Systematic Listing and the Product Rule

GCSE Mathematics • **Foundation Tier** • Grades 3–6 • Non-calculator

WORKED SOLUTIONS

Name: worked example Class: _____ Total: 55 / 55

Show all your working. Marks are given for correct method as well as the final answer.

1. List all the two-digit numbers that can be made using the digits 3, 5 and 8, with no digit repeated. **[2 marks]**

fix the FIRST digit, then vary the second
3: 35 38 5: 53 58 8: 83 85
a system is what stops you missing one

Answer: 35, 38, 53, 58, 83, 85

2. Work out how many two-digit numbers can be made from 3, 5 and 8 if digits MAY be repeated. **[2 marks]**

3 choices for the first, 3 for the second
$3 \times 3 = 9$

Answer: 9

3. A menu has 4 starters and 6 mains. Work out how many different two-course meals are possible. **[2 marks]**

$4 \times 6 = 24$

Answer: 24

4. A menu has 4 starters, 6 mains and 3 puddings. Work out how many three-course meals are possible. **[2 marks]**

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

Answer: 72

5. A password is 3 letters followed by 2 digits. Letters and digits may repeat. Work out how many are possible. **[3 marks]**

$26 \times 26 \times 26 \times 10 \times 10$
$17\,576 \times 100$
$= 1\,757\,600$

Answer: 1 757 600

6. List all the ways of arranging the letters A, B and C. **[2 marks]**

start with A, then B, then C
6 arrangements

Answer: ABC, ACB, BAC, BCA, CAB, CBA

7. Work out how many ways 5 different books can be put in a row. **[2 marks]**

$5 \times 4 \times 3 \times 2 \times 1$
one fewer choice each time
$= 120$

Answer: 120

8. Work out how many ways 4 people can sit on 4 chairs. **[2 marks]**

$4 \times 3 \times 2 \times 1 = 24$

Answer: 24

9. Complete the sample space diagram for the TOTAL when a three-sided spinner $(1, 2, 3)$ and a four-sided spinner $(1, 2, 3, 4)$ are spun. **[3 marks]**

+	1	2	3	4
1				
2				
3				

each cell is the sum of its row and column
row 1: 2 3 4 5
row 2: 3 4 5 6
row 3: 4 5 6 7

Answer: 12 outcomes, totals 2 to 7

10. Using that sample space, work out the probability the total is 5. **[2 marks]**

+	1	2	3	4
1				
2				
3				

totals of 5: (1,4) (2,3) (3,2)
3 out of 12

Answer: $\frac{3}{12} = \frac{1}{4}$

11. Using that sample space, work out the probability the total is more than 5. **[2 marks]**

+	1	2	3	4
1				
2				
3				

6, 6, 7 → 3 outcomes
more than 5 does NOT include 5

Answer: $\frac{3}{12} = \frac{1}{4}$

12. Two ordinary dice are thrown. Work out how many outcomes there are. **[2 marks]**

$6 \times 6 = 36$

Answer: 36

13. Two ordinary dice are thrown. Work out the probability of a double. **[3 marks]**

doubles: (1,1)(2,2)(3,3)(4,4)(5,5)(6,6)
6 out of 36

Answer: $\frac{6}{36} = \frac{1}{6}$

14. A coin is flipped three times. List all the outcomes. **[3 marks]**

$2 \times 2 \times 2 = 8$ of them
fix the first, then work through the rest

Answer: HHH HHT HTH HTT THH THT TTH TTT

15. A coin is flipped three times. Work out the probability of exactly two heads. **[3 marks]**

HHT, HTH, THH
3 out of 8

Answer: $\frac{3}{8}$

16. A three-digit code uses digits 1 to 9 with no repeats. Work out how many codes are possible. **[3 marks]**

$9 \times 8 \times 7$
$= 504$

Answer: 504

17. A car number plate is 2 letters then 3 digits, repeats allowed. Work out how many are possible. **[3 marks]**

$26 \times 26 \times 10 \times 10 \times 10$
$676 \times 1000 = 676\,000$

Answer: 676 000

18. Work out how many even three-digit numbers can be made from $1, 2, 3, 4$ with no repeats. **[4 marks]**

the LAST digit must be 2 or 4: 2 choices
deal with the restriction FIRST
then 3 choices, then 2
$2 \times 3 \times 2 = 12$

Answer: 12

19. A cafe offers 3 breads, 5 fillings and 2 sauces.

(a) Work out how many different sandwiches are possible. **[2 marks]**

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

(b) One filling sells out. Work out how many are possible now. **[2 marks]**

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

Answer: 30 ; 24

20. A four-digit PIN uses digits 0 to 9.

(a) Work out how many PINs are possible if repeats are allowed. **[2 marks]**

$10 \times 10 \times 10 \times 10$

$= 10\,000$

(b) Work out how many start with an odd digit and have no repeats. **[4 marks]**

first digit odd: 1 3 5 7 9 $\rightarrow$ 5 choices

then 9, then 8, then 7

$5 \times 9 \times 8 \times 7$

$= 2520$

Answer: 10 000 ; 2520

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