

Compound Interest, Growth and Decay

Solutions

For AQA GCSE Mathematics (8300) • Higher tier

Each question is shown in grey, followed by the working, one step per line. The final answer is in a box. *Marks* shows how the marks are usually given in the exam, and **Tip** points out a common mistake.

1 (1 mark)

£2000 is invested for 5 years at 3% compound interest per year.
Circle the calculation for the value of the investment after 5 years.

Options: 2000×1.3^5 , $2000 \times 1.03 \times 5$, 2000×1.03^5 , 2000×0.03^5

A 3% increase each year means the multiplier is $1 + 0.03 = 1.03$

Compound interest: multiply by 1.03 once for each year.

For 5 years: 2000×1.03^5

Answer: 2000×1.03^5

Tip: The multiplier for 3% is 1.03, not 1.3 (that would be a 30% increase).

2 (1 mark)

A population of bacteria doubles every hour.

At the start there are 800 bacteria.

Circle the expression for the number after n hours.

Options: $800 + 2n$, $800 \times 2n$, 800×2^n , 800^{2n}

After 1 hour: 800×2

After 2 hours: $800 \times 2 \times 2 = 800 \times 2^2$

After n hours: 800×2^n

Answer: 800×2^n

3 (3 marks)

£5000 is invested at 3% compound interest per year.
Work out the value of the investment after 4 years.

Multiplier for a 3% increase: 1.03

4 years, so use the power 4:

$$5000 \times 1.03^4 = 5627.544 \dots$$

Round to the nearest penny: £5627.54

Answer: £5627.54

Tip: Do not work out 3% of £5000 and multiply by 4. That is **simple** interest. With compound interest, each year's interest also earns interest.

Marks: 1 mark for using 1.03. 1 mark for the power 4. 1 mark for £5627.54.

4 (3 marks)

A van is bought for £18 500
Its value depreciates by 12% each year.
Work out its value after 4 years.

“Depreciates” means the value goes down.

A 12% decrease each year: multiplier $1 - 0.12 = 0.88$

$$18\,500 \times 0.88^4 = 11\,094.364 \dots$$

Round to the nearest penny: £11 094.36

Answer: £11 094.36

Tip: Don't take off $4 \times 12\% = 48\%$ in one go. Each year the 12% is taken from the **new**, smaller value.

Marks: 1 mark for 0.88. 1 mark for $18\,500 \times 0.88^4$. 1 mark for £11 094.36.

5 (4 marks)

Maya invests £5000 for 3 years in an account paying 4% compound interest per year.
Nell invests £5000 for 3 years in an account paying simple interest.
At the end of the 3 years they have both earned the same amount of interest.
Work out the rate of simple interest per year that Nell gets.
Give your answer to 2 decimal places.

Maya (compound interest): $5000 \times 1.04^3 = £5624.32$

Maya's interest = $5624.32 - 5000 = £624.32$

Nell earns the same interest, £624.32, over 3 years.

Nell's interest each year = $624.32 \div 3 = £208.106 \dots$

As a percentage of £5000: $208.106 \dots \div 5000 \times 100 = 4.162 \dots \%$

To 2 decimal places: 4.16%

Answer: 4.16%

Tip: Simple interest is the same amount every year, so divide the total interest by the number of years before finding the percentage.

Marks: 1 mark for 5000×1.04^3 . 1 mark for £624.32. 1 mark for dividing by 3 and by 5000. 1 mark for 4.16.

6 (3 marks)

The number of members of a gym increases by 5% in the first year and by 15% in the second year.

Kat says,

“Over the two years, the number of members has increased by 20%.”

Is she correct?

You must show your working.

The two increases are applied one after the other, so multiply the multipliers.

First year: multiplier 1.05. Second year: multiplier 1.15.

Overall multiplier = $1.05 \times 1.15 = 1.2075$

1.2075 means an overall increase of 20.75%, not 20%.

So Kat is not correct.

Answer: No (overall increase is 20.75%)

Tip: You cannot add percentage changes. The 15% is worked out on the **new** number of members, which is bigger than the original.

Marks: 1 mark for 1.05×1.15 (or using a number of members, e.g. $100 \rightarrow 105 \rightarrow 120.75$). 1 mark for 1.2075 or 20.75%. 1 mark for No, with the correct value.

7 (3 marks)

The value of an antique clock increases by the same percentage each year.

At the end of 2021 it was worth £1600

At the end of 2023 it was worth £1764

Work out its value at the end of 2026

From 2021 to 2023 is 2 years, so $1600 \times m^2 = 1764$, where m is the yearly multiplier.

$$m^2 = 1764 \div 1600 = 1.1025$$

$$m = \sqrt{1.1025} = 1.05 \text{ (a 5\% increase each year)}$$

From 2023 to 2026 is 3 more years:

$$1764 \times 1.05^3 = 2042.0505$$

Round to the nearest penny: £2042.05

Answer: £2042.05

Tip: The £164 increase is over 2 years, so the yearly multiplier is $\sqrt{1.1025}$, not 1.1025.

Marks: 1 mark for $1764 \div 1600$ and a square root. 1 mark for 1764×1.05^3 (or 1600×1.05^5). 1 mark for £2042.05.

8 (3 marks)

An investment of £2000 earns compound interest at $r\%$ per year.

After 2 years it is worth £2163.20

Work out the value of r .

Let the yearly multiplier be m . Then $2000 \times m^2 = 2163.20$

$$m^2 = 2163.20 \div 2000 = 1.0816$$

$$m = \sqrt{1.0816} = 1.04$$

A multiplier of 1.04 means a 4% increase each year.

Answer: 4

Tip: Do not find the total increase (8.16%) and halve it. That treats it as simple interest. Square root the multiplier instead.

Marks: 1 mark for $2163.20 \div 2000$. 1 mark for $\sqrt{1.0816}$. 1 mark for 4.

9 (3 marks)

The number of birds on an island is decreasing by 10% each year.

There are 64 birds now.

After how many years will there first be fewer than 40 birds?

A 10% decrease each year: multiplier 0.9

After 4 years: $64 \times 0.9^4 = 41.99 \dots$ (not yet fewer than 40)

After 5 years: $64 \times 0.9^5 = 37.79 \dots$ (fewer than 40)

So the first time is after 5 years.

Answer: 5

Tip: Show the values for 4 years **and** 5 years. This proves that 5 is the first year below 40.

Marks: 1 mark for using 0.9. 1 mark for the values after 4 and 5 years. 1 mark for 5.

10 (4 marks)

The population of a city is now 8 400 000

The population is predicted to

increase by 2% per year for 3 years

and then

decrease by 1.5% per year for 2 years.

Work out the predicted population of the city 5 years from now.

Give your answer to 3 significant figures.

Increase of 2% for 3 years: multiplier 1.02^3

After 3 years: $8\,400\,000 \times 1.02^3 = 8\,914\,147.2$

Decrease of 1.5% for 2 years: multiplier 0.985^2

After 5 years: $8\,914\,147.2 \times 0.985^2 = 8\,648\,728.4 \dots$

To 3 significant figures: 8 650 000

Answer: 8 650 000

Tip: A 1.5% decrease is a multiplier of 0.985, not 0.85. Keep the full value in your calculator and only round at the end.

Marks: 1 mark for 1.02^3 . 1 mark for 0.985^2 . 1 mark for a complete method. 1 mark for 8 650 000.
