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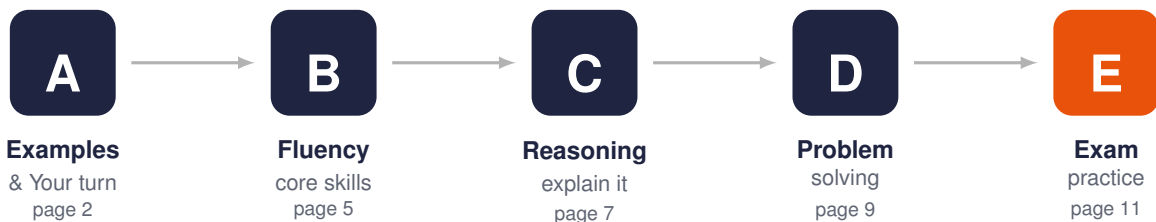
GCSE MATHEMATICS • NUMBER

Systematic Listing

Worksheet

Pearson Edexcel GCSE (1MA1) & International GCSE (4MA1) • No calculator

Free Systematic Listing worksheet for GCSE and iGCSE Maths, with full worked solutions



Tap a section to jump straight to it

By the end of this worksheet you can: list outcomes in an organised way so that none are missed or repeated • list arrangements and pairs • solve listing problems with conditions • *Higher*: use the product rule for counting, with and without repetition, with restrictions, and when order does not matter.

Which questions are for me?

FOUNDATION Everyone starts here. These skills appear on both tiers.

HIGHER The product rule for counting. This is Higher-only content: multiplying choices, codes with and without repeats, restrictions, and counting pairs when order does not matter.

Every section has both, clearly labelled. Questions get harder as you go, and every skill in Sections A to D is needed in Section E.

Track your progress

Section	B	C	D	E
Foundation marks	17	11	15	11
Higher marks	12	15	17	14
My score				

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A**Worked examples & Your turn**

Read each example carefully. Cover it up, then answer the question beside it using the same method.

FOUNDATION

Everyone starts here

Worked example A1: listing two events

A spinner can land on Red, Green or Blue. A coin can land on Heads or Tails.

List all the possible outcomes.

Fix the first item. List everything that goes with it. Then move on.

RH RT GH GT BH BT

6 outcomes

Your turn A1

A four-sided dice is numbered 1, 2, 3, 4. A coin can land on Heads or Tails.

List all the possible outcomes.

Worked example A2: listing arrangements

List all the three-digit numbers that use each of the digits 2, 5 and 8 once.

How many of them are even?

Fix the first digit, and work through in order of size.

258 285 528 582 825 852

Even numbers end in 2 or 8: 258, 528, 582, 852

6 numbers, 4 are even

Your turn A2

List all the three-digit numbers that use each of the digits 1, 4 and 7 once.

How many of them are less than 200?

Worked example A3: pairs where order does not matter

Two of the four friends Ana, Ben, Cal and Dee are chosen to play a game.

List all the possible pairs.

*"Ana and Ben" is the same pair as "Ben and Ana". Only pair each person with the people **after** them.*

AB AC AD BC BD CD

6 pairs

Your turn A3

An ice cream shop has five flavours: V, C, S, M and T. Kim chooses two **different** flavours.

List all the possible pairs.



HIGHER*Higher only: the product rule for counting***Worked example A4: multiplying the choices**

A menu has 4 starters, 6 main courses and 3 desserts.

How many different three-course meals are there?

For **each** starter there are 6 mains, and for each of those there are 3 desserts. Multiply.

$$4 \times 6 \times 3 = 72$$

72

Your turn A4

Raj has 5 shirts, 3 pairs of trousers and 2 jackets.

How many different outfits of a shirt, trousers and a jacket can he make?

Worked example A5: with and without repeats

A code has 3 digits, each chosen from 1, 2, 3, 4, 5

How many codes are there if **(a)** digits can repeat
(b) digits cannot repeat?

With repeats there are 5 choices every time.

(a) $5 \times 5 \times 5 = 125$

Without repeats there is one fewer choice each time.

(b) $5 \times 4 \times 3 = 60$

(a) 125 (b) 60

Your turn A5

A code has 4 letters, each chosen from A, B, C, D, E, F

How many codes are there if **(a)** letters can repeat
(b) letters cannot repeat?

Worked example A6: deal with the restriction first

Three-digit numbers are made from the digits 1, 2, 3, 4, 5 with no digit repeated.

How many of them are even?

Fill the restricted place first. The last digit must be 2 or 4: 2 choices.

Then fill the other places from what is left: 4 choices, then 3.

$$2 \times 4 \times 3 = 24$$

24

Your turn A6

Four-digit numbers are made from the digits 1, 2, 3, 4, 5, 6 with no digit repeated.

How many of them are odd?



Worked example A7: when order does not matter

12 teams are in a league. Each team plays every other team once.

How many matches are played?

Choosing a first team and a second team gives $12 \times 11 = 132$

But "A plays B" and "B plays A" are the same match, so every match has been counted twice. Halve it.

$$132 \div 2 = 66$$

66

Your turn A7

9 people meet. Each person shakes hands once with every other person.

How many handshakes are there?



B**Fluency**

Each question is a designed sequence. From one part to the next, ask yourself: what changed, and what did it do to the answer?

FOUNDATION

Everyone starts here

- B1** (a) List all the outcomes when two coins are thrown. (b) List all the outcomes when three coins are thrown.
- (c) How many outcomes are there when a coin is thrown and a six-sided dice is rolled?
- (d) How many outcomes are there when two six-sided dice are rolled? [4 marks]
- B2** A café sells two main courses: pasta (P) and curry (C). It sells three drinks: tea (T), juice (J) and water (W).
- List all the possible combinations of one main course and one drink. [2 marks]
- B3** (a) List the ways of arranging the letters A and B in a row.
- (b) List the ways of arranging the letters A, B and C in a row.
- (c) List the two-digit numbers that can be made from the digits 1, 2, 3 if digits **can** repeat.
- (d) List the two-digit numbers that can be made from the digits 1, 2, 3 if digits **cannot** repeat. [4 marks]
- B4** Order does not matter. List all the ways of choosing
- (a) 2 letters from A, B, C (b) 2 letters from A, B, C, D (c) 2 letters from A, B, C, D, E
- (d) 3 letters from A, B, C, D [4 marks]
- B5** (a) List the ways of paying exactly 20p using only 10p and 5p coins.
- (b) A red dice and a blue dice are rolled. List the ways of scoring a total of 7, writing the red score first. [3 marks]



HIGHER*Higher only: the product rule for counting***B6** Work out the number of ways of choosing

- (a) one item from 3 and one item from 4 (b) one item from 3, one from 4 and one from 5
(c) a letter of the alphabet followed by a digit from 0 to 9 (d) heads or tails on each of 5 coins

[4 marks]**B7** Work out the number of

- (a) four-digit PINs using the digits 0 to 9, when digits can repeat
(b) four-digit PINs using the digits 0 to 9, when digits cannot repeat
(c) three-letter codes from A, B, C, D, E, when letters cannot repeat
(d) three-letter codes from A, B, C, D, E, when letters can repeat

[4 marks]**B8** Work out the number of ways of choosing

- (a) a pair from 6 people (b) a pair from 10 people (c) a pair from 20 people
(d) one boy and one girl from 8 boys and 7 girls

[4 marks]

C**Reasoning**

Show your working and explain your thinking. A correct answer without a reason does not score full marks.

FOUNDATION

Everyone starts here

- C1** Sam lists the outcomes when two coins are thrown as HH, HT, TT. He says there are 3 outcomes. Explain the mistake Sam has made. [2 marks]
- C2** Ella lists the three-digit numbers that use 1, 2 and 3 once each: 123, 132, 213, 231, 312. Which number has Ella missed? Explain how listing in order helps you to avoid this. [2 marks]
- C3** A lunch deal has 3 types of sandwich and 2 types of drink. Jo says, " $3 + 2 = 5$, so there are 5 different lunch deals." Is Jo correct? Give a reason. [2 marks]
- C4** Two six-sided dice are rolled. In how many ways can the total be 8? List them. [2 marks]
- C5** Amy, Bea and Cat stand in a line for a photo.
(a) List all the possible orders. (b) How many of these have Amy in the middle? [3 marks]



HIGHER*Higher tier only*

- C6** Tom wants to choose 2 people from a group of 10. He works out $10 \times 9 = 90$
- (a) Explain why this is wrong if the 2 people are a pair with no special roles.
- (b) Describe a situation where 90 **is** the correct answer. [3 marks]
- C7** A company needs 60 000 different codes. Each code is 2 letters followed by 2 digits. Letters and digits can repeat.
- Are there enough codes? You must show your working. [2 marks]
- C8** There are n teams in a league. Each team plays every other team twice, once at home and once away.
- (a) Explain why the number of matches is $n(n - 1)$. (b) There are 90 matches. Find n . [3 marks]
- C9** How many whole numbers from 100 to 999 have three **different** digits? [3 marks]
- C10** How many **even** whole numbers from 100 to 999 have three different digits?
- You must show your working. [4 marks]



D**Problem solving**

You decide the method. Read the whole question first, and show every step.

FOUNDATION

Everyone starts here

- D1** An ice cream is vanilla (V), chocolate (C) or strawberry (S). It has either nuts (N) or a flake (F). It comes in either a cone or a tub.

Work out how many different ice creams there are by listing them in an organised way.

[3 marks]

- D2** A door code uses each of the digits 1, 2, 3 and 4 exactly once. The code starts with 3

List all the possible codes.

[3 marks]

- D3** Here are three number cards.

1

3

4

- (a)** List all the two-digit numbers that can be made using two of the cards. **(b)** How many of them are prime? **[3 marks]**

- D4** Lena has plenty of 20p coins and 10p coins. List all the ways she can pay exactly 50p.

[3 marks]

- D5** There are 5 runners in a race: P, Q, R, S and T.

(a) In how many ways can the gold and silver medals be won? Show how you know.

(b) Two of the five runners are chosen for a relay team. How many different pairs are there?

[3 marks]



HIGHER*Higher tier only*

- D6** A number plate has 2 letters followed by 3 digits. Letters and digits can repeat.
(a) How many number plates are possible? (b) How many are possible if the two letters must be different? [3 marks]
- D7** Five people, A, B, C, D and E, sit in a row of five seats. A and B must sit at the two ends.
In how many ways can the five people be seated? [3 marks]
- D8** A class has 12 boys and 15 girls. Work out the number of ways of choosing
(a) one boy and one girl (b) any two students (c) two girls [4 marks]
- D9** In a tournament, every player plays every other player once. There are 28 games altogether.
How many players are there? [3 marks]
- D10** A code has 4 digits. Each digit can be any of 0 to 9
How many codes have **at least one** repeated digit? [4 marks]



**Exam practice**

Exam-style questions. Write your answers in the spaces. Aim for about one minute per mark.

FOUNDATION*Foundation and Higher crossover*

- E1** Spinner A can land on 1, 2 or 3. Spinner B can land on Red (R) or Blue (B).
List all the possible outcomes when both spinners are spun.

(Total for Question E1 is 2 marks)

- E2** A meal deal has one main and one dessert.
Mains: pizza, pasta, curry Desserts: cake, fruit
(a) List all the possible meal deals.

(2)

- (b) Tim does not like fruit. How many of the meal deals could Tim choose?

(1)

(Total for Question E2 is 3 marks)



E3 Here are three cards.

4

6

9

(a) List all the three-digit numbers that can be made using all three cards.

(2)

(b) Write down the largest **even** number in your list.

.....

(1)

(Total for Question E3 is 3 marks)

E4 Ali, Ben, Cal and Dan are in a club. Two of them are chosen to be in a team.

(a) List all the possible teams of two.

(2)

(b) How many of the teams include Ali?

.....

(1)

(Total for Question E4 is 3 marks)



HIGHER*Higher tier only*

- E5** A restaurant menu has 5 starters, 8 main courses and 4 desserts.
Work out the number of different three-course meals.

.....
(Total for Question E5 is 2 marks)

- E6** The code for a safe has 3 digits. Each digit is from 1 to 9
(a) How many different codes are possible?

.....
(1)

- (b) How many codes have three different digits?

.....
(2)

- (c) How many codes with three different digits are odd numbers?

.....
(2)

(Total for Question E6 is 5 marks)



E7 There are 20 players in a squad.

(a) In how many ways can a captain and a vice-captain be chosen?

.....
(1)

(b) In how many ways can 2 players be chosen to collect the kit?

.....
(2)

(Total for Question E7 is 3 marks)

E8 There are n counters in a bag. Each counter has a different number on it.

Two counters are taken from the bag. There are 105 different possible pairs.

Work out the value of n . You must show algebraic working.

$n =$

(Total for Question E8 is 4 marks)

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