

Section 1: Definitions and notation

Section test

Questions 1 to 3 are about the following sequences:

- A 2, 5, 8, 11, 14, ...
 B 3, 6, 12, 24, 48, ...
 C 1, 1, 2, 3, 5, 8, ...
 D 1, 3, 5, 3, 1, 3, ...

- 1) Which of the above sequences is an arithmetic sequence?
 Which of the above sequences is a geometric sequence?
 Which of the above sequences could be a periodic sequence with period less than 5?

- 2) A sequence is defined by $a_{k+1} = 2a_k - 1$, $a_1 = 2$
 Find the 6th term of this sequence.

Find $\sum_1^5 a_k$.

- 3) A sequence is defined by $a_k = k(k+1)$
 Find the 5th term of this sequence.

Find $\sum_1^4 a_k$.

Questions 4 to 6 are about the sequence

$$1, -2, 4, -8, 16, -32$$

- 4) The sequence is defined inductively by

(a) $a_{k+1} = a_k - 2$, $a_1 = 1$

(b) $a_{k+1} = 2a_k$, $a_1 = 1$

(c) $a_{k+1} = a_k - 2^k$, $a_1 = 1$

(d) $a_{k+1} = -2a_k$, $a_1 = 1$

- 5) The sequence is defined deductively by

(a) $a_k = -2^{k-1}$

(b) $a_k = (-2)^{k-1}$

(c) $a_k = (-2)^k$

(d) $a_k = -2^k$

- 6) Find $\sum_4^6 a_k$.

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Solutions to section test

1) The terms in sequence A go up by 3 each time, so A is an arithmetic sequence.

The terms in B are obtained by multiplying the previous term by 2, so B is a geometric sequence.

The 5th and 6th terms in sequence D are the same as the 1st and 2nd terms, so sequence D could be periodic with period 4.

2) $a_1 = 2$

$$a_2 = 2a_1 - 1 = 2 \times 2 - 1 = 3$$

$$a_3 = 2a_2 - 1 = 2 \times 3 - 1 = 5$$

$$a_4 = 2a_3 - 1 = 2 \times 5 - 1 = 9$$

$$a_5 = 2a_4 - 1 = 2 \times 9 - 1 = 17$$

$$a_6 = 2a_5 - 1 = 2 \times 17 - 1 = 33$$

Using the terms from above,

$$\sum_{k=1}^5 a_k = 2 + 3 + 5 + 9 + 17 = 36.$$

3) Putting $k = 5$: $a_5 = 5(5 + 1) = 5 \times 6 = 30$

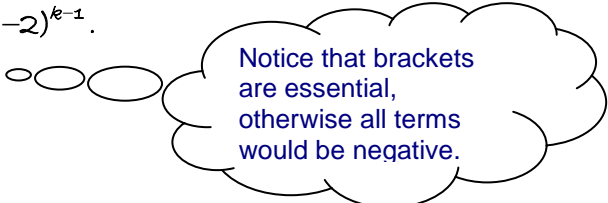
$$\begin{aligned} \sum_{k=1}^4 a_k &= (1 \times 2) + (2 \times 3) + (3 \times 4) + (4 \times 5). \\ &= 2 + 6 + 12 + 20 \\ &= 40 \end{aligned}$$

4) Each term is obtained by multiplying the previous term by -2, so the inductive definition is $a_{k+1} = -2a_k$, $a_1 = 1$.

5) Since each term is obtained by multiplying the previous term by -2, the deductive formula involves a power of -2. Since the first term is 1, the terms of the sequence are given by $(-2)^0, (-2)^1, (-2)^2, \dots$

The deductive definition is therefore $a_k = (-2)^{k-1}$.

6) $\sum_{k=4}^6 a_k = a_4 + a_5 + a_6 = -8 + 16 - 32 = -24$



Notice that brackets are essential, otherwise all terms would be negative.