MATHSAURUS

A Level Mathematics Year 2 Exam Questions by Topic
Chapter 3: Sequences and series

These questions are taken from the Specimen Exam materials and the real 2018 papers for the new syllabus AS and A-level mathematics courses and arranged by chapter of the textbooks by Goldie et al (available here: `https://amzn.to/39umfr5` and `https://amzn.to/3hE8kBL`). There are a mixture of questions from OCR A, OCR B (MEI), Edexcel and AQA. Although the style of questions varies a little across the exam boards the content of the syllabus is almost identical so these are suitable for students preparing for any exam board.

Free problem sets for all other chapters, as well as video solutions, full past papers and other content for GCSE and A-level maths can be found at:

`https://mathsaurus.com/`

Edexcel Sample Paper 2 Question 10:

10. In a geometric series the common ratio is r and sum to n terms is S_n

Given

$$S_\infty = \frac{8}{7} \times S_6$$

show that $r = \pm\frac{1}{\sqrt{k}}$, where k is an integer to be found.

(4)

OCR A 2018 Paper 1 Question 7:

7 Chris runs half marathons, and is following a training programme to improve his times. His time for his first half marathon is 150 minutes. His time for his second half marathon is 147 minutes. Chris believes that his times can be modelled by a geometric progression.

(i) Chris sets himself a target of completing a half marathon in less than 120 minutes. Show that this model predicts that Chris will achieve his target on his thirteenth half marathon. **[4]**

(ii) After twelve months Chris has spent a total of 2974 minutes, to the nearest minute, running half marathons. Use this model to find how many half marathons he has run. **[3]**

(iii) Give two reasons why this model may not be appropriate when predicting the time for a half marathon. **[2]**

OCR A Sample Paper 1 Question 7:

7 Firm A made a £5000 profit during its first year. In each subsequent year, the profit increased by £1500 so that the profit was £6500 during the second year, £8000 during the third year and so on.

Firm B made a £5000 profit during its first year. In each subsequent year, the profit was 90% of the previous year's profit.

(i) Find an expression, in its simplest form, for the total profit made by firm A during the first n years. **[2]**

(ii) Find an expression, in its simplest form, for the total profit made by firm B during the first n years. **[3]**

(iii) Find how many years it will take for the total profit of firm A to reach £385 000. **[3]**

(iv) Comment on the profits made by each firm in the long term. **[2]**

OCR B MEI 2018 Paper 1 Question 6:

6 Aleela and Baraka are saving to buy a car. Aleela saves £50 in the first month. She increases the amount she saves by £20 each month.

(i) Calculate how much she saves in two years. **[2]**

Baraka also saves £50 in the first month. The amount he saves each month is 12% more than the amount he saved in the previous month.

(ii) Explain why the amounts Baraka saves each month form a geometric sequence. **[1]**

(iii) Determine whether Baraka saves more in two years than Aleela. **[3]**

OCR B MEI Sample Paper 1 Question 2:

2 A geometric series has first term 3. The sum to infinity of the series is 8. Find the common ratio. **[3]**

OCR B MEI Sample Paper 3 Question 4:

4 Show that $\sum_{r=1}^{4} \ln \frac{r}{r+1} = -\ln 5$. **[3]**

AQA 2018 Paper 1 Question 3:

3 A periodic sequence is defined by $U_n = \sin\left(\frac{n\pi}{2}\right)$

State the period of this sequence.

Circle your answer.

[1 mark]

8 2π 4 π

AQA 2018 Paper 1 Question 9:

9 An arithmetic sequence has first term a and common difference d.

The sum of the first 36 terms of the sequence is equal to the square of the sum of the first 6 terms.

9 (a) Show that $4a + 70d = 4a^2 + 20ad + 25d^2$

[4 marks]

9 (b) Given that the sixth term of the sequence is 25, find the smallest possible value of a.

[5 marks]

Edexcel 2018 Paper 2 Question 4:

4. (i) Show that $\sum_{r=1}^{16}(3 + 5r + 2^r) = 131\,798$

(4)

(ii) A sequence $u_1, u_2, u_3, \ldots$ is defined by

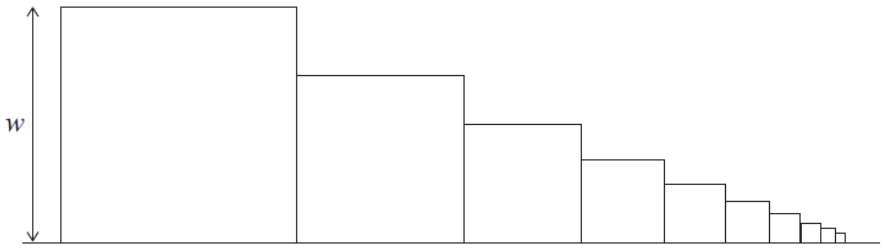
$$u_{n+1} = \frac{1}{u_n}, \quad u_1 = \frac{2}{3}$$

Find the exact value of $\sum_{r=1}^{100} u_r$

(3)

AQA 2018 Paper 3 Question 9:

9 Helen is creating a mosaic pattern by placing square tiles next to each other along a straight line.



The area of each tile is half the area of the previous tile, and the sides of the largest tile have length w centimetres.

9 (a) Find, in terms of w, the length of the sides of the second largest tile.

[1 mark]

9 (b) Assume the tiles are in contact with adjacent tiles, but do not overlap.

Show that, no matter how many tiles are in the pattern, the total length of the series of tiles will be less than $3.5w$.

[4 marks]

9 (c) Helen decides the pattern will look better if she leaves a 3 millimetre gap between adjacent tiles.

Explain how you could refine the model used in part **(b)** to account for the 3 millimetre gap, and state how the total length of the series of tiles will be affected.

[2 marks]

AQA Sample Paper 2 Question 9:

9 (a) Three consecutive terms in an arithmetic sequence are $3e^{-p}, 5, 3e^{p}$

Find the possible values of p. Give your answers in an exact form.

[6 marks]

9 (b) Prove that there is no possible value of q for which $3e^{-q}$, 5, $3e^{q}$ are consecutive terms of a geometric sequence.

[4 marks]