \frac{3}{5}$

(c) $a = 15$

(d) $S_\infty = 37.5$

17. (a) -

(b) 2024

(c) $S_{21} = £1,704,814$

18. (a) -

(b) -

(c) $r = \frac{3}{2}$

(d) $S_\infty = 2267$

19. (a) $S_\infty = 160$

(b) $S_{12} = 127.8$

(c) $n = 44$