

Sample Space Diagrams

Solutions

For Pearson Edexcel GCSE Mathematics (1MA1) • Foundation tier

Each question is shown in grey, followed by the working, one step per line. The final answer is in a box. *Marks* shows how the marks are usually given in the exam, and **Tip** points out a common mistake.

1 (3 marks)

In a café, Tia picks one main and one dessert.

Mains: sandwich (S), burger (B), pasta (P)

Desserts: yogurt (Y), grapes (G)

(a) List all the possible outcomes.

Take each main in turn and pair it with each dessert:

S Y, S G

B Y, B G

P Y, P G

That is $3 \times 2 = 6$ outcomes.

Answer: 6 outcomes

Marks: 2 marks for all 6 outcomes. 1 mark for at least 3 correct.

(b) Each outcome is equally likely.

Write down the probability that Tia picks a sandwich and a yogurt.

Only one of the 6 outcomes is S Y.

All the outcomes are equally likely.

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

2 (2 marks)

A sandwich bar has four fillings: ham (H), cheese (C), egg (E) and tuna (T).

Priya chooses two **different** fillings.

Write down all the possible combinations of fillings that Priya can choose.

The two fillings must be different, so HH, CC, EE and TT are not allowed.

Start with ham: HC, HE, HT

Then cheese (HC is already listed): CE, CT

Then egg: ET

That is 6 combinations. CH is the same combination as HC, so it is only listed once.

Answer: 6 combinations: HC, HE, HT, CE, CT, ET

Tip: Work in order so you do not miss any. Do not list CH as well as HC: they are the same combination.

Marks: 2 marks for all 6 with no extras or repeats. 1 mark for at least 4 correct.

3 (2 marks)

- (a) Kemi spins a fair spinner with 5 equal sections numbered 1, 2, 3, 4 and 5
She says,

“A number is either even or odd, so the probability of getting an even number is $\frac{1}{2}$ ”

Is Kemi correct?

You must explain your answer.

The even numbers are 2 and 4

That is 2 of the 5 equally likely numbers.

So the probability is $\frac{2}{5}$, not $\frac{1}{2}$.

Answer: No, it is $\frac{2}{5}$

Tip: Two possible results (even or odd) does not mean each has probability $\frac{1}{2}$. Count the equally likely outcomes.

- (b) Kemi throws two fair coins.

She says,

“The results can be two heads, two tails or one of each, so the probability of two heads is $\frac{1}{3}$ ”

Is Kemi correct?

You must explain your answer.

List the outcomes for coin 1 then coin 2: HH, HT, TH, TT

There are 4 equally likely outcomes, and “one of each” covers two of them (HT and TH).

Only HH is two heads, so the probability is $\frac{1}{4}$, not $\frac{1}{3}$.

Answer: No, it is $\frac{1}{4}$

Tip: HT and TH are different outcomes. Listing them both shows that the three results are not equally likely.

4 (3 marks)

Hana has a fair 4-sided spinner numbered 0, 1, 2, 3 and an ordinary fair 6-sided dice. She spins the spinner and rolls the dice, then multiplies the two numbers to get her score.

The rows of the diagram show the spinner.

- (a) Complete the possibility space diagram.

Each box is the row number times the column number.

For example, row 3, column 4: $3 \times 4 = 12$

Dice

	1	2	3	4	5	6
0	0	0	0	0	0	0
1	1	2	3	4	5	6
2	2	4	6	8	10	12
3	3	6	9	12	15	18

Answer: See table

- (b) Find the probability that Hana gets a score of 0

There are $4 \times 6 = 24$ outcomes.

Any number times 0 is 0, so the whole 0 row is 0

That is 6 of the 24 outcomes.

Answer: $\frac{6}{24}$ (or $\frac{1}{4}$)

- (c) Find the probability that Hana gets a score of 12 or more.

Scores of 12 or more: 12 (from 2×6), 12, 15 and 18 (from the 3 row)

That is 4 of the 24 outcomes (12 itself counts).

Answer: $\frac{4}{24}$ (or $\frac{1}{6}$)

Tip: "12 or more" includes 12. There are two 12s in the table.

5 (2 marks)

Grace has three cards numbered 1, 2 and 3 and a fair 4-sided spinner numbered 2, 4, 6 and 8

She takes a card at random and spins the spinner.

She multiplies the number on the card by the number on the spinner.

Work out the probability that the product is greater than 10

There are $3 \times 4 = 12$ equally likely outcomes.

Card 1: $1 \times 2 = 2$, $1 \times 4 = 4$, $1 \times 6 = 6$, $1 \times 8 = 8$

Card 2: 4, 8, 12, 16

Card 3: 6, 12, 18, 24

Greater than 10: 12, 16, 12, 18, 24

That is 5 of the 12 products.

Answer: $\frac{5}{12}$

Marks: 1 mark for a list or table of the 12 products. 1 mark for $\frac{5}{12}$.

6 (5 marks)

Ravi rolls two fair six-sided dice.

He works out the difference between the two scores.

	1	2	3	4	5	6
1	0	1				
2		0				
3						
4						
5						
6						0

(a) Complete the sample space diagram.

Each entry is the larger score minus the smaller score.

When the scores are the same, the difference is 0

	1	2	3	4	5	6
1	0	1	2	3	4	5
2	1	0	1	2	3	4
3	2	1	0	1	2	3
4	3	2	1	0	1	2
5	4	3	2	1	0	1
6	5	4	3	2	1	0

Answer: See solution

Marks: 2 marks for a fully correct diagram. 1 mark for at least 20 correct.

- (b) Work out the probability that the difference is 0

The difference is 0 down the diagonal: 6 times.

There are 36 outcomes altogether.

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

- (c) Work out the probability that the difference is more than 3

More than 3 means a difference of 4 or 5.

Difference 4: (1,5), (5,1), (2,6), (6,2)

Difference 5: (1,6), (6,1)

That is 6 of the 36 outcomes.

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

Tip: "More than 3" does not include 3. Count only the 4s and 5s.

Marks: 1 mark for counting 6 outcomes (or $\frac{k}{36}$). 1 mark for $\frac{6}{36}$ or an equivalent.

7 (3 marks)

A fair 4-sided spinner, numbered 1 to 4, is spun and a fair six-sided dice is rolled.
The two numbers are added to give a total.

Show that the probability that the total is 5 is $\frac{1}{6}$

Spinner has 4 numbers and the dice has 6

So there are $4 \times 6 = 24$ equally likely outcomes.

Total 5 (spinner, dice): (1, 4), (2, 3), (3, 2), (4, 1)

That is 4 outcomes.

$$P(\text{total } 5) = \frac{4}{24}$$

Divide top and bottom by 4: $\frac{4}{24} = \frac{1}{6}$

Answer: $\frac{4}{24} = \frac{1}{6}$

Marks: 1 mark for 24 outcomes. 1 mark for the 4 ways to get 5. 1 mark for showing $\frac{4}{24} = \frac{1}{6}$.

8 (3 marks)

Spinner X has 3 equal sections coloured red, blue and green.
Spinner Y has 4 equal sections coloured red, blue, green and yellow.
Both spinners are spun.

Work out the probability that both spinners land on the same colour.

There are $3 \times 4 = 12$ equally likely outcomes.

Same colour: RR, BB, GG

Spinner X has no yellow, so YY is not possible.

That is 3 of the 12 outcomes.

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

Answer: $\frac{3}{12}$

Marks: 1 mark for a list or 12 outcomes. 1 mark for 3 same-colour outcomes. 1 mark for $\frac{3}{12}$ or an equivalent.

9 (3 marks)

Alex rolls two fair six-sided dice.
He multiplies the two scores.
He wins a prize if the product is a multiple of 5

Alex says,

“The probability that I win a prize is more than $\frac{1}{3}$ ”

Is Alex correct?

You must show how you get your answer.

Two dice give $6 \times 6 = 36$ equally likely outcomes.

The product is a multiple of 5 only when at least one dice shows 5.

First dice 5: (5,1), (5,2), (5,3), (5,4), (5,5), (5,6)

Second dice 5: (1,5), (2,5), (3,5), (4,5), (6,5)

(5,5) is only counted once, so there are 11 outcomes.

$$P(\text{prize}) = \frac{11}{36}$$

Write $\frac{1}{3}$ with the same denominator: $\frac{1}{3} = \frac{12}{36}$

$\frac{11}{36}$ is less than $\frac{12}{36}$, so Alex is wrong.

Answer: No, $\frac{11}{36} < \frac{12}{36}$

Tip: Compare fractions exactly, using the same denominator. Rounding $\frac{1}{3}$ to 0.3 gives the wrong conclusion.

Marks: 1 mark for 36 outcomes or a sample space. 1 mark for 11. 1 mark for comparing $\frac{11}{36}$ with $\frac{12}{36}$ and a conclusion.
