

## (20) Application of Series

### WORKING AT D/E

(1) Doris has 1kg of chocolate. She eats half of the bar one day, then half of the remaining amount the next day and so on such that she has 500g on day one, 250g on day two, 125g on day three and so on. The amount of chocolate **remaining** can be modelled by the equation  $M = 1000 \times 0.5^n$ , where  $M$  is the mass in grams and  $n$  is the number of days since she started eating it.

- (a) Show, using the formula, that on the 5<sup>th</sup> day of eating she will eat 31.25g of chocolate.  
(b) Find the total amount of chocolate she has eaten after 8 days, giving your answer to the nearest gram.

(2) Cyril is given £10 pocket money by his parents one day to start his savings, Each week after this his pocket money increases by £2

- (a) Find out how much pocket money he will get in the 18<sup>th</sup> week.  
Cyril saves all of his pocket money for 20 weeks.  
(b) Use the formula book to find the total amount he has saved.

### WORKING AT B/C

(1) Doris is selling trees. She charges £20 for a 30cm tree which is the smallest available height. For every 10cm increase in the height of the tree she charges an additional £5 such that a 40cm tree costs £25, a 50cm tree costs £30 and so on.

- (a) Explain why the cost of a tree follows an arithmetic progression.  
(b) Find the cost of buying a 2.4m high tree. Cyril wants to make a decorative garden. He decides to buy the first 20 sizes of tree Doris sells.  
(c) Find the total cost of the trees Cyril buys.  
(d) Cyril's father has £800 to spend on a tree. Work out the height of the largest possible tree he can buy.

(2) Doris sets up an Instagram page. On the first day 3 new people begin to follow her. Every day after that double the number of new people follow her as they did the day before such that on the 2<sup>nd</sup> day 6 new people follow, on the 3<sup>rd</sup> day 12 new people follow and so on.

The number of new ( $N$ ) people following her after ( $t$ ) days can be modelled by the formula

$$N = 3 \times 2^{t-1}, \quad t \geq 1$$

- (a) Use the formula to show that 24 people followed Doris on the 4<sup>th</sup> day  
(b) Find out how long it will take before 1000 new people follow her each day.  
(c) Find out the total number new followers she will have after 12 days.  
(d) Comment on the suitability of the model.

### WORKING AT A\*/A

(1) Cyril is training for a marathon. He finds a circuit around his local park. On the first day he plans to run one lap. Every day after this he plans to run one more than twice as many laps as did the previous day such that on day one he run would run 1 lap, day two he would run 3 laps, day three he runs 7 laps and so on.

- (a) Explain why this model is neither an arithmetic series or geometric series.  
(b) Write a model using a recurrence relation for the number of laps ( $u$ ) after ( $n$ ) days Cyril runs.  
(c) Using your answer to part (b), evaluate

$$\sum_{r=1}^5 u_r$$

- (d) Explain what your answer to part (c) represents in the context of the question.  
(e) Given that each lap was 1000m, comment on the suitability of the model.

(2) Doris is washing dishes for her parents. On day one she is paid 1p and every day after than she is paid twice as much as she was the day before such that on day two she is paid 2p, on day three she is paid 4p and so on. Doris plans to save all of the money she is paid. Find out how long it will take her to save at least £1'000'000.