Your notes

GCSE Maths: revision notes

Systematic listing and the product rule

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Start here: counting without missing any

- Some questions ask how many ways something can happen: outfits, codes, meals. Guessing misses some, so you need a system.
- Listing systematically means keeping the first choice fixed while you go through every option for the next one, then changing the first choice.
- The **product rule** is the shortcut: if there are m ways to do one thing and n ways to do another, there are m × n ways to do both.

Systematic listing

- List **outcomes** in a logical order so you don't miss any or repeat any.
- Fix the first item and change the others, then move to the next first item: for a coin and a spinner numbered 1 to 3: H1, H2, H3, T1, T2, T3.

The product rule

- If there are m ways of doing one thing and n ways of doing another, there are m × n ways of doing both.
- 3 starters and 4 main courses give 3 × 4 = 12 different meals.
- It works for more than two choices: 4 tops, 3 pairs of trousers and 2 pairs of shoes give 24 outfits.

With and without repeats

- If items can be repeated, each position has the same number of choices: 4-digit PINs from 0–9 give 10 × 10 × 10 × 10 = 10 000.

- If items can't be repeated, the number of choices goes down by one each time: 3 different books can be arranged in $3 \times 2 \times 1 = 6$ ways.
- Deal with restrictions first, for example a code that can't start with 0.

Exam tip

- For 'how many ways', multiply the number of choices at each stage. Write the sum down before you work it out.

Common mistakes

- Adding the choices rather than multiplying them.
- Forgetting there's one fewer choice when an item can't be used twice.

Worked examples

A café has 3 starters and 4 main courses. How many different two-course meals are there?

For each of the 3 starters, there are 4 mains to go with it. **3 lots of 4**

Use the product rule. **3×4**

Answer: 12 meals

List all the ways to arrange the letters A, B and C.

Fix A first, and swap the other two. **ABC, ACB**

Then B first. **BAC, BCA**

Then C first. **CAB, CBA**

Check with the product rule: 3 choices for the first letter, 2 for the second, 1 for the last. **$3 \times 2 \times 1 = 6$**

Answer: 6 ways

Key terms

Outcome	A possible result.
Systematic	Organised and in a logical order.
Product rule	The total number of combinations is found by multiplying the number of choices for each part.
Arrangement	A way of putting items in order.
Combination	A selection of items.

Quick questions

Cover the answers and test yourself: remembering is what makes it stick.

Your notes

1. A café has 3 starters and 4 main courses. How many different two-course meals are there?
2. How many 4-digit PINs can be made using the digits 0–9, if digits can be repeated?
3. In how many ways can 3 different books be arranged on a shelf?
4. How many 2-letter codes can be made from the 26 letters, if letters can be repeated?
5. How many outcomes are there when two coins are flipped?
6. 5 people are in a team. In how many ways can a captain and a vice-captain be chosen?
7. How many 3-digit numbers can be made from the digits 1, 2 and 3, using each digit once?
8. Jo has 4 tops, 3 pairs of trousers and 2 pairs of shoes. How many different outfits can she make?

Answers

1. 12
2. 10 000
3. 6
4. 676
5. 4
6. 20
7. 6
8. 24

What to do next

Practise 12 questions on this topic

Try 4 exam questions, with mark schemes

Read the lesson, one step at a time

Free revision for GCSE and KS3 at lycolearn.co.uk. Some notes are for one exam board only, and say so in brackets.

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