



KS3.M-P4 Experimental Probability and Relative Frequency

AQA KS3.M-P4 · Calculators not allowed · about 50 minutes

Name: _____ Date: ____ / ____ / ____

Answer ALL questions. Show all your working.

- 1** A fair coin is tossed once. Write down the probability that it lands heads.

(1)

- 2** A six-sided die is rolled once. State the probability of rolling a 4.

(1)

- 3** A bag contains 5 red counters and 3 blue counters. A counter is chosen at random. Give the probability the counter is blue.

(1)

- 4** A student tosses a coin 50 times and gets 28 heads. Calculate the relative frequency of heads from this experiment.

(2)

- 5** A spinner with 8 equal sections is spun 40 times. The number of times it landed on section A was 6. Find the expected frequency for section A and compare to the experimental frequency. State which is larger.

(2)

6 A fair coin is tossed 100 times. What is the expected number of tails?

(2)

7 A die is rolled 120 times. The face 6 appears 18 times. Calculate the relative frequency of rolling a 6 and compare it to the theoretical probability. Which is higher?

(2)

8 A class carries out an experiment rolling a spinner with 5 equal sectors. After 75 spins, sector B came up 20 times. Calculate the relative frequency of B and give it as a fraction in simplest form.

(2)

9 A fair six-sided die is rolled 60 times. Using expected frequency, how many times would you expect to roll a number less than 4 (that is 1, 2 or 3)?

(2)

10 A coin is biased so that heads has probability 0.6 and tails 0.4. In 50 tosses, find the expected number of heads.

(2)

- 11** A spinner has 3 equal colours: red, green and yellow. A pupil spins it 90 times and records red 28 times. Calculate the relative frequency of red and find the difference between experimental and expected frequencies (experimental minus expected).

(2)

- 12** You flip a two-sided coin 20 times and get 12 heads. Another student flips a different coin 20 times and gets 8 heads. Which experimental result is closer to the expected frequency and by how many flips? Show working.

(2)

- 13** A die is rolled 30 times. The recorded counts for faces 1 to 6 are: 6, 4, 9, 3, 5, 3. Which face deviates most from the expected frequency and by how many rolls?

(3)

- 14** A spinner with 4 equal sections is spun 48 times and lands on sector C 18 times. Find the expected frequency for sector C and state how many more times it appeared than expected.

(2)

- 15** A biased coin has probability of heads 0.7. It is tossed 10 times and 9 heads are observed. Calculate the relative frequency of heads, the expected number of heads, and the difference experimental minus expected.

(3)

- 16** A class of 24 students each flips a fair coin twice, giving 48 tosses in total. They observe 30 heads. Find the relative frequency of heads, the expected number of heads, and say how many more heads were observed than expected.

(3)

- 17** Design a simple experiment to test whether a coin is fair. Give the main steps you would take and explain briefly what result would suggest the coin is fair.

(4)

- 18** A die is rolled 600 times and the face 6 appears 110 times. Calculate the experimental probability of rolling a 6 as a fraction and as a decimal. Give the theoretical probability and find the difference (experimental minus theoretical).

(4)

Mark scheme · KS3.M-P4 Experimental Probability and Relative Frequency

Question 1

- **B1** $\frac{1}{2}$ or 0.5 or 50% cao
- Answer: **$\frac{1}{2}$**

Question 2

- **B1** $\frac{1}{6}$ or about 0.166... or 16.7% cao
- Answer: **$\frac{1}{6}$**

Question 3

- **B1** $\frac{3}{8}$ cao
- Answer: **$\frac{3}{8}$**

Question 4

- **M1** correct method: heads divided by total $\frac{28}{50}$ or equivalent
- **A1** 0.56 or 56% cao
- Answer: **0.56**

Question 5

- **M1** expected frequency calculated as $\frac{1}{8}$ of 40 = $\frac{40}{8}$ or 5
- **A1** expected = 5, experimental = 6 so experimental is larger cao
- Answer: **5; experimental 6, experimental is larger**

Question 6

- **M1** method: $\frac{1}{2}$ of 100 or 100×0.5
- **A1** 50 cao
- Answer: **50**

Question 7

- **M1** relative frequency shown as $\frac{18}{120} = 0.15$ or equivalent
- **A1** theoretical is $\frac{1}{6} = 0.166...$ so theoretical is larger cao
- Answer: **0.15; theoretical $\frac{1}{6}$ (about 0.166...), theoretical is larger**

Question 8

- **M1** method: $\frac{20}{75}$ or equivalent shown
- **A1** $\frac{4}{15}$ cao
- Answer: **$\frac{4}{15}$**

Question 9

- **M1** method: probability $\frac{3}{6} = \frac{1}{2}$ then expected frequency $\frac{1}{2}$ of 60
- **A1** 30 cao
- Answer: **30**

Question 10

- **M1** method: 50×0.6
- **A1** 30 cao
- Answer: **30**

Question 11

- **M1** relative frequency $28/90 = 14/45$ or $0.311...$ shown
- **A1** expected $90/3 = 30$ so difference = $28 - 30 = -2$ cao
- Answer: **14/45; difference -2**

Question 12

- **M1** method: expected for 20 flips is 10 heads and differences calculated $|12-10|$ and $|8-10|$
- **A1** both are equally close by 2 flips cao
- Answer: **Both equally close by 2 flips**

Question 13

- **M1** expected frequency shown as $30/6 = 5$
- **M1** deviations calculated: $|6-5|$, $|4-5|$, $|9-5|$, $|3-5|$, $|5-5|$, $|3-5|$
- **A1** face 3 deviates most by 4 rolls cao
- Answer: **Face 3 by 4**

Question 14

- **M1** expected frequency $1/4$ of $48 = 12$ shown
- **A1** experimental 18 so $18 - 12 = 6$ more cao
- Answer: **Expected 12; experimental 18; 6 more**

Question 15

- **M1** relative frequency calculated as $9/10$
- **M1** expected number shown as $10 \times 0.7 = 7$
- **A1** difference $9 - 7 = 2$ cao
- Answer: **0.9; expected 7; difference 2**

Question 16

- **M1** relative frequency $30/48$ or 0.625 shown
- **M1** expected number $1/2$ of $48 = 24$ shown
- **A1** experimental higher by $30 - 24 = 6$ cao
- Answer: **0.625; expected 24; experimental higher by 6**

Question 17

- **M1** suggest carrying out a large number of tosses, e.g. at least 50 or 100
- **M1** state recording outcomes and calculating relative frequency of heads
- **M1** state comparing relative frequency to theoretical probability 0.5
- **A1** conclude that a result close to 0.5 after many trials suggests the coin is fair cao
- Answer: **Do at least 50 to 100 tosses, record and calculate relative frequency of heads, compare to 0.5; a result close to 0.5 suggests the coin is fair**

Question 18

- **M1** experimental probability as fraction $110/600$ simplified to $11/60$
- **M1** convert to decimal $11/60 = 0.183333...$ shown
- **M1** theoretical probability $1/6 = 0.166666...$ stated
- **A1** difference $11/60 - 1/6 = 1/60$ (about $0.016666...$) cao
- Answer: **11/60 (0.18333...); theoretical 1/6 (0.16666...); difference 1/60 (about 0.01667)**