GCSE Maths – Number

Systematic Listing

Notes

WORKSHEET

Systematic Listing

Systematic listing is a technique used to work out all **possible combinations** or **outcomes** in a particular situation. The systematic, ordered nature of this method means that no combinations are missed.

For example, we may use a cafe menu as an example.

Example: A cafe is selling drinks and snacks. Today, the drinks they are selling are **tea**, **coffee**, and **orange juice**. The snacks are **apples**, **cake** and **crisps**. How many possible combinations are there of one drink and one snack?

We can systematically list all possible combinations:

- *Tea and an apple*
- *Tea and cake*
- *Tea and crisps*

- *Coffee and an apple*
- *Coffee and cake*
- *Coffee and crisps*

- *Orange juice and an apple*
- *Orange juice and cake*
- *Orange juice and crisps*

In total, there are 9 possible combinations.

We work through each possible combination, starting with the first drink and first snack, in an ordered fashion.

A better way could be to create a table, which makes finding the possible combinations easier.

Example: There are 4 **year 7** students and 6 **year 8** students. How many possible ways can a year 7 and year 8 student sit together?

Create a table.

	1	2	3	4	5	6
1	✔	✔	✔	✔	✔	✔
2	✔	✔	✔	✔	✔	✔
3	✔	✔	✔	✔	✔	✔
4	✔	✔	✔	✔	✔	✔

There are 24 ticks, therefore, 24 combinations.

The Product Rule (Higher Only)

Systematic listing is a useful strategy to find all possible combinations, but it is impractical if we are dealing with larger groups. Instead, we use the **product rule**.

To apply the product rule, we **count** how many objects there are in each group and **multiply** these. For example, going back to the cafe menu example, if there are 5 drinks on offer and 6 snacks, there are 30 possible combinations.

Example: At a restaurant, there are 6 possible starters, 5 mains and 4 desserts on offer. Using the product rule, calculate how many possible combinations of starter, main and dessert there are.

Using the product rule, we multiply the number of starters x number of mains x number of desserts.

$6 \times 5 \times 4 = 120$ *combinations.*

Example: Two 6-sided dice are rolled together. Work out the possible number of combinations.

Both dice will have 6 sides.
Therefore, possible combinations $= 6 \times 6 = 36$
36 *possible combinations.*

One thing we need to watch out for with the product rule is **duplicates**. In this case, we need to adjust the numbers in each group.

Example: Calculate the number of possible combinations, of 3 numbers in a lottery with 20 numbered balls.

In the first draw, there are 20 possible numbers.
However, in the second draw, there are 19 remaining numbers to pick from. Therefore, using a re-adjusted product rule:

$20 \times 19 \times 18 = 6840$ *possible combinations.*

Example: Work out the number of ways 7,8,9,1,2,5 can be ordered.

If we start from 7, *it will have 6 options.*
8 *will have 5 options because one of the locations will already be taken by* 7.

Similarly, next will have 4, *then* $3, 2, 1$.

Therefore, total ways:
$6 \times 5 \times 4 \times 3 \times 2 \times 1 = 720$

Systematic Listing - Practice Questions

1. A school plays different sports: cricket, football, basketball, table tennis, volleyball. How many possible combinations can be made from 1 person and 1 sport?

2. You roll a six sided dice and flip a coin at the same time. List all possible outcomes.

HIGHER ONLY

3. There are a group of boys and a group of girls auditioning to play Romeo and Juliet. There are 20 boys and 17 girls. Work out the total number of pairs that can be made for the role of Romeo and Juliet.

4. A bike has a two digit lock. The digits range from 1 to 9 including 1 and 9. How many possible combinations can be made in the lock?

5. How many possible ways of ordering the numbers 1, 5, 6, 7, 5?

Worked solutions for the practice questions can be found amongst the worked solutions for the corresponding worksheet file.