

Exponential Growth And Decay

Quick revision notes [Open it online](#)

Name: _____

Date: _____

At a glance

Repeated percentage change: growth, decay, working backwards, finding the rate and the time.

1. Growth and decay multipliers
2. Working backwards and finding the rate
3. Finding the number of periods

1. Growth and decay multipliers

☐ I revised this

- Repeated percentage change multiplies by the same number each period.
- Growth of $r\%$ → multiplier $(1 + r/100)$. Decay of $r\%$ → multiplier $(1 - r/100)$.
- After n periods: amount = starting amount $\times$ multiplier ^{n} .
- Typical contexts: population, bacteria, compound interest (growth); depreciation, radioactive decay, cooling (decay).

Change	Multiplier
+4%	1.04
+12.5%	1.125
-15%	0.85
-2.5%	0.975
doubles	2
halves	0.5

Formulas

$A = P(1 + r/100)^n$	growth
$A = P(1 - r/100)^n$	decay

Worked example

A car worth \$12 000 loses 15% of its value each year. Find its value after 3 years.

1. Multiplier 0.85.
2. $12\,000 \times 0.85^3 = 7369.5$.

\$7369.50

2. Working backwards and finding the rate

☐ I revised this

- Starting amount = final amount $\div$ multiplier ^{n} .
- To find the rate: (final $\div$ start) = multiplier ^{n} , so take the n -th root to get the multiplier.
- Multiplier 1.1 means 10% growth; 0.92 means 8% decay.

Worked example

A value grows from 400 to 484 in 2 years at a constant percentage rate. Find the rate.

1. $484 \div 400 = 1.21$.
2. Multiplier = $\sqrt{1.21} = 1.1$.

10% per year

3. Finding the number of periods

☐ I revised this

- No logarithms needed: try $n = 1, 2, 3, \dots$ on the calculator until the amount passes the target.
- Give the first whole period that passes it, and show the values either side.
- Half-life questions: each half-life multiplies the amount by 0.5.

How to do it

1. Write amount = $P \times \text{multiplier}^n$.
2. Try values of n .
3. Write the value just below and just above the target.
4. Answer with the first n that passes it.

Worked example

\$800 is invested at 3% compound interest. After how many whole years is it first worth more than \$1000?

1. $800 \times 1.03^7 = 983.9\dots$

2. $800 \times 1.03^8 = 1013.4\dots$

8 years

Common mistakes

Don't write	Write instead
✗ 15% depreciation for 2 years = 30% off	✓ Multiply by 0.85 twice: 0.7225 (27.75% off)
✗ Using 1.15 for a 15% decrease	✓ Decrease: 0.85
✗ Giving the year just before the target is reached	✓ Give the first whole period that passes it
✗ Dividing by 2 for the rate from a 2-year change	✓ Take the square root of the overall multiplier

In the exam

- Write the multiplier first; most method marks come from it.
- Show the trial values when finding the number of years.
- Read whether the question wants the amount, the increase/decrease, or the percentage.

My notes

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