4.5 Modelling with Sequences & Series

Question Paper

Course	Edexcel IAL Maths: Pure 2
Section	4. Sequences & Series
Topic	4.5 Modelling with Sequences & Series
Difficulty	Easy

Time allowed: **60**

Score: **/46**

Percentage: **/100**

Question 1

Lauren is to start training in order to run a marathon.
Each week she will run a number of miles according to the formula

$$u_n = 4n - 1$$

where u_n is the number of miles to be run in week n.

(a) Work out how far Lauren will run in weeks 1, 2 and 3.

[2 marks]

Question 1

(b) Work out how far Lauren will run in her 10^{th} week of training.

[2 marks]

Question 1

(c) Lauren tends to train for 10 weeks.
Find the total number of miles Lauren will run across all 10 weeks of her training schedule.

[3 marks]

Question 1

(d) Explain why the model would become unrealistic for large values of n, for example for the training schedule of an elite athlete.

[1 mark]

Question 2

Bernie is saving money in order to purchase a new computer.
In the first week of saving Bernie puts £1 into a money box.
In week 2 Bernie adds £2 to the money box, £3 in week 3 and so on.

(a) Find the total amount of money in Bernie's money box after 10 weeks

[1 mark]

Question 2

(b) Show that the total amount of money in Bernie's money box at the end of week n is £ $\frac{n}{2}(n+1)$.

[2 marks]

Question 2

(c) The computer Bernie wishes to buy costs £250.
Will he have saved enough money after 20 weeks?

[2 marks]

Question 2

(d) Give a reason why this might this not be the best way for Bernie to save money?

[1 mark]

Question 3

A ball is dropped from the top of a building and is allowed to bounce until it comes to rest. The height the ball reaches after each bounce is modelled by the geometric sequence

$$u_n = 2 \times (0.8)^{n-1}$$

(a) (i) Write down the height the ball reaches after its first bounce and the common ratio between subsequent bounces.
(ii) Find the height the ball bounces to after its fifth bounce.

[3 marks]

Question 3

(b) (i) Find the sum of the heights the ball reaches after 10 bounces.

(ii) Explain why the total distance travelled by the ball from the moment it first hits the ground to the moment it returns to the ground after the 10^{th} bounce is twice your answer to part (i).

[4 marks]

Question 3

(c) State whether the sequence $u_1, u_2, u_3, \ldots$ is increasing or decreasing.

[1 mark]

Question 4

Due to soil quality improvements and an expanding business a farmer is able to grow an increasing variety of crops each year according to the formula

$$u_n = 3n - 1$$

where u_n is the number of different crops the farmer can grow in year n since they first started the business.

(a) How many different crops was the farmer able to grow in the first year of business?

[2 marks]

Question 4

(b) In which year will the farmer be able to grow exactly 11 different crops?

[2 marks]

Question 4

(c) In which year will the farmer first be able to begin the year growing more than 30 different crops?

[2 marks]

Question 5

A training track for cyclists is in the shape of a circle and the distance around one lap is 600 m.

A cyclist trains every day for a fortnight, each day increasing the number of laps of the track they complete. On day 1, they complete 5 laps of the track and increase the number of laps by 3 each day.

(a) Write down a formula for the number of laps, u_n, the cyclist completes on day n.

[2 marks]

Question 5

(b) Find the number of laps the cyclist will complete on day 10 of training.

[2 marks]

Question 5

(c) (i) Find the total number of laps the cyclist will complete over the fortnight.
(ii) Find the total distance the cyclist will cover over the fortnight.

[4 marks]

Question 6

Two sequences are being used to model the value of a car, n years after it was new. At new, the car's value is £30 000.

Model 1 is an arithmetic sequence where the value of the car, u_n, at n years old, is given by the formula $u_n = 30\,000 - 5000n$.
Model 2 is a geometric sequence where the value of the car, u_n, at n years old, is given by the formula $u_n = 30\,000(0.6)^n$.

(a) (i) Find the age of the car when Model 1 predicts its value has halved.
(ii) Find the age of the car when Model 2 predicts its value has halved.

[4 marks]

Question 6

(b) Which model predicts the greater value for the car when it is 5 years old?

[3 marks]

Question 6

(c) (i) State a problem with Model 1 for higher values of n.

(ii) Justify why Model 2 never predicts the value of the car to be £0.

[3 marks]