



- 1 Hollie puts £8000 into a savings account.
The value of the account increases by 5% each year.
Work out the value of the account after 2 years.

(3 marks)

The multiplier for a 5% increase is 1.05
After 2 years the value is 8000×1.05^2
 $8000 \times 1.1025 = £8820$

£8820

- 2 Rosa puts £3000 into a savings account.
The account pays 2% compound interest per year.
Work out the value of her savings at the end of 2 years.

(2 marks)

Each year the balance becomes 102% of its previous value, so multiply by 1.02. In year 2 you earn interest on the new balance, including the first year's interest
End of year 1

$$3000 \times 1.02 = £3060$$

End of year 2

$$3060 \times 1.02 = £3121.20$$

Check with the multiplier method

$$3000 \times 1.02^2 = £3121.20$$

£3121.20

- 3 Dev buys a van for £15 000.
The value of the van depreciates by 12% each year.
Calculate the value of the van at the end of 3 years.
Give your answer to the nearest penny.

(3 marks)

The multiplier for a 12% decrease is 0.88

After 3 years the value is 15000×0.88^3

$$0.88^3 = 0.681472, \text{ so the value is } 15000 \times 0.681472 =$$

$$£10222.08$$

£10222.08

4

Ben buys a car for £16 000.

The value of the car depreciates by 15% each year.

Work out the value of the car at the end of 2 years.

(2 marks)

End of year 1

$$16\,000 \times 0.85 = £13\,600$$

End of year 2

$$13\,600 \times 0.85 = £11\,560$$

Check

$$16\,000 \times 0.85^2 = £11\,560$$

£11560

5

The number of visitors to a website increases by 50% one month and then increases by 50% again the next month.

Petra says, "Two increases of 50% make an increase of 100%."

Petra is wrong.

Find the overall percentage increase over the two months.

(3 marks)

The multiplier for a 50% increase is 1.5, or $\frac{3}{2}$

Two increases give an overall multiplier of $1.5 \times 1.5 = 2.25$

A multiplier of 2.25 is an increase of 125%, not 100%

125%

6

Zainab invests £2500 in an account paying 3% compound interest per year.

Work out the total interest she earns in 3 years. Give your answer to the nearest penny.

(3 marks)

End of year 1

$$2500 \times 1.03 = £2575$$

End of year 2

$$2575 \times 1.03 = £2652.25$$

End of year 3

$$2652.25 \times 1.03 = £2731.8175$$

Interest = $2731.8175 - 2500 = £231.82$ to the nearest penny

£231.82

- 7 Zara invests £2500 in a savings account paying 3% compound interest per year.
Work out the total amount in the account after 4 years.

(3 marks)

3% increase: multiplier 1.03

$$= 2500 \times 1.03^4$$

$$= 2500 \times 1.1255...$$

$$\boxed{£2813.77}$$

- 8 The population of a colony of seabirds falls by the same percentage each year.

Three years ago the population was 64 000.

The population is now 46 656.

Find the annual percentage decrease.

(3 marks)

If the annual multiplier is m , then $64000 \times m^3 = 46656$

$$m^3 = 46656 \div 64000 = 0.729$$

$$m = \sqrt[3]{0.729} = 0.9, \text{ which is a } 10\% \text{ decrease each year}$$

$$\boxed{10\%}$$

- 9 Theo puts £4000 into a savings account for 2 years.

The account pays 4% compound interest in the first year and 2% compound interest in the second year.

Work out the value of the account at the end of 2 years.

(3 marks)

End of year 1

$$4000 \times 1.04 = £4160$$

End of year 2

$$4160 \times 1.02 = £4243.20$$

$$\boxed{£4243.20}$$

10

Oliver invests £4000 for 3 years at 2.5% per year.

- Work out the total interest if it is simple interest.
- Work out the total interest if it is compound interest.
- How much more interest is earned with compound interest?

(4 marks)

a) simple: same amount each year

$$4000 \times 0.025 = 100 \text{ a year}$$

$$100 \times 3 = 300$$

£300

b) compound

$$= 4000 \times 1.025^3$$

$$= 4307.56...$$

$$4307.56 - 4000 = 307.56$$

£307.56

c)

$$307.56 - 300 = 7.56$$

£7.56

11

Ellis invests £4000 in a savings account for 3 years.

The account pays compound interest at an annual rate of 3% for the first year

2.5% for each of the second and third years.

Work out the value of the investment at the end of 3 years.

Give your answer to the nearest penny.

(4 marks)

After the first year

$$4000 \times 1.03 = £4120$$

After the second year

$$4120 \times 1.025 = £4223$$

After the third year

$$4223 \times 1.025 = £4328.575$$

The value is £4328.58 to the nearest penny

£4328.58

12

A delivery van is bought for £24 500.

Its value depreciates by 18% each year.

Work out the value of the van at the end of 3 years. Give your answer to the nearest pound.

(3 marks)

Multiplier for an 18% decrease is 0.82

$$\text{Value} = 24\,500 \times 0.82^3 = 24\,500 \times 0.551368 = £13\,508.516$$

To the nearest pound this is £13 509

£13509

13

Mia invested some money for 2 years at 4% compound interest per year. After 2 years she had £2163.20 in the account.

a. Work out how much she invested.

b. Mia's brother invests the same amount for 3 years at 3.5% compound interest per year. Who has more money in the account at the end of their investment, and by how much?

(5 marks)

a) 2 years at 4%

$$\text{multiplier} = 1.04^2 = 1.0816$$

$$\text{original} \times 1.0816 = 2163.20$$

$$\text{original} = 2163.20 \div 1.0816$$

£2000

b)

$$= 2000 \times 1.035^3$$

$$= £2217.44$$

$$2217.44 - 2163.20 = 54.24$$

Brother, by £54.24

14

Sasha has £6000 to invest for 4 years.

Account A pays 2.5% compound interest per year.

Account B pays 2.6% simple interest per year.

Which account gives more interest after 4 years, and by how much?

(5 marks)

Account A (compound)

$$= 6000 \times 1.025^4$$

$$= £6622.88$$

$$\text{interest} = 6622.88 - 6000 = 622.88$$

Account B (simple)

$$6000 \times 0.026 = 156 \text{ a year}$$

$$156 \times 4 = 624$$

Compare

$$624 - 622.88 = 1.12$$

Account B, by £1.12

15

At the start of an experiment there are 20 000 bacteria in a dish.

The number of bacteria increases by 8% each hour.

A scientist claims there will be more than 25 000 bacteria after 3 hours.

Work out whether the scientist is correct.

You must show your working.

(3 marks)

The multiplier for an 8% increase is 1.08

After 3 hours

$$20000 \times 1.08^3 = 20000 \times 1.259712 = 25194.24$$

25194 > 25000, so the scientist is correct

16

Freya buys a motorbike for £7200.

Its value depreciates by 12% each year.

Show that the value of the motorbike at the end of 3 years is less than £5000.

(3 marks)

Multiplier for a 12% decrease is 0.88

$$\text{Value} = 7200 \times 0.88^3 = 7200 \times 0.681472 = £4906.5984$$

£4906.60 is less than £5000

17

A running club has 800 members.

The number of members increases by 15% each year.

Find the number of complete years it takes for the number of members to first exceed 1600.

(4 marks)

The multiplier for a 15% increase is 1.15

After 4 years

$$800 \times 1.15^4 = 800 \times 1.7490... = 1399.2, \text{ which is below 1600}$$

After 5 years

$$800 \times 1.15^5 = 800 \times 2.0113... = 1609.1, \text{ which exceeds 1600}$$

So it takes 5 years

5 years

18

Idris puts £5000 into an account for 2 years.

The account pays 3% compound interest in the first year and $r\%$ compound interest in the second year.

At the end of 2 years the account is worth £5253.

Work out the value of r .

(3 marks)

End of year 1

$$5000 \times 1.03 = £5150$$

$$5253 \div 5150 = 1.02$$

So the second-year rate is 2%, giving $r = 2$

Check

$$5150 \times 1.02 = £5253$$

2

19

The population of a town is growing by 12% each year.

Find the number of complete years it will take for the population to become more than double its current size.

(3 marks)

The population is multiplied by 1.12 each year, so we need the smallest n with $1.12^n > 2$

$$1.12^6 = 1.9738..., \text{ which is less than 2}$$

$$1.12^7 = 2.2106..., \text{ which is more than 2}$$

So it takes 7 years

7 years

20

Meg has £2000 to invest for 3 years. She can choose one of two accounts.

Account A pays 2.5% compound interest every year.

Account B pays 3% compound interest in the first year, then 2.2% compound interest in each of the next 2 years.

Work out which account gives Meg more money at the end of 3 years, and by how much.

(4 marks)

Account A

$$2000 \times 1.025^3 = 2000 \times 1.076890625 = £2153.78$$

Account B

$$2000 \times 1.03 = £2060, \text{ then}$$

$$2060 \times 1.022^2 =$$

$$2060 \times 1.044484 = £2151.64$$

$$\text{Account A gives more, by } 2153.78 - 2151.64 = £2.14$$

21

Town A has a population of 150 000. Its population is falling by 4% each year.

Town B has a population of 120 000. Its population is rising by 5% each year.

Work out which town will have the larger population at the end of 3 years.

You must show your working.

(4 marks)

Town A

$$150000 \times 0.96^3 = 150000 \times 0.884736 = 132710.4, \text{ so about } 132710 \text{ people}$$

Town B

$$120000 \times 1.05^3 = 120000 \times 1.157625 = 138915 \text{ people}$$

$138915 > 132710$, so Town B will have the larger population

22

Ava invests £6000 at a rate of $x\%$ compound interest per year.

At the end of 2 years the investment is worth £6615.

Work out the value of x .

(4 marks)

$$6615 \div 6000 = 1.1025$$

The yearly multiplier is $\sqrt{1.1025} = 1.05$

So the rate is 5%, giving $x = 5$

Check

$$6000 \times 1.05 = 6300, \text{ then } 6300 \times 1.05 = £6615$$

5

23

The value of a painting increased by 10% each year for two years.

The painting is now worth £9680.

Find the value of the painting two years ago.

(4 marks)

Two increases of 10% give an overall multiplier of $1.1^2 = 1.21$

If the original value was V , then $V \times 1.21 = 9680$

$$V = 9680 \div 1.21 = £8000$$

Check

$$8000 \times 1.1 = 8800 \text{ and } 8800 \times 1.1 = 9680$$

£8000

24

Tomasz puts £8000 into an account paying 4% compound interest per year.

At the end of the first year, after the interest has been added, he withdraws £1500.

He leaves the rest in the account for another year.

Work out how much is in the account at the end of the second year.

(4 marks)

End of year 1

$$8000 \times 1.04 = £8320$$

After the withdrawal

$$8320 - 1500 = £6820$$

End of year 2

$$6820 \times 1.04 = £7092.80$$

£7092.80

25

Nina has £10 000 to invest for 3 years. She can choose one of two accounts.

Steady Saver pays 2.1% compound interest every year.

Flex Saver pays 3.5% compound interest in the first year, then 1.5% compound interest in each of the next 2 years.

Which account should Nina choose to get the most money after 3 years? You must show how much more it pays.

(5 marks)

Steady Saver

$$10\,000 \times 1.021^3 = 10\,000 \times 1.064332261 = \text{£}10\,643.32$$

Flex Saver

$$\begin{aligned} 10\,000 \times 1.035 &= \text{£}10\,350, \\ \text{then } 10\,350 \\ &\times 1.015^2 = 10\,000 \times \\ &1.066282875 \\ &= \text{£}10\,662.83 \end{aligned}$$

$$\text{Flex Saver pays more, by } 10\,662.83 - 10\,643.32 = \text{£}19.51$$

Nina should choose Flex Saver

26

Kira invests £8000 in an account paying 5% compound interest per year.

At the end of 2 years she uses all the money in the account to buy a car.

The value of the car depreciates by $d\%$ each year.

Exactly 2 years after she buys it, the car is worth £5644.80.

Work out the value of d .

(6 marks)

Value of the investment after 2 years

$$8000 \times 1.05^2 = 8000 \times 1.1025 = \text{£}8820$$

So the car cost £8820

$$5644.80 \div 8820 = 0.64, \text{ so the 2-year depreciation multiplier is } 0.64$$

$$\text{Yearly multiplier} = \sqrt{0.64} = 0.8$$

A multiplier of 0.8 means a 20% decrease each year, so $d = 20$

Check

$$8820 \times 0.8 = 7056, \text{ then } 7056 \times 0.8 = \text{£}5644.80$$

20