

Relative Frequency and Expected Outcomes

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 (2 marks)

- (a) A fair 6-sided dice is going to be rolled 300 times.
Write down an estimate for the number of times the dice will land on 4

$$\text{For a fair dice, } P(4) = \frac{1}{6}$$

$$\text{Estimate} = \frac{1}{6} \times 300 = 50$$

Answer: 50

- (b) Ravi spins a spinner 10 times.
It lands on red 6 times.
Ravi says,

“The spinner must be biased towards red.”

Is Ravi right?

Give a reason for your answer.

10 spins is only a small number of trials.

Results from a few spins can easily be different from what you expect, even on a fair spinner.

Ravi needs to spin the spinner a lot more times before he can decide.

Answer: No, 10 spins is not enough to decide

Tip: Say **why**: the number of trials is too small. Just writing “no” gets no marks.

2 (2 marks)

The probability that a train is late is 0.12

There are 250 trains in one week.

Work out an estimate for the number of these trains that are late.

Estimate = probability $\times$ number of trains

$$0.12 \times 250 = 30$$

Answer: 30

Tip: Multiply, do not divide. $250 \div 0.12$ is more than 250 trains, which cannot be right. Give a number of trains, not a probability.

Marks: 1 mark for 0.12×250 . 1 mark for 30.

3 (2 marks)

A gardener says that 3 out of every 8 seeds in a packet will grow into a flower.

Maria plants 120 of these seeds.

Work out an estimate for the number of flowers that will grow.

$$P(\text{a seed grows into a flower}) = \frac{3}{8}$$

$$\text{Estimate} = \frac{3}{8} \times 120$$

$$120 \div 8 = 15, \text{ and } 15 \times 3 = 45$$

Answer: 45

Marks: 1 mark for $\frac{3}{8} \times 120$. 1 mark for 45.

4 (4 marks)

Ella spins a 4-sided spinner 120 times.
The table shows her results.

Letter	A	B	C	D
Frequency	18	26	36	40

- (a) Work out the relative frequency of the spinner landing on *C*.

The spinner landed on *C* 36 times out of 120 spins.

$$\text{Relative frequency} = \frac{36}{120} = 0.3$$

Answer: $\frac{36}{120} = 0.3$

- (b) Work out an estimate for the number of times the spinner will land on *A* if it is spun 500 times.

$$\text{Relative frequency of } A: \frac{18}{120} = 0.15$$

$$\text{Estimate} = 0.15 \times 500 = 75$$

Answer: 75

Marks: 1 mark for $\frac{18}{120} \times 500$. 1 mark for 75.

- (c) Is the spinner fair?
You must give a reason for your answer.

For a fair spinner, each letter would come up about $120 \div 4 = 30$ times.

A only came up 18 times.

D came up 40 times.

These are a long way from 30, so the spinner is probably not fair.

Answer: No, frequencies not close to 30 each

5 (2 marks)

Kai throws a drawing pin 80 times.

It lands point up 28 times.

Kai is going to throw the drawing pin 200 more times.

Work out an estimate for the number of times it will land point up.

Relative frequency of point up: $\frac{28}{80} = 0.35$

Estimate = $0.35 \times 200 = 70$

Answer: 70

Marks: 1 mark for $\frac{28}{80} \times 200$. 1 mark for 70.

6 (2 marks)

A spinner has 5 equal sections, numbered 1 to 5

Jess spins the spinner 25 times. It lands on 1 nine times.

Leo spins the same spinner 250 times. It lands on 1 fifty-two times.

- (a) Jess says the spinner is biased towards 1
Leo says the spinner is fair.
Whose conclusion is more likely to be right?
You must give a reason for your answer.

For a fair spinner with 5 equal sections, $P(1) = \frac{1}{5} = 0.2$

Jess: $\frac{9}{25} = 0.36$. Leo: $\frac{52}{250} = 0.208$

Leo's relative frequency is very close to 0.2

Leo spun the spinner 250 times, so his results are more reliable than Jess's 25 spins.

Answer: Leo, because he did more spins (and 0.208 is close to 0.2)

Tip: The reason must mention the number of spins. More trials give a more reliable result.

- (b) Leo is going to spin the spinner 1000 times.

Use Leo's results to work out an estimate for the number of times the spinner will land on 1

Relative frequency from Leo's results: $\frac{52}{250} = 0.208$

Estimate = $0.208 \times 1000 = 208$

Answer: 208

7 (3 marks)

A game at a fair costs £1 to play.

The probability of winning the game is 0.15

If you win, you get £5

200 people play the game.

Work out an estimate for the profit the fair makes.

Money taken: $200 \times £1 = £200$

Expected number of winners: $0.15 \times 200 = 30$

Money paid out: $30 \times £5 = £150$

Profit = money taken – money paid out

$£200 - £150 = £50$

Answer: £50

Marks: 1 mark for 30 winners. 1 mark for £150 and £200. 1 mark for £50.

8 (4 marks)

Here is a biased 5-sided spinner.

The table shows some of the probabilities that the spinner will land on A , B , C , D and E .

Letter	A	B	C	D	E
Probability	0.3	0.15	0.25		

The probability that the spinner will land on D is twice the probability that it will land on E .

- (a) The spinner is going to be spun 300 times.
Work out an estimate for the number of times it will land on D .

The probabilities add up to 1.

D and E together: $1 - 0.3 - 0.15 - 0.25 = 0.3$

D is twice E , so share 0.3 in the ratio 2:1.

$0.3 \div 3 = 0.1$, so $P(E) = 0.1$ and $P(D) = 0.2$

Estimate = $0.2 \times 300 = 60$

Answer: 60

Tip: "Twice" means share in the ratio 2:1 (3 parts). Halving 0.3 gives the wrong answer.

Marks: 1 mark for 0.3. 1 mark for $P(D) = 0.2$. 1 mark for 60.

- (b) Freya spins the spinner 300 times.
It lands on D 67 times.
Freya says,

"This shows the probability in the table for D must be wrong."

Is Freya right? Give a reason for your answer.

60 is only an **estimate** of the number of times it lands on D .

Results vary each time you do an experiment.

67 is quite close to 60, so this does not show the table is wrong.

Answer: No, 60 is only an estimate and results vary; 67 is close to 60

9 (3 marks)

When a bottle top is thrown, it can land open side up or open side down.
Zara throws a bottle top 150 times.
It lands open side up 60 times.

- (a) Work out an estimate for the probability that the bottle top will land open side up.

$$\text{Relative frequency} = \frac{60}{150} = 0.4$$

Answer: $\frac{60}{150} = 0.4$

- (b) Callum is going to throw the same bottle top twice.
Use Zara's results to work out an estimate for the probability that it will land open side up both times.

$$\text{Each throw: } P(\text{open side up}) = 0.4$$

The two throws are independent, so multiply.

$$0.4 \times 0.4 = 0.16$$

Answer: 0.16

Tip: "Both times" means multiply the probabilities. Adding them ($0.4 + 0.4$) is wrong.

Marks: 1 mark for 0.4×0.4 . 1 mark for 0.16.

10 (3 marks)

There are 30 counters in a bag.
Each counter is red, blue or green.
There are 6 red counters.
There are twice as many blue counters as red counters.
Theo takes at random a counter from the bag.
He records its colour and puts the counter back in the bag.
Theo does this 150 times.
Work out an estimate for the number of times he takes a green counter.

$$\text{Blue: } 2 \times 6 = 12 \text{ counters}$$

$$\text{Green: } 30 - 6 - 12 = 12 \text{ counters}$$

$$P(\text{green}) = \frac{12}{30} = 0.4$$

$$\text{Estimate} = 0.4 \times 150 = 60$$

Answer: 60

Tip: Theo puts each counter back, so the probability of green stays $\frac{12}{30}$ every time.

Marks: 1 mark for 12 green counters. 1 mark for $\frac{12}{30}$ (0.4). 1 mark for 60.
