eClassroom

GCSE Mathematics

# Growth & Decay

## Questions

Pearson Edexcel GCSE & iGCSE Mathematics

# Section A — Foundation

## Worked Examples

**[Fluency]**

**£2000 is invested at 5% compound interest per annum. Find the value after 3 years.**

$2000 \times 1.05^3 = 2000 \times 1.157625 = \$2315.25$

Value = **£2315.25**

**[Reasoning]**

**A car worth £20 000 depreciates at 25% per year. After how many years is it worth less than £5000?**

Model: V=20000×0.75⊃n. Need 0.75⊃n < 0.25

n=4: 0.75&sup4;=0.316 >0.25  n=5: 0.75&sup5;=0.237<0.25

After **5 years**.

**[Problem Solving]**

**Bacteria start at 500 and double every hour. How many after 4 hours?**

N = 500×2&sup4; = 500×16 = **8000**

**[Fluency]**

**1.** £3000 is invested at 4% compound interest per annum. Find the value after 3 years. Give your answer to the nearest penny.

**(3 marks)**

**[Fluency]**

**2.** A car is bought for £15 000. It depreciates by 12% each year. Find its value after 4 years. Give your answer to the nearest penny.

**(3 marks)**

**[Reasoning]**

**3.** £2000 is invested for 3 years.
Option A: 5% simple interest per annum.
Option B: 4.8% compound interest per annum.
Which option gives more money? Show full working.

**(4 marks)**

**[Fluency]**

**4.** A town has population 8000. It grows at 3% per year. Find the population after 5 years. Round to the nearest whole number.

**(3 marks)**

[Fluency]

**5.** Bacteria start at 500 and double every hour. How many bacteria are there after 4 hours?

**(2 marks)**

[Reasoning]

**6.** An investment doubles in 12 years with compound interest.
Estimate the approximate annual interest rate. Show your method.

**(3 marks)**

[Problem Solving]

**7.** The value V of a car after n years is given by $V = 20\,000 \times 0.75^{n}$.

**(a)** Write down the initial value of the car. (1)

**(b)** Find the value after 3 years. (2)

**(c)** After how many complete years is the value first below £5000? (2)

**(5 marks)**

[Reasoning]

**8.** A radioactive substance halves every 8 years (half-life = 8 years). There are initially 200 g. How much remains after 24 years?

**(2 marks)**

[Problem Solving]

**9.** An investment of £P grows to £5618 after 2 years and to £5899 after 3 years (compound interest).

**(a)** Find the annual interest rate. (2)

**(b)** Find the initial investment P. (2)

**(4 marks)**

[Problem Solving]

**10.** Inflation runs at 2.5% per year. A basket of goods costs £100 today.

**(a)** Find the cost of the basket in 10 years. (2)

**(b)** How much is today's £100 worth in purchasing power in 10 years? (2)

**(4 marks)**

## Section B — Higher

### Worked Examples

**[Fluency]**

**A quantity decays according to N = 500×0.8⊃t. Find N when t=6.**

$$N = 500 \times 0.8^6 = 500 \times 0.262144 \approx 131.07$$

**[Reasoning]**

**Solve 1000×1.03⊃n = 1500. Find n.**

$$1.03^n = 1.5 \Rightarrow n = \frac{\log 1.5}{\log 1.03} \approx 13.72$$

So n = **14 years** (first complete year)

**[Problem Solving]**

**Two investments: A starts £4000 at 3.5%, B starts £3800 at 4.2%. After how many years does B overtake A?**

$$4000 \times 1.035^n = 3800 \times 1.042^n$$

$$\left(\frac{1.042}{1.035}\right)^n = \frac{4000}{3800} \Rightarrow n \approx 8$$

**[Fluency]**

**1.** A quantity N decays according to the model N = 500×0.8⊃t, where t is in years.
Find N when t = 6. Give your answer correct to 2 decimal places.

**(2 marks)**

**[Fluency]**

**2.** A radioactive element has a half-life of 5730 years (carbon-14).
What fraction of the original amount remains after 17 190 years?

**(2 marks)**

**[Fluency]**

**3.**

Solve for n, giving your answer correct to 1 decimal place:

$$1000 \times 1.03^n = 1500$$

**(3 marks)**

[Reasoning]

**4.** Investment A: £4000 at 3.5% compound interest per annum.
Investment B: £3800 at 4.2% compound interest per annum.
After how many complete years does B first exceed A?
Show your working.

**(4 marks)**

[Reasoning]

**5.**

A population P decays exponentially: P = P■×e$^{-0.1t}$.
Find t when P = P■/4. Give your answer correct to 2 decimal places.

**(3 marks)**

[Reasoning]

**6.** Explain the difference between linear and exponential growth.
Give one real-world example of each.

**(2 marks)**

[Problem Solving]

**7.** A population follows the model P = 2×10&sup6;×1.02⊃t, where t is years from now.
After how many complete years will the population first exceed 3×10&sup6;?

**(3 marks)**

[Problem Solving]

**8.** An investment doubles in 15 years with compound interest.
Find the exact annual rate as a percentage, correct to 3 decimal places.

**(3 marks)**

[Problem Solving]

**9.** A drug concentration in the bloodstream follows C = 200×0.75⊃t mg, where t is in hours.
After how many complete hours does the concentration first fall below 50 mg?

**(3 marks)**

[Problem Solving]

**10.** The sum of the geometric series 1 + r + r² + … + r$^{n-1}$ is given by S = (1–r⊃n)/(1–r).
Use this formula with r=1.05 and n=10 to find the future value of
£1000 invested at the end of each year for 10 years at 5% per annum.
Give your answer to the nearest pound.

**(4 marks)**