R31...Geometric Progression- Growth and Decay (not money)

OCR

21 The number of gannets on an island is assumed to follow this exponential growth model.

$$N = 0.45 \times 1.07^{x}$$

N is the number of gannets, in thousands.
x is the number of years after 1st January 2010.

(a) Complete the table for $N = 0.45 \times 1.07^{x}$.

A74
R31

x	0	5	10	15	20
N	0.45	0.63		1.24	

[2]

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A74
R31

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[2]

Edexcel

10 In 2016 the population of the UK was 6.5×10^7

Laura wants to calculate an estimate for the population of the UK in 2020
She assumes that the population increases by 0.6% each year.

(a) Using Laura's assumption, calculate an estimate for the population of the UK in 2020

Kieran also assumes that the population of the UK increases by 0.6% each year.

He says that it will take over 80 years for the population to increase by 50% because $\frac{50}{0.6} = 83.\dot{3}$

Kieran's method is wrong.

(b) Explain what is wrong with his method.

.....

.....

(1)

Assuming that the population of the UK increases by 0.6% each year,

(c) show that the population of the UK each year forms a geometric progression.

(2)

(Total for Question 10 is 5 marks)

Created by W Neill

10 In 2016 the population of the UK was 6.5×10^7

Laura wants to calculate an estimate for the population of the UK in 2020
She assumes that the population increases by 0.6% each year.

3sf

(a) Using Laura's assumption, calculate an estimate for the population of the UK in 2020

$6.5 \times 10^7 \times 1.006^4 = 66574096$

6.66×10^7 ✓ 66600000 ✓

Kieran also assumes that the population of the UK increases by 0.6% each year.

He says that it will take over 80 years for the population to increase by 50% because $\frac{50}{0.6} = 83.\dot{3}$

Kieran's method is wrong.

✓ $0.6\dot{} = 83.\dot{3}$

(b) Explain what is wrong with his method.

Kieran has used simple interest

Needs to be compound interest (increases more every year that passes) ✓ (1)

Assuming that the population of the UK increases by 0.6% each year,

(c) show that the population of the UK each year forms a geometric progression.

6.5×10^7

65,000,000 × 1.006 × 1.006 × 1.006

= 65390000 = 65782340 = 66177034

390,000 392340 394694

as it is going up at a quicker rate each year, it is a geometric progression.

(2)

(Total for Question 10 is 5 marks)

17 At the start of year n, the quantity of a radioactive metal is P_n
At the start of the following year, the quantity of the same metal is given by

$$P_{n+1} = 0.87P_n$$

At the start of 2016 there were 30 grams of the metal.

What will be the quantity of the metal at the start of 2019?
Give your answer to the nearest gram.

.....grams

(Total for Question 17 is 3 marks)

17 At the start of year n, the quantity of a radioactive metal is P_n
At the start of the following year, the quantity of the same metal is given by

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At the start of 2016 there were 30 grams of the metal.

What will be the quantity of the metal at the start of 2019?
Give your answer to the nearest gram.

$P_{16} = 30$ grams

$P_{17} = 0.87 \times 30 = 26.1$g

$P_{18} = 0.87 \times 26.1 = 22.707$g

$P_{19} = 0.87 \times 22.707 = 19.75$g

20

..... grams

(Total for Question 17 is 3 marks)

13 At the beginning of 2009, Mr Veale bought a company.
The value of the company was £50 000

Each year the value of the company increased by 2%.

(a) Calculate the value of the company at the beginning of 2017
Give your answer correct to the nearest £100

£.....

(2)

At the beginning of 2009 the value of a different company was £250 000
In 6 years the value of this company increased to £325 000

This is equivalent to an increase of x% each year.

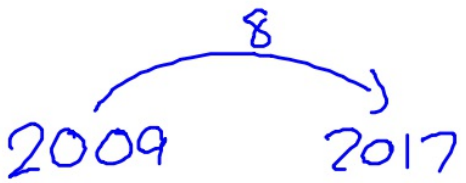
(b) Find the value of x.
Give your answer correct to 2 significant figures.

.....

(3)

(Total for Question 13 is 5 marks)

Created by W Neill



13 At the beginning of 2009, Mr Veale bought a company.
The value of the company was £50 000

Each year the value of the company increased by 2%.

(a) Calculate the value of the company at the beginning of 2017
Give your answer correct to the nearest £100

£50000 × 1.02^{8} =

£58600

£.....

(2)

At the beginning of 2009 the value of a different company was £250 000
In 6 years the value of this company increased to £325 000

This is equivalent to an increase of x% each year.

(b) Find the value of x.
Give your answer correct to 2 significant figures.

$? = 1.04469$

100%.

$£250{,}000 \times ?^{6} = 325000$

$x = 4.469\%$

$?^{6} = 1.3$

$? = \sqrt[6]{1.3}$

4.5%

(3)

(Total for Question 13 is 5 marks)

18 At time $t = 0$ hours a tank is full of water.

Water leaks from the tank.
At the end of every hour there is 2% less water in the tank than at the start of the hour.

The volume of water, in litres, in the tank at time t hours is V_t

Given that

$$V_0 = 2000$$
$$V_{t+1} = kV_t$$

write down the value of k.

$k =$ .....

(Total for Question 18 is 1 mark)

18 At time $t = 0$ hours a tank is full of water.

Water leaks from the tank.
At the end of every hour there is 2% less water in the tank than at the start of the hour.

The volume of water, in litres, in the tank at time t hours is V_t

Given that

multipler

$V_0 = 2000$ ✓ 2000 Litres

$V_{t+1} = kV_t$

write down the value of k.

K ... -2%.

$k =$ 0.98

(Total for Question 18 is 1 mark)

9 Jack bought a new boat for £12 500

The value, £V, of Jack's boat at the end of n years is given by the formula

$$V = 12\,500 \times (0.85)^n$$

(a) At the end of how many years was the value of Jack's boat first less than 50% of the value of the boat when it was new?

.....

(2)

A savings account pays interest at a rate of $R\%$ per year.
Jack invests £5500 in the account for one year.

At the end of the year, Jack pays tax on the interest at a rate of 40%.
After paying tax, he gets £79.20

(b) Work out the value of R.

.....

(3)

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The value, £V, of Jack's boat at the end of n years is given by the formula

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(a) At the end of how many years was the value of Jack's boat first less than 50% of the value of the boat when it was new?

£12500 ÷ 2 = £6250 ← 50%

£12500 × 0.85^5 = £5546

5 years as £5546 < £6250 ✓

.....

(2)

A savings account pays interest at a rate of $R\%$ per year.
Jack invests £5500 in the account for one year.

At the end of the year, Jack pays tax on the interest at a rate of 40%.
After paying tax, he gets £79.20

(b) Work out the value of R.

÷6 (£79.20 = 60%
£13.20 = 10%) ÷6
£132 = 100%

£5500 × [%] = £132

$\% = \frac{135}{5500}$

$= 0.024$

2.4%

(3)

AQA