Cambridge IGCSE · Mathematics (0580) · Notes

Percentages, interest and exponential growth and decay

Read online at pastopic.com/cambridge/mathematics-0580/notes/percentages-and-exponential-change

Last checked 28 September 2026

Read first: Fractions, decimals, ordering and the four operations, Powers, roots, indices and surds

What you need to know

Core and Extended share most of this topic. The parts marked **Extended only** are for Papers 2 and 4. By the end of this topic you should be able to:

1. **Find a percentage of a quantity**, such as 35% of 260, including percentages over 100%.
2. **Write one quantity as a percentage of another**, such as a test score or a share of a total.
3. **Increase or decrease a quantity by a percentage, and find a percentage increase or decrease.** This includes discounts, deposits, earnings, tax, and profit and loss (as an amount or as a percentage).
4. **Work with simple interest and compound interest.** You must know how to work these out yourself, because no formula is given in the exam.
5. **Extended only:** work with **repeated percentage changes**, such as a rise one year and a fall the next.
6. **Extended only:** use **reverse percentages**: find the original amount when you know the amount after a percentage change, for example the cost price from the selling price and the percentage profit.
7. **Extended only:** use **exponential growth and decay**, for example a population that grows by the same percentage each year, or a car that loses value (depreciation). You do not need the number e.

Drawing graphs of exponential growth and decay is part of the graphs of functions topic, not this one.

Understand it

What a percentage is

"Per cent" means "out of 100". So 35% is $\frac{35}{100}$, or 0.35 as a decimal. To change a percentage to a decimal, divide by 100: 7% is 0.07, 12.5% is 0.125, and 250% is 2.5.

A percentage of a quantity

To find a percentage of something, change the percentage to a decimal and multiply:

$$35\% \text{ of } 260 = 0.35 \times 260 = 91.$$

Percentages over 100% work the same way: 250% of 18 is $2.5 \times 18 = 45$. The answer is bigger than the quantity you started with.

One quantity as a percentage of another

Make a fraction with the **whole** on the bottom, then multiply by 100:

$$42 \text{ out of } 56 = \frac{42}{56} \times 100 = 75\%.$$

Both quantities must be in the **same unit** first: 45 cm as a percentage of 3 m is $\frac{45}{300} \times 100 = 15\%$.

Multipliers: increase and decrease in one step

Increasing by 12% means you keep the whole 100% and add 12%, so you end with 112% of the amount. Decreasing by 12% leaves 88%. The decimal for what you end with is the **multiplier**:

Change	You end with	Multiplier
increase by 12%	112%	1.12
decrease by 12%	88%	0.88
increase by $r\%$	$(100 + r)\%$	$1 + \frac{r}{100}$
decrease by $r\%$	$(100 - r)\%$	$1 - \frac{r}{100}$

So \$85 increased by 12% is $85 \times 1.12 =$ \$95.20, and \$85 decreased by 12% is $85 \times 0.88 =$ \$74.80. You can also do it in two steps (12% of 85 is 10.20, then add or subtract), but the multiplier is quicker and it is what you need for interest and for reverse percentages.

Percentage change

To find **by what percentage** something has changed, compare the change with the **original** amount:

$$\text{percentage change} = \frac{\text{new} - \text{original}}{\text{original}} \times 100.$$

From 250 to 290: the change is 40, and $\frac{40}{250} \times 100 = 16\%$ increase. **Profit and loss** are the same idea: the original is the **cost price** (what the seller paid), not the selling price.

Reverse percentages (Extended only)

Extended only: sometimes you know the amount **after** the change and need the amount **before**. After a 12% decrease a price is \$61.60. Then

$$\text{original} \times 0.88 = 61.60 \quad \Rightarrow \quad \text{original} = \frac{61.60}{0.88} = 70.$$

So the original price was \$70.

Adding 12% of \$$61.60$ back on would give $61.60 \times 1.12 =$ \$$68.99$, which is wrong: the 12% was taken from the original price, not from the sale price. **To go back, divide by the multiplier.**

Repeated percentage change (Extended only)

Extended only: when one change follows another, each one acts on the **new** amount, so you multiply the multipliers. A 25% increase followed by a 20% decrease gives

$$1.25 \times 0.8 = 1,$$

so the amount ends where it started. The two percentages do **not** add up to a 5% increase.

Simple interest

With **simple interest** you earn the same amount of interest every year, worked out on the amount you first put in (the **principal**). For principal P, rate $r\%$ per year and time n years:

$$\text{interest} = \frac{P \times r \times n}{100}.$$

\$$1200$ at 3.5% per year for 4 years earns $\frac{1200 \times 3.5 \times 4}{100} =$ \$$168$, so the investment is worth $1200 + 168 =$ \$$1368$.

Compound interest

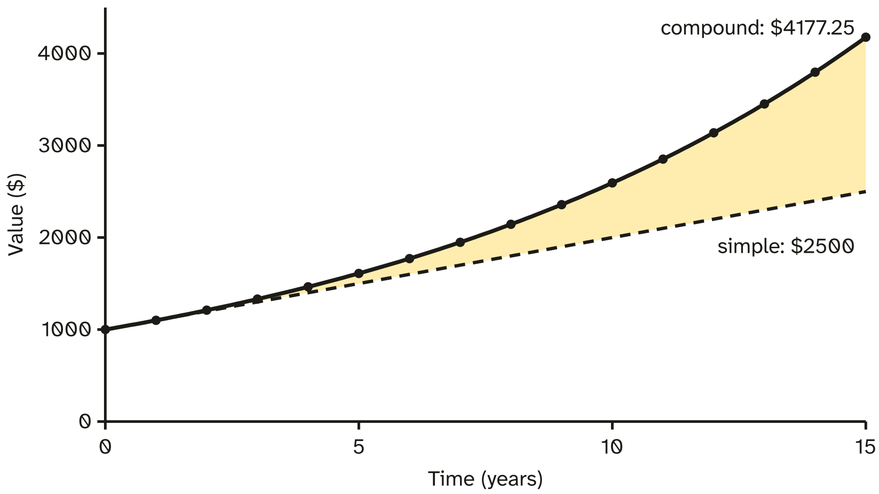
With **compound interest** the interest is added to the account each year, and next year's interest is worked out on the new, bigger amount. So you earn interest on your interest. Each year the amount is multiplied by the same multiplier:

Year	Value of \$$1200$ at 3.5%
start	1200
end of year 1	$1200 \times 1.035 = 1242$
end of year 2	$1242 \times 1.035 = 1285.47$
end of year n	1200×1.035^n

$$\text{value after } n \text{ years} = P\left(1 + \frac{r}{100}\right)^n.$$

After 4 years: $1200 \times 1.035^4 = 1377.027\ldots =$ \$$1377.03$, a little more than the \$$1368$ from simple interest. The **interest** is the value minus the principal.

The gap grows over time. The diagram shows \$$1000$ at 10% per year for 15 years: simple interest adds the same \$$100$ each year (a straight line), while compound interest grows faster and faster (a curve).



Exponential growth and decay (Extended only)

Extended only: compound interest is one example of **exponential growth**: anything that changes by the **same percentage** in each time period follows

$$\text{value after } n \text{ periods} = \text{starting value} \times (\text{multiplier})^n.$$

- **Growth** (a population rising by $r\%$ a year): multiplier $1 + \frac{r}{100}$, more than 1.
- **Decay** (a car losing $r\%$ of its value each year, a substance decaying): multiplier $1 - \frac{r}{100}$, less than 1.

A machine worth $\$30\,000$ that loses 20% of its value each year is worth $30\,000 \times 0.8^2 = \$19\,200$ after 2 years. It loses \$6000 in the first year but only \$4800 in the second, because the 20% is taken from a smaller value each time.

The period does not have to be a year. If the rate is "per month" or "every 15 minutes", then n counts months or 15-minute blocks.

Key facts and formulas

None of these is in the List of formulas on the exam paper, and the syllabus says the interest formulas are not given: learn them all.

Formula	Status
$r\%$ of $Q = \dfrac{r}{100} \times Q$	Learn it
A as a percentage of $B = \dfrac{A}{B} \times 100$ (same units)	Learn it
Multiplier for an increase of $r\%$: $1 + \dfrac{r}{100}$; for a decrease: $1 - \dfrac{r}{100}$	Learn it
Percentage change $= \dfrac{\text{new} - \text{original}}{\text{original}} \times 100$; percentage profit $= \dfrac{\text{profit}}{\text{cost price}} \times 100$	Learn it
(Extended only) Reverse percentage: original $= \dfrac{\text{new amount}}{\text{multiplier}}$	Learn it

Formula	Status
(Extended only) Repeated changes: multiply the multipliers	Learn it
Simple interest $I = \frac{Prn}{100}$; value $= P + I$	Learn it
Compound interest: value $= P\left(1 + \frac{r}{100}\right)^n$; interest $=$ value $-P$	Learn it
(Extended only) Exponential growth or decay: $V = A \times k^n$, with $k = 1 \pm \frac{r}{100}$	Learn it
Finding the rate: $1 + \frac{r}{100} = \left(\frac{\text{final}}{\text{start}}\right)^{1/n}$	Learn it

How to do it

In the questions we have tagged for this topic (128 questions from Papers 1–4, 2021–2025, two of them printed on two papers), the types came up this often. 43 of the 128 questions mix two or more types, so the counts add up to more than 128.

Question type	Questions
A percentage of a quantity, or one quantity as a percentage of another	43
Increasing or decreasing by a percentage	27
Percentage increase, decrease, profit or loss	25
Compound interest: value or interest	24
Reverse percentages	23
Simple interest	21
Finding a rate or a number of years	18
Exponential growth and decay	16
Repeated percentage change	9

1. A percentage of a quantity, or one quantity as a percentage of another (43 questions)

1. **Decide which it is.** "Find 23% of ..." or "calculate the discount" asks for a percentage **of** a quantity. "Write ... as a percentage of ..." or "what percentage of ..." asks for one quantity **as** a percentage.
2. **Percentage of:** multiply by the decimal. 23% of $\$640$ is $0.23 \times 640 = \$147.20$.
3. **As a percentage:** part $\div$ whole $\times 100$, with both in the same unit. 18 minutes as a percentage of 2 hours is $\frac{18}{120} \times 100 = 15\%$.
4. **Round** as asked: money to the cent, other answers to 3 significant figures if not exact.

Variations you will meet:

- **From a table, pie chart or ratio**: find the part and the whole first. A pie chart sector of 99° is $\frac{99}{360} \times 100 = 27.5\%$ of the total.
- **A deposit and payments**: a deposit of 25% of $\$1840$ is $\$460$. Add the deposit to the other payments to get the total paid, then compare it with the single price if asked.
- **Percentages over 100%**: 240% of 35 is $2.4 \times 35 = 84$. Change them to decimals to put values such as $\frac{3}{8}$ of m, 36% of m and 130% of m in order.
- **Part of a shape or a volume**: "the percentage not occupied" or "the percentage shaded" is (that area or volume) $\div$ (whole) $\times 100$.
- **Earnings plus a percentage**, such as a fixed wage plus a percentage of the profit: work out the percentage, then add.

2. Increasing or decreasing by a percentage (27 questions)

1. **Write the multiplier**: add the percentage to 100 for an increase, subtract it for a decrease, then divide by 100.
2. **Multiply** the original amount by it. $\$385$ increased by 8% is $385 \times 1.08 = \$415.80$.
3. Or, in two steps: find the percentage of the amount, then add it on or take it off. Both earn full marks.

Variations you will meet:

- **Discounts and sales** ("reduced by", "a loss of"): decrease. **Tax, service charges, pay rises** ("more than", "a profit of"): increase.
- **Selling at a percentage profit**: selling price $=$ cost price $\times$ the multiplier. If the cost changes and the percentage profit stays the same, apply the same multiplier to the **new** cost.
- **Higher pay for extra hours**: 25% more than $\$14$ per hour is $14 \times 1.25 = \$17.50$ per hour; pay the normal rate for the normal hours and the higher rate for the rest.
- **With a letter**: "the price on Tuesday is 25% more than $\$x$" is $1.25x$. Write the total as an equation and solve it.
- **Two different changes in one question** (such as a fall of 20% one year and then 15% the next) are repeated changes; see type 9.

3. Percentage increase, decrease, profit or loss (25 questions)

1. **Find the change**: new $-$ original (ignore the sign for a decrease).
2. **Divide by the original**, the amount **before** the change, and multiply by 100.
3. Say whether it is an increase or a decrease if the question does not.

For example, from 48 to 57 the change is 9, so the increase is $\frac{9}{48} \times 100 = 18.75\%$.

Variations you will meet:

- **Percentage profit or loss**: divide the profit (or loss) by the **cost price**. Bought for $\$44$ and sold for $\$57.20$: profit $\$13.20$, and $\frac{13.20}{44} \times 100 = 30\%$ profit. Bought for $\$260$ and sold for $\$221$: $\frac{39}{260} \times 100 = 15\%$ loss.

- **The multiplier way**: $\frac{\text{new}}{\text{original}} \times 100 - 100$. A result of 118% means an increase of 18%, not 118%.
- **"Is the profit at least $x\%$?"**: work out the actual percentage (or the price that $x\%$ would give) and compare, then answer yes or no.
- **"Show that the percentage increase is ..."**: show the change, the division by the original and the result.
- **After working out totals first**, such as the cost of a payment plan compared with the single price: the single price is the original.

4. Compound interest: value or interest (24 questions)

1. **Write the multiplier** $1 + \frac{r}{100}$.
2. **Raise it to the power** of the number of periods, and multiply by the principal: value $= P\left(1 + \frac{r}{100}\right)^n$.
3. **Answer the question asked**: the **value** (or amount) is the whole result; the **interest** is the value minus the principal.

For example, $\$2700$ at 3% per year for 5 years: $2700 \times 1.03^5 = 3130.040\ldots = \$3130.04$. The interest is $\$430.04$.

Variations you will meet:

- **A rate per month**: n is the number of **months**. 0.4% per month for 3 years is $\times 1.004^{36}$. Don't change it into a yearly rate.
- **"Correct to the nearest dollar" or "nearest $\$10$"**: round only at the end, and to what is asked.
- **Borrowing** with compound interest works the same way: the amount repaid is the value.
- **Compare with simple interest** (see type 6): work out both final values and say which is larger.

5. Reverse percentages (23 questions)

Extended only: this type is only in the Extended syllabus.

1. **Write the multiplier** for the change that has already happened.
2. **Divide** the amount you know by the multiplier. After a 20% discount a price is $\$92$: the original was $\frac{92}{0.8} = \$115$.
3. **Check** by going forward: $115 \times 0.8 = 92$.

Variations you will meet:

- **"A is $p\%$ of the total"**: total $= A \div \frac{p}{100}$. 48 is 64% of $\frac{48}{0.64} = 75$.
- **Cost price from selling price and percentage profit**: sold for $\$69$ at a 15% profit, so the cost was $\frac{69}{1.15} = \$60$ and the profit was $\$9$. If the question asks for the profit, subtract.
- **Tax included**: $\$80.50$ including 15% tax is $\frac{80.50}{1.15} = \$70$ before tax, so the tax is $\$10.50$.
- **"x is 16% more than last year"** or "this was a decrease of 10% on the year before": divide by 1.16 or 0.9.
- **The value some years ago** after exponential change: divide by the multiplier raised to the number of years (see type 8).

- **Several items**: if the sale price of 5 items is given, find one item's sale price first, then divide by the multiplier.

6. Simple interest (21 questions)

1. **Interest** $= \dfrac{P \times r \times n}{100}$. $\$850$ at 2.4% per year for 5 years: $\frac{850 \times 2.4 \times 5}{100} = \$102$.
2. **Value** (or "total amount") $=$ principal $+$ interest $= 850 + 102 = \$952$.
3. Read which one the question asks for.

Variations you will meet:

- **Finding the rate**: rearrange, $r = \dfrac{100 \times I}{P \times n}$. $\$1600$ earning $\$216$ in 6 years: $r = \frac{100 \times 216}{1600 \times 6} = 2.25$. If you are given the final value, subtract the principal first to get I.
- **Finding the time or the principal**: rearrange the same formula in the same way.
- **Simple and compound together**: use the right method for each account.

7. Finding a rate or a number of years (18 questions)

Finding the rate r (compound interest or growth):

1. Write the equation: $P\left(1 + \frac{r}{100}\right)^n = \text{final value}$.
2. Divide by P, then take the nth root: $1 + \frac{r}{100} = \left(\frac{\text{final}}{P}\right)^{1/n}$.
3. Subtract 1 and multiply by 100.

For example, $\$6200$ grows to $\$7100$ in 4 years: $\left(\frac{7100}{6200}\right)^{1/4} = 1.03446\ldots$, so $r = 3.45$ (3 s.f.). On a calculator, use the $\sqrt[x]{\ }$ key, or raise to the power $\frac{1}{4}$.

Finding the number of complete years (or days, or hours):

1. Write the condition, such as $900 \times 1.05^n > 1200$.
2. **Try values of** n on your calculator until the condition first becomes true, and write down the values either side: $n = 5$ gives $\$1148.65$, $n = 6$ gives $\$1206.09$.
3. The answer is the first value that works: 6 complete years.

Variations you will meet:

- **"The value has doubled"**: use any starting value P and final value $2P$, so $\left(1 + \frac{r}{100}\right)^n = 2$. Doubling in 15 years gives $r = (2^{1/15} - 1) \times 100 = 4.73$.
- **Given the interest, not the value**: add the interest to the principal first.
- **Then use the rate**: once you have the multiplier, use it to find the value at another time. Keep the unrounded multiplier in your calculator.
- **"In which year ..."**: find the number of years, then add it to the starting year.
- **For decay**, the condition is "first less than", and the multiplier is less than 1.

- **The rate for one year**: this is simply a percentage increase, $\frac{\text{new}-\text{original}}{\text{original}} \times 100$.

8. Exponential growth and decay (16 questions)

Extended only: this type is only in the Extended syllabus.

1. **Find the multiplier**: $1+\frac{r}{100}$ for growth, $1-\frac{r}{100}$ for decay.
2. **Count the periods** n: years, days, hours, or blocks of time (for example 15-minute blocks).
3. **Value** $=$ start $\times$ multiplier^n. A population of $72\,000$ growing at 1.5% per year: after 6 years $72\,000 \times 1.015^6 = 78\,727.9\ldots$, about $78\,728$.

Variations you will meet:

- **The decrease or the increase**: find the new value, then subtract.
- **A formula**: "a value of $\$38\,000$ decreases by 18% each year" gives $V = 38\,000 \times 0.82^n$. Write it with $V =$ and the numbers in.
- **Going back in time**: divide by the multiplier^n. After decreasing by 5% a year for 3 years a value is 8573.75; 3 years ago it was $\frac{8573.75}{0.95^3} = 10\,000$.
- **The form** $P = ab^x$: a is the value when $x = 0$. If $P = 500$ at $x = 0$ and $P = 720$ at $x = 2$, then $a = 500$ and $b^2 = \frac{720}{500} = 1.44$, so $b = 1.2$. Then use $P = 500 \times 1.2^x$ for other values of x.
- **Number of periods until a limit**: see type 7.
- **Salary or amount raised** increasing by the same percentage each year: the same method, counting the years carefully (from 2032 to 2038 is 6 years).

9. Repeated percentage change (9 questions)

Extended only in the syllabus. A Core paper has also asked for two changes in a row; there you can simply apply one change at a time.

1. **Write a multiplier for each change**, each one based on the amount just before it.
2. **Multiply the multipliers** to get the overall multiplier.
3. **Change it back to a percentage**: overall multiplier $\times 100 - 100$. A negative result is a decrease.

For example, an increase of 40% then a decrease of 40%: $1.4 \times 0.6 = 0.84$, an overall **decrease** of 16%, not 0%.

Variations you will meet:

- **Finding the value at the end**: multiply the start value by each multiplier in turn.
- **Finding one unknown rate**: a rate of 4% in the first year and an overall increase of 9.2% after two years gives $\frac{1.092}{1.04} = 1.05$, so the second year's rate was 5%.
- **Finding the start value**: divide the final value by the overall multiplier.

- **With a letter**: if someone spends x in one month and 5% more each month than the month before, the three months are x, $1.05x$ and $1.05^2x = 1.1025x$. If the total is 630.50, then $3.1525x = 630.50$ and $x = 200$.

Worked examples

The bold codes show where marks are earned, as in Cambridge mark schemes. The number is how many marks.

- **M1** method mark: for a correct method, even if the numbers slip.
- **A1** accuracy mark: for a correct answer; it needs the M mark before it.
- **B1** mark for a correct result on its own, with no method needed.

Example 1

(a) A jacket costs $\$76$. In a sale, the price is reduced by 35%. Calculate the sale price. **[2]**

(b) Leo buys a bike for $\$240$. He sells it for $\$282$. Calculate his percentage profit. **[2]**

(c) Write 27 as a percentage of 120. **[1]**

(a) $76 \times (1 - 0.35) = 76 \times 0.65$ **M1** (or **B1** for the discount, $\$26.60$)

$= \$49.40$ **A1**

(b) Profit $= 282 - 240 = 42$. Percentage profit $= \dfrac{42}{240} \times 100$ **M1**

$= 17.5\%$ **A1**

(c) $\dfrac{27}{120} \times 100 = 22.5\%$ **B1**

Example 2

Nadia invests $\$3700$ at a rate of 4.5% per year **simple** interest. Omar invests $\$3700$ at a rate of 4% per year **compound** interest.

(a) Calculate the total value of Nadia's investment at the end of 6 years. **[3]**

(b) Calculate the interest Omar earns in the 6 years. **[3]**

(a) Interest $= \dfrac{3700 \times 4.5 \times 6}{100}$ **M1**

$= \$999$ **A1**

Value $= 3700 + 999 = \$4699$ **A1**

(b) Value $= 3700 \times 1.04^6 = 4681.680\ldots$ **M1**

Interest $= 4681.680\ldots - 3700$ **M1**

$= \$981.68$ **A1**

Example 3

Extended only: reverse percentages and repeated change.

(a) The monthly rent of a flat increases by 16%. The new rent is $\$638$. Calculate the rent before the increase. **[2]**

(b) The price of a share rises by 30% in one year. In the next year the new price falls by 25%. Find the overall percentage change in the price over the two years. **[3]**

(a) Original $\times 1.16 = 638$ **M1**

Original $= \dfrac{638}{1.16} = \$550$ **A1**

(b) Overall multiplier $= 1.3 \times 0.75$ **M1**

$= 0.975$ **A1**

$0.975 \times 100 - 100 = -2.5$, so the price falls by 2.5% overall. **A1** (a decrease, not an increase of 5%)

Example 4

Extended only: parts (a) and (b), exponential decay.

(a) A car costs $\$17\,600$. Its value decreases exponentially at a rate of 14% per year. Calculate the value of the car at the end of 3 years. Give your answer correct to the nearest dollar. **[2]**

(b) Find the number of complete years it takes for the value of this car to first fall below $\$5500$. **[3]**

(c) Tamsin invests $\$2600$ at a rate of $r\%$ per year compound interest. At the end of 9 years the investment is worth $\$3400$. Find the value of r. **[3]**

(a) $17\,600 \times 0.86^3$ **M1**

$= 11\,194.58\ldots = \$11\,195$ **A1**

(b) Solve $17\,600 \times 0.86^n < 5500$ by trying values of n:

$n = 7$: $17\,600 \times 0.86^7 = 6123.52\ldots$ (still above 5500)

$n = 8$: $17\,600 \times 0.86^8 = 5266.23\ldots$ (below 5500) **M2** for evaluating both

The answer is 8 years. **A1**

(c) $2600\left(1+\frac{r}{100}\right)^9 = 3400$ **M1**

$1+\frac{r}{100} = \sqrt[9]{\frac{3400}{2600}} = 1.030255\ldots$ **M1**

$r = 3.03$ (3 s.f.) **A1**

Common mistakes

- **Dividing by the wrong amount in a percentage change.** Examiners regularly see candidates divide by the new value or the selling price instead of the original or the cost price. Always divide by the amount **before** the change.
- **Reversing a percentage by working it forward.** Examiners see candidates take 15% of a price that already includes 15%, or multiply by 1.18 when they should divide. If a price after a 25% rise is $\$150$, the original is $\frac{150}{1.25} = \$120$, not $150 \times 0.75 = \$112.50$.
- **Adding the percentages of repeated changes.** A rise of 10% then 30% is $1.1 \times 1.3 = 1.43$, a 43% rise, not 40%. Reports describe answers of 33% from adding two percentages and 3% from subtracting them.
- **Giving the multiplier as the answer.** An overall multiplier of 1.43 is a 43% increase; writing 143% or 1.43 as "the percentage increase" loses the mark.
- **Using the wrong kind of interest.** Every year examiners see simple interest used for compound questions and the other way round. Check the words "simple" and "compound".
- **Giving the interest when the value was asked for, or the other way round.** "Value", "total amount" and "amount he repays" include the principal; "interest" does not. Some candidates also add or subtract the principal a second time.
- **Changing a monthly rate into a yearly one.** 0.5% per month for 2 years is $1.005^{24} = 1.127\ldots$, which is not the same as 6% per year for 2 years ($1.06^2 = 1.1236$). Use the rate per month and the number of months.
- **Not taking the root when finding a rate.** From $P\left(1+\frac{r}{100}\right)^n = A$, you need the nth root of $\frac{A}{P}$, not $\frac{A}{P} \div n$. Also, don't write $\left(1-\frac{r}{100}\right)$ for growth.
- **Decaying at a fixed amount.** Exponential decay takes the same **percentage** each time, not the same amount, so you cannot find the first loss and multiply it by the number of years.
- **Counting the years wrongly**, for example 5 years from 2027 to 2031 (it is 4), or giving the number of years when the question asks for the year.
- **Rounding too early.** Examiners report inaccurate rates and values from rounding the multiplier or an in-between value. Keep the full calculator value until the end.
- **Ignoring the accuracy asked for**, such as "correct to the nearest dollar" or "nearest $\$10$".

How to get the marks

- **Write the calculation** before the answer, such as 76×0.65 or $\frac{42}{240} \times 100$. If the final answer is wrong, the method mark can still be awarded.

- **Compound interest**: the method mark is for $P\left(1+\frac{r}{100}\right)^n$ with the right numbers. Working it out year by year is correct but slow, and easy to spoil by rounding.
- **"Find the number of complete years"**: show the values for the two numbers of years either side of the limit, then give the whole number. The mark scheme gives credit for evaluating these trials even if the final answer is wrong.
- **Finding a rate**: show the equation first, such as $2600\left(1+\frac{r}{100}\right)^9=3400$. This earns a method mark on its own. Give the rate to at least 3 significant figures.
- **"Show that" comparisons** (for example, which of two investments is larger): work out **both** final values, write them down, and finish with a sentence that compares them.
- **Formulas for exponential change**: write the formula in full, with $V=$ at the start and n as the power, such as $V=38\,000\times0.82^n$. Leaving out the "$V=$" or the power loses marks.
- **Money**: give answers to the nearest cent (two decimal places) unless the question says otherwise; "$\$43.6$" should be written "$\$43.60$".
- **Accuracy**: give exact answers in full, otherwise to 3 significant figures, or to the accuracy the question asks for. Round only at the end.

Quick check

1. Find 115% of 64.
2. The price of a laptop falls from $\$850$ to $\$731$. Calculate the percentage decrease.
3. Priya invests $\$4200$ at a rate of 2.75% per year simple interest. Calculate the total interest she earns in 8 years.
4. **(Extended)** After a pay rise of 7%, Ben's weekly wage is $\$481.50$. Calculate his weekly wage before the rise.
5. **(Extended)** A colony of 6500 bacteria grows exponentially at a rate of 22% per hour. (a) Find the number of bacteria after 5 hours, to the nearest whole number. (b) Find the number of complete hours until the colony first has more than $30\,000$ bacteria.

Answers

1. $1.15 \times 64 = 73.6$.
2. The decrease is $850 - 731 = 119$, and $\frac{119}{850} \times 100 = 14\%$.
3. $\frac{4200 \times 2.75 \times 8}{100} = \$924$.
4. $\frac{481.50}{1.07} = \$450$.
5. (a) $6500 \times 1.22^5 = 17\,567.6\ldots$, so $17\,568$ bacteria. (b) After 7 hours there are $6500 \times 1.22^7 = 26\,147.6\ldots$ and after 8 hours $6500 \times 1.22^8 = 31\,900.09\ldots$, so it takes 8 hours.

Past questions to try

- **0580/22/O/N/24 Q15**: the number of bacteria after a few hours of exponential growth.
- **0580/11/O/N/24 Q20**: the percentage loss when a car is sold for less than it cost.
- **0580/23/O/N/21 Q15**: a reverse percentage, the cost before a percentage increase.
- **0580/21/O/N/21 Q12**: the overall percentage change after a decrease and then an increase.