Modelling with series - Edexcel Past Exam Questions

1. (*a*) A geometric series has first term *a* and common ratio *r*. Prove that the sum of the first *n* terms of the series is

$$\frac{a(1-r^n)}{1-r}.$$ **(4)**

Mr King will be paid a salary of £35 000 in the year 2005. Mr King's contract promises a 4% increase in salary every year, the first increase being given in 2006, so that his annual salaries form a geometric sequence.

(*b*) Find, to the nearest £100, Mr King's salary in the year 2008. **(2)**

Mr King will receive a salary each year from 2005 until he retires at the end of 2024.

(*c*) Find, to the nearest £1000, the total amount of salary he will receive in the period from 2005 until he retires at the end of 2024. **(4)**

June 05 Q9

2. A trading company made a profit of £50 000 in 2006 (Year 1).

A model for future trading predicts that profits will increase year by year in a geometric sequence with common ratio *r*, *r* > 1.

The model therefore predicts that in 2007 (Year 2) a profit of £50 000*r* will be made.

(*a*) Write down an expression for the predicted profit in Year *n*. **(1)**

The model predicts that in Year *n*, the profit made will exceed £200 000.

(*b*) Show that $n > \dfrac{\log 4}{\log r} + 1$. **(3)**

Using the model with *r* = 1.09,

(*c*) find the year in which the profit made will first exceed £200 000, **(2)**

(*d*) find the total of the profits that will be made by the company over the 10 years from 2006 to 2015 inclusive, giving your answer to the nearest £10 000. **(3)**

June 07 Q8

3. A car was purchased for £18 000 on 1st January.

On 1st January each following year, the value of the car is 80% of its value on 1st January in the previous year.

(*a*) Show that the value of the car exactly 3 years after it was purchased is £9216. **(1)**

The value of the car falls below £1000 for the first time *n* years after it was purchased.

(*b*) Find the value of *n*. **(3)**

An insurance company has a scheme to cover the cost of maintenance of the car. The cost is £200 for the first year, and for every following year the cost increases by 12% so that for the 3rd year the cost of the scheme is £250.88.

(*c*) Find the cost of the scheme for the 5th year, giving your answer to the nearest penny. **(2)**

(*d*) Find the total cost of the insurance scheme for the first 15 years. **(3)**

Jan 10 Q6

4. The adult population of a town is 25 000 at the end of Year 1.

A model predicts that the adult population of the town will increase by 3% each year, forming a geometric sequence.

(*a*) Show that the predicted adult population at the end of Year 2 is 25 750. **(1)**

(*b*) Write down the common ratio of the geometric sequence. **(1)**

The model predicts that Year *N* will be the first year in which the adult population of the town exceeds 40 000.

(*c*) Show that
$$(N-1)\log 1.03 > \log 1.6$$ **(3)**

(*d*) Find the value of *N*. **(2)**

At the end of each year, each member of the adult population of the town will give £1 to a charity fund.

Assuming the population model,

(*e*) find the total amount that will be given to the charity fund for the 10 years from the end of Year 1 to the end of Year 10, giving your answer to the nearest £1000. **(3)**

June 10 Q9