# Applied Sequences and Series Exam Questions Sheet 2

**Q1.**
A company, which is making 140 bicycles each week, plans to increase its production. The number of bicycles produced is to be increased by $d$ each week, starting from 140 in week 1, to $140 + d$ in week 2, to $140 + 2d$ in week 3 and so on, until the company is producing 206 in week 12.

(a) Find the value of $d$.

**(2)**

After week 12 the company plans to continue making 206 bicycles each week.

(b) Find the total number of bicycles that would be made in the first 52 weeks starting from and including week 1.

**(5)**

**(Total for question = 7 marks)**

**Q2.**
A competitor is running a 20 kilometre race.

She runs each of the first 4 kilometres at a steady pace of 6 minutes per kilometre.
After the first 4 kilometres, she begins to slow down.

In order to estimate her finishing time, the time that she will take to complete each subsequent kilometre is modelled to be 5% greater than the time that she took to complete the previous kilometre.

Using the model,

(a) show that her time to run the first 6 kilometres is estimated to be 36 minutes 55 seconds,

**(2)**

(b) show that her estimated time, in minutes, to run the $r$ th kilometre, for $5 \leq r \leq 20$, is

$$6 \times 1.05^{r-4}$$

**(1)**

(c) estimate the total time, in minutes and seconds, that she will take to complete the race.

**(4)**

**(Total for question = 7 marks)**

**Q3.**
The value, £$V$, of a vintage car $t$ years after it was first valued on 1st January 2001, is modelled by the equation

$$V = Ap^t \quad \text{where } A \text{ and } p \text{ are constants}$$

Given that the value of the car was £32 000 on 1st January 2005 and £50 000 on 1st January 2012

(a) (i) find $p$ to 4 decimal places,

(ii) show that $A$ is approximately 24 800

**(4)**

(b) With reference to the model, interpret

(i) the value of the constant $A$,
(ii) the value of the constant $p$.

**(2)**

Using the model,

(c) find the year during which the value of the car first exceeds £100 000

**(4)**

**(Total for question = 10 marks)**

**Q4.**

Jess started work 20 years ago. In year 1 her annual salary was £17 000. Her annual salary increased by £1 500 each year, so that her annual salary in year 2 was £18 500, in year 3 it was £20 000 and so on, forming an arithmetic sequence. This continued until she reached her maximum annual salary of £32 000 in year $k$. Her annual salary then remained at £32 000.

(a) Find the value of the constant $k$.

**(2)**

(b) Calculate the total amount that Jess has earned in the 20 years.

**(5)**

**(Total for question = 7 marks)**

**Q5.**

A car has six forward gears.

The fastest speed of the car

- in 1st gear is 28 km $h^{-1}$
- in 6th gear is 115 km $h^{-1}$

Given that the fastest speed of the car in successive gears is modelled by an **arithmetic sequence**,

(a) find the fastest speed of the car in 3rd gear.

**(3)**

Given that the fastest speed of the car in successive gears is modelled by a **geometric sequence**,

(b) find the fastest speed of the car in 5th gear.

**(3)**

**(Total for question = 6 marks)**