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	Medium

Time allowed: **40**

Score: **/37**

Percentage: **/100**

Question 1

Lloyd is to start training in order to run a marathon.
For the first week of training he will run a total of 2 miles.
Each subsequent week he'll increase the total number of miles run by 3 miles.
He intends training for 15 weeks.

(a) Calculate how far Lloyd will run during his eighth week of training

[2 marks]

Question 1

(b) Work out how much further Lloyd will run in his last week of training compared to his first.

[2 marks]

Question 1

(c) Find the total number of miles Lloyd will run across all 15 weeks of his training schedule.

[3 marks]

Question 2

Frankie opens a savings account with £400.
Compound interest is paid at an annual rate of 3%.

(a) Show that at the end of the first year Frankie has £412 in the savings account.

[1 mark]

Question 2

At the start of the second year, and each subsequent year, Frankie adds another £400 to the savings account.

(b) Write down the amount of interest the £400 invested at the start of year 2 will earn by the start of year 3.

[1 mark]

Question 2

(c) Explain why the amount of money in the savings account, in pounds, at the end of year 2 can be written as

$$(400 \times 1.03) \times 1.03 + 400 \times 1.03.$$

[2 marks]

Question 2

(d) Hence show that after n years, the amount in pounds in Frankie's savings account will be

$$400(1.03 + 1.03^2 + 1.03^3 + \cdots + 1.03^n).$$

[2 marks]

Question 2

(e) Show that the sum of the geometric series $1.03 + 1.03^2 + 1.03^3 + \cdots + 1.03^n$ is given by

$$\frac{103}{3}(1.03^n - 1)$$

[2 marks]

Question 2

(f) Hence find the amount of money in Frankie's savings account at the end of 12 years.

[2 marks]

Question 3

A ball is dropped, and it bounces to a height of 1.42 m.
Each subsequent bounce reaches a height 60% of the previous bounce.

(a) Show that the heights of bounces form a geometric sequence with first term 1.42 and common ratio 0.6.

[2 marks]

Question 3

(b) Show that the sum of the first 10 terms of this sequence is 3.53 m, to the nearest centimetre.

[2 marks]

Question 3

(c) Hence write down the distance travelled by the ball from when it first hits the ground to when it returns to the ground after its tenth bounce.

[2 marks]

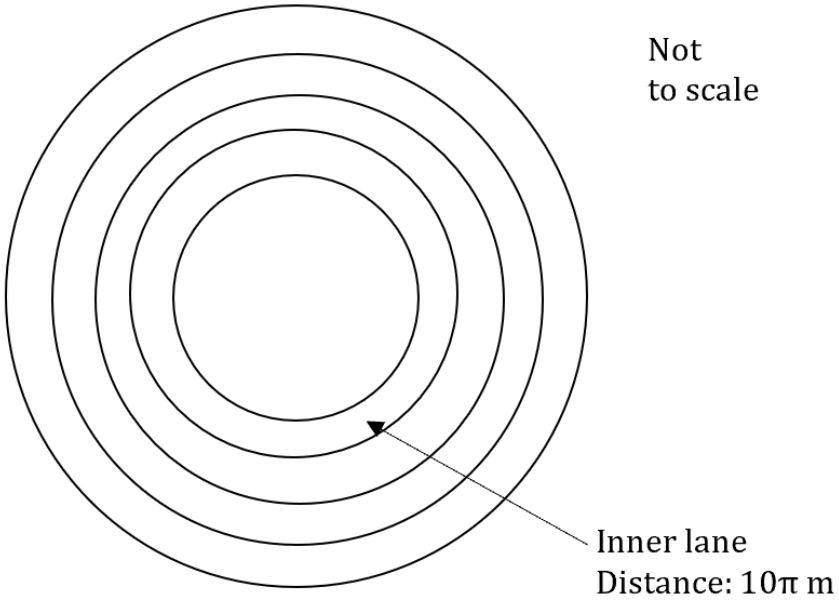
Question 3

(d) A student wants to compare the accuracy of this model with experimental data.
The student decides to investigate what happens on the 25th bounce.
Suggest a problem the student may encounter.

[1 mark]

Question 4

A training track for cyclists is in the shape of a circle made up of several lanes.



One lap of the inner lane is 10π m, with each lane working outwards having a lap distance of 5π m more than the lane immediately inside it.

During a training session, a cyclist is expected to complete one lap of each lane, starting with the inner lane, before moving onto the next one.

(a) A cyclist trains until they have completed the first five lanes.
Find the total distance travelled by the cyclist.

[2 marks]

Question 4

There are 8 lanes in total on the training track.

(b) Find the lap distance of the outside lane.

[2 marks]

Question 4

(c) During a particular training session, a cyclist completes a lap of each lane but in addition, also completes a further 10 laps of the outside lane.
Find the total distance the cyclist travels during this training session.

[3 marks]

Question 5

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 £25 000.

Model 1 is an arithmetic sequence.
Model 2 is a geometric sequence.

Both models predict the same value for the car, £7 500, when it is exactly 8 years old.

(a) Find the common difference for Model 1 and the common ratio for Model 2, giving answers to three significant figures where appropriate.

[2 marks]

Question 5

(b) Find the value of the car according to Model 2 in the year Model 1 predicts its value to be £5000.

[3 marks]

Question 5

(c) State one benefit of Model 2 over Model 1 for estimating the value of older cars.

[1 mark]