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GCSE MATHEMATICS • NUMBER

Systematic Listing

Worked Solutions

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

Full worked solutions for the free Systematic Listing worksheet, GCSE and iGCSE Maths



Tap a section to jump straight to it

Full worked solutions for every question on the Systematic Listing worksheet, in the same order and with the same question numbers.

How to mark your work. Tick each step you got right, not just the final answer. In the exam, method marks are given for correct working even when the final answer is wrong. If you lost marks, find the *first* line where your working is different from ours. That is the thing to fix.

In Section E: **M** = method mark, **P** = process mark, **A** = accuracy mark, **B** = independent mark, **C** = communication mark.

Question sheet

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A**Your turn answers**

Your list can be in a different order, but it must be organised and complete.

FOUNDATION

A1 1H 1T 2H 2T 3H 3T 4H 4T **8 outcomes**

A2 147 174 417 471 714 741 Less than 200: 147 and 174 **6 numbers, 2 are less than 200**

A3 VC VS VM VT CS CM CT SM ST MT **10 pairs**

HIGHER

A4 $5 \times 3 \times 2 =$ **30**

A5 (a) $6 \times 6 \times 6 \times 6 =$ **1296** (b) $6 \times 5 \times 4 \times 3 =$ **360**

A6 The last digit must be 1, 3 or 5: 3 choices. Then 5, 4 and 3 choices for the other places. $3 \times 5 \times 4 \times 3 =$ **180**

A7 $9 \times 8 = 72$, but each handshake has been counted twice. $72 \div 2 =$ **36**

B**Fluency solutions**

One mark for each correct part unless stated. The notes in *italics* explain why each sequence was chosen.

FOUNDATION

B1 (a) HH HT TH TT (b) HHH HHT HTH HTT THH THT TTH TTT (c) $2 \times 6 =$ **12** (d) $6 \times 6 =$ **36**

Each extra coin doubles the list: 2, 4, 8. For (d) a list would be long, which is why counting methods matter.

B2 PT PJ PW CT CJ CW (6 combinations)



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- B3** (a) AB BA (b) ABC ACB BAC BCA CAB CBA
 (c) 11 12 13 21 22 23 31 32 33 (d) 12 13 21 23 31 32

Not allowing repeats removes 11, 22 and 33, so 9 becomes 6.

- B4** (a) AB AC BC (b) AB AC AD BC BD CD (c) AB AC AD AE BC BD BE CD CE DE
 (d) ABC ABD ACD BCD

The numbers of pairs are 3, 6, 10. In (d), choosing 3 from 4 is the same as choosing which 1 to leave out, so there are 4.

- B5** (a) $10p + 10p$ $10p + 5p + 5p$ $5p + 5p + 5p + 5p$ (3 ways)
 (b) (1, 6) (2, 5) (3, 4) (4, 3) (5, 2) (6, 1) (6 ways)

HIGHER

- B6** (a) $3 \times 4 = 12$ (b) $3 \times 4 \times 5 = 60$ (c) $26 \times 10 = 260$ (d) $2 \times 2 \times 2 \times 2 \times 2 = 32$

- B7** (a) $10 \times 10 \times 10 \times 10 = 10\,000$ (b) $10 \times 9 \times 8 \times 7 = 5040$ (c) $5 \times 4 \times 3 = 60$ (d) $5 \times 5 \times 5 = 125$

- B8** (a) $6 \times 5 \div 2 = 15$ (b) $10 \times 9 \div 2 = 45$ (c) $20 \times 19 \div 2 = 190$ (d) $8 \times 7 = 56$

In (d) the two people come from different groups, so nothing is counted twice and you do not halve.

C

Reasoning solutions

Your wording can be different. Check that your reason makes the same point.

FOUNDATION

- C1** HT and TH are different outcomes (the first coin heads, or the second coin heads). There are 4 outcomes: HH, HT, TH, TT.

- C2** 321 Listing in order of size means each starting digit gets two numbers, so a gap is easy to spot.

- C3** No. Each of the 3 sandwiches can go with each of the 2 drinks, so there are $3 \times 2 = 6$ lunch deals.

- C4** (2, 6) (3, 5) (4, 4) (5, 3) (6, 2) 5 ways

- C5** (a) ABC ACB BAC BCA CAB CBA (b) BAC and CAB 2



HIGHER

- C6** (a) 10×9 counts “Ann then Bob” and “Bob then Ann” as different. For a pair they are the same, so halve it: $90 \div 2 = 45$.
 (b) When the two people have different roles, for example choosing a captain and then a vice-captain.
- C7** $26 \times 26 \times 10 \times 10 = 67\,600$ $67\,600 > 60\,000$, so **yes, there are enough**
- C8** (a) Each of the n teams plays $n - 1$ home matches, one against each other team. That is $n(n - 1)$ matches, and every match is some team’s home match.
 (b) $n(n - 1) = 90$ $10 \times 9 = 90$ **$n = 10$**
- C9** First digit: 9 choices (not 0). Second digit: 9 choices (0 is now allowed, but not the first digit). Third digit: 8 choices.
 $9 \times 9 \times 8 = 648$
- C10** Deal with the last digit first, in two cases, because 0 is special.
 Ends in 0: first digit 9 choices, middle digit 8 choices: $9 \times 8 = 72$
 Ends in 2, 4, 6 or 8 (4 choices): first digit 8 choices (not 0, not the last digit), middle digit 8 choices: $4 \times 8 \times 8 = 256$
 $72 + 256 = 328$

D

Problem solving solutions

There is often more than one correct method. Any complete, correct method scores full marks.

FOUNDATION

- D1** Cone: VN VF CN CF SN SF Tub: VN VF CN CF SN SF **12 ice creams**
- D2** 3124 3142 3214 3241 3412 3421 (6 codes)
- D3** (a) 13 14 31 34 41 43 (b) 13, 31, 41 and 43 are prime ($14 = 2 \times 7$ and $34 = 2 \times 17$) **4**
- D4** Work through the number of 20p coins: two 20p and one 10p one 20p and three 10p five 10p (3 ways)



D5 (a) 5 choices for gold, then 4 for silver: $5 \times 4 = 20$ (b) PQ PR PS PT QR QS QT RS RT ST 10

HIGHER

D6 (a) $26 \times 26 \times 10 \times 10 \times 10 = 676\,000$ (b) $26 \times 25 \times 10 \times 10 \times 10 = 650\,000$

D7 Ends: A and B can be placed in 2 ways. Middle three seats: $3 \times 2 \times 1 = 6$ ways. $2 \times 6 = 12$

D8 (a) $12 \times 15 = 180$ (b) 27 students: $27 \times 26 \div 2 = 351$ (c) $15 \times 14 \div 2 = 105$

D9 $\frac{n(n-1)}{2} = 28$ $n(n-1) = 56$ $8 \times 7 = 56$ 8 players

D10 Count the opposite and subtract. All codes: $10^4 = 10\,000$ No repeats: $10 \times 9 \times 8 \times 7 = 5040$
At least one repeat: $10\,000 - 5040 = 4960$

E

Exam practice solutions

Marks are shown on the right of each line.

FOUNDATION *Foundation and Higher crossover*

E1 1R 1B 2R 2B 3R 3B B2 (B1 for at least 4 correct)

E2 (a) pizza cake, pizza fruit, pasta cake, pasta fruit, curry cake, curry fruit B2 (B1 for at least 4)
(b) 3 B1

E3 (a) 469 496 649 694 946 964 B2 (B1 for at least 4)
(b) 964 B1

E4 (a) Ali Ben, Ali Cal, Ali Dan, Ben Cal, Ben Dan, Cal Dan B2 (B1 for at least 4)
(b) 3 B1



HIGHER

E5	$5 \times 8 \times 4$	<i>M1</i>
	160	<i>A1</i>
E6	(a) $9 \times 9 \times 9 =$ 729	<i>B1</i>
	(b) $9 \times 8 \times 7$	<i>M1</i>
	504	<i>A1</i>
	(c) Last digit 1, 3, 5, 7 or 9: 5 choices. Then 8 and 7 choices. $5 \times 8 \times 7$	<i>M1</i>
	280	<i>A1</i>
E7	(a) $20 \times 19 =$ 380	<i>B1</i>
	(b) $20 \times 19 \div 2$	<i>M1</i>
	190	<i>A1</i>
E8	$\frac{n(n-1)}{2} = 105$	<i>M1</i>
	$n^2 - n - 210 = 0$	<i>M1</i>
	$(n-15)(n+14) = 0$	<i>M1</i>
	n must be positive, so $n = 15$	<i>A1</i>

