

Product Rule for Counting

Starter

- (Review of last lesson)** A tetrahedron has the numbers 1, 3, 4 and 4 written on its faces. A coin has the numbers 2 and 5 on its sides. The tetrahedron and coin are both tossed and the sum of the result is found.

 - Draw a probability space diagram to show the possible outcomes.
 - Find the probability that the sum is:
 - 6
 - 6 or 7
 - greater than 4.
- A password has one entry. The password can be made up of letters (upper or lower case) and digits. How many different passwords are there?
- If you have two entries, how many different passwords are there?

Notes

When solving such problems, draw a box for each entry and write the number of ways each box can be filled inside the box. Then find the product of the numbers in the box.

For question 3 from the starter, we would draw two boxes and write 62 in each box because there are 62 different ways to have each entry.

62	62
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Two entries

If there are p ways of doing the 1st entry and q ways of doing the 2nd entry, then the total number of ways of doing the two tasks is $p \times q$.

N.B. This can be extended to any number of entries (see **E.g. 1**)

E.g. 1 A code has 3 entries — the first is the letter b or g (depending on whether the person is a boy or girl), the second is an odd digit and the third is a lower case letter from the alphabet.

Working:

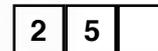
Three entries so 3 boxes:



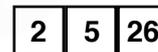
1st entry (box): b or g so 2 ways



2nd entry: odd digit (i.e. 1, 3, 5, 7, 9) so 5 ways



3rd entry (box): lower case letter so 26 ways



Total number of ways = $2 \times 5 \times 26 = 260$ *product of numbers in boxes*

n entries, all having the same number of ways

If there are n entries and each entry has w number of ways, then the total number of ways is w^n . See starter, question 2.

E.g. 2 A password has 6 entries. The first 2 entries must be a capital letters but a letter cannot be repeated. The next 2 entries must be digits, again without repeat. The last 2 letters can be lower case letters, capital letters or digits with repeats allowed. How many different passcode are there?

Working:

6 entries so 6 boxes

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1st entry: capital letter so 26 ways

2nd entry: capital letter but no repeat so 25 ways

3rd entry: digit so 10

4th entry: digit but no repeat so 9

5th and 6th entries: lower case letters, capital letters or digits so 62

26	25	10	9	62	62
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$$26 \times 25 \times 10 \times 9 \times 62^2 = 224, 874, 000$$

E.g. 3 A code has 3 entries. Each entry must be a digit 0-9 and the overall code must be odd. How many different codes are there if the first entry cannot be zero?

E.g. 4 Peter looks in his freezer and sees 12 microwave meals. Assuming he eats one microwave meal per day, Monday-Friday, how many possible combinations are there?

E.g. 5 A restaurant has a menu with 3 choices for a starter, 5 choices for the main dish and 4 choices for dessert.

- (a) How many possible 3-course meals are there?
- (b) Given that all customers must choose a main meal, how many 2-course meals are there?

Video: [Product rule for counting](#)

[Solutions to Starter and E.g.s](#)

Exercise

9-1 class textbook:	p240 E8.1 Qu 1-15 odd
A*-G class textbook:	No exercise
9-1 homework book:	p82 E8.1 Qu 1-8
A*-G homework book:	No exercise

Summary

Two entries — p ways of doing the 1st entry and q ways of doing the 2nd entry, then the total number of ways of doing the two tasks is $p \times q$.

n entries, all having the same number of ways — n entries and each entry has w number of ways, then the total number of ways is w^n .

[Homework book answers \(only available during a lockdown\)](#)