



MAS162 DISCRETE MATHEMATICS AND LOGIC
Semester 2 2024

Test 1

Time allowed: 30 minutes

Test conditions:

- You can use one A4 hand-written page of notes (one-sided) during the test, and any hand-held scientific or graphics calculator.
- Closed book: you may not access the internet or any materials other than your one-sided page of notes during the test.
- You may not communicate with anyone about the contents of the test until after you have submitted your answers.

Declaration: I have written and will submit my own answers to this test under the above conditions.

Name:

Student Number:

Signature:

Write your answers in the spaces provided. Remember to show full working/reasoning.

1. [7 marks] (a) State whether the sequence (t_n) defined recursively by

$$t_1 = 1, \quad t_n = 2t_{n-1}, \quad n \geq 2$$

is an arithmetic or a geometric sequence, and then write down a direct formula for the n -th term. Use your formula to find t_6 .

- (b) Find a recursive definition of the sequence with direct formula:

$$t_n = \frac{2^n}{n!}, \quad n \geq 1.$$

2. [8 marks] A tower is to be built out of square shaped blocks according to the following scheme: the top layer consists of 1 block, the second layer consists of 3 blocks in an L-shape, and each subsequent layer below is also L-shaped, with the side length increasing by one block-width each layer. The top 4 layers of such a tower are pictured below.



- (a) Write b_n for the number of blocks used in the n th layer counting down from the top, so that $b_1 = 1$, $b_2 = 3$ and so on. Find a recursive formula for b_n .
- (b) Find a direct formula for b_n .
- (c) Write T_n for the total number of blocks in such a tower with n layers, and find a recursive definition for T_n .

- (d) The following MATLAB code is supposed to display the first 10 terms of the sequence T_n but it contains some errors.

```
terms=zeros(1,10);  
terms(1)=1;  
for i=1:10  
    terms(i)=terms(i)+2*i;  
end  
terms
```

- i. What would the above code output?

- ii. How would you change the code to produce the correct output?

SPACE FOR EXTRA WORKING