Worksheet - Probability: experiments, Venn and tree diagrams

Year: Year 11 · 20

Show your working.

Question 1

Question 1 – A spinner with eight sections *(Section A · Skills practice)*

A fair spinner has eight equal sections numbered 1 to 8.

a. Find the probability of spinning a prime number. [2 marks]
b. Find the probability of spinning a multiple of 3. [2 marks]
c. Find the probability of not spinning a 5. [1 mark]
d. The spinner is spun 96 times. How many times would you expect to spin a 5? [2 marks]

Question 2

Question 2 – Relative frequency from an experiment *(Section A · Skills practice)*

Jamal drops a drawing pin and records how often it lands point up.

Number of drops	20	50	100	200
Point up	14	29	61	118

a. Work out the relative frequency for each number of drops, to 2 decimal places. [3 marks]
b. Which gives the best estimate of the probability? Explain. [2 marks]
c. Use it to estimate how many times the pin lands point up in 500 drops. [2 marks]

Question 3

Question 3 – Two dice *(Section A · Skills practice)*

Two fair dice are thrown and the scores are added.

a. Complete the sample space diagram (a 6 by 6 table of totals). [3 marks]
b. Find the probability that the total is 7. [2 marks]
c. Find the probability that the total is at least 10. [2 marks]
d. Find the probability that both dice show the same number. [1 mark]

Question 4

Question 4 – A Venn diagram of sports *(Section A · Skills practice)*

30 pupils were asked if they play football (F) or hockey (H). 12 play football, 10 play hockey and 4 play both.

a. Draw a Venn diagram showing the number in each region. [3 marks]
b. Find $P(F \cap H)$ and $P(F \cup H)$. [3 marks]
c. Find the probability that a pupil plays neither sport. [2 marks]

Question 5

Question 5 – Two independent events *(Section A · Skills practice)*

A spinner lands on red with probability 0.3. It is spun twice.

a. Draw a tree diagram and label all branches. [3 marks]
b. Find the probability of two reds. [2 marks]
c. Find the probability of exactly one red. [3 marks]
d. Find the probability of at least one red. [2 marks]

Question 6

Question 6 – A frequency tree *(Section A · Skills practice)*

There are 200 pupils in Year 11: 120 are girls and 80 are boys. Three quarters of the girls and half of the boys cycle to school.

a. Complete a frequency tree. [4 marks]
b. How many pupils cycle? [1 mark]
c. A pupil who cycles is picked at random. What is the probability that the pupil is a girl? [2 marks]

Question 7

Question 7 – Is the die fair? *(Section B · Real-life practice)*

A die is rolled 60 times. The results are shown.

Score	1	2	3	4	5	6
Frequency	8	9	11	10	9	13

a. How many times would you expect each score if the die is fair? [1 mark]
b. Work out the relative frequency of a 6 to 3 decimal places. [2 marks]
c. Is there strong evidence that the die is biased? Explain. [3 marks]
d. How could you get a more reliable result? [1 mark]

Question 8

Question 8 – School lunch choices *(Section B · Real-life practice)*

At a school, each pupil chooses pizza with probability 0.4, pasta with probability 0.35

and salad with probability 0.25.

a. Check that the probabilities are valid. [1 mark]
b. 240 pupils have lunch. How many are expected to choose pizza? [2 marks]
c. Two pupils choose independently. Find the probability that both choose pasta. [2 marks]
d. Find the probability that neither of them chooses salad. [2 marks]

Question 9

Question 9 – Counters with replacement *(Section B · Real-life practice)*

A bag contains 3 red and 5 blue counters. A counter is taken, its colour is noted and it is put back. Then a second counter is taken.

a. Draw a tree diagram. [3 marks]
b. Find $P(\text{both red})$ and $P(\text{both blue})$. [3 marks]
c. Find the probability that the two counters are different colours. [3 marks]

Question 10

Question 10 – Counters without replacement *(Section B · Real-life practice)*

A bag contains 4 red and 6 blue counters. Two counters are taken at random without replacement.

a. Complete a tree diagram. [3 marks]
b. Find $P(\text{different colours})$. [3 marks]
c. Find $P(\text{same colour})$. [3 marks]

Question 11

Question 11 – Languages in Year 11 *(Section B · Real-life practice)*

80 students were asked if they study French (F) or Spanish (S). 45 study French, 35 study Spanish and 12 study both.

a. Draw a Venn diagram. [3 marks]
b. Find $P(F \cup S)$. [2 marks]
c. Find the probability that a student studies exactly one of the two languages. [2 marks]
d. A student who studies French is chosen. What is the probability that they also study Spanish? [2 marks]

Question 12

Question 12 – Two spinners *(Section B · Real-life practice)*

Spinner A has the numbers 1, 2, 3, 4 and spinner B has the numbers 1, 2, 3. Both are

fair. The two scores are multiplied.

a. Draw a sample space diagram of all the products. [3 marks]
b. Find the probability that the product is even. [2 marks]
c. Find the probability that the product is 6. [2 marks]
d. Find the probability that the product is greater than 5. [2 marks]

Question 13

Question 13 – Weekend weather *(Section B · Real-life practice)*

The probability of rain on Saturday is 0.4 and on Sunday is 0.3. The days are independent.

a. Draw a tree diagram. [3 marks]
b. Find the probability that it rains on both days. [2 marks]
c. Find the probability that it rains on neither day. [2 marks]
d. Find the probability that it rains on exactly one day. [3 marks]

Question 14

Question 14 – Penalty kicks *(Section B · Real-life practice)*

A footballer scores a penalty with probability 0.8 each time. She takes three penalties independently.

a. Find the probability that she scores all three. [2 marks]
b. Find the probability that she misses at least one. [2 marks]
c. Find the probability that she scores exactly two. [3 marks]
d. Find the probability that she scores none. [1 mark]

Question 15

Question 15 – Venn diagram with algebra *(Section C · Problem solving)*

50 pupils were asked about music and drama. 28 do music, 22 do drama and 8 do neither. Let x be the number who do both.

a. Show that $28 - x + x + 22 - x + 8 = 50$ and solve for x. [4 marks]
b. Complete the Venn diagram. [2 marks]
c. Find the probability that a pupil does exactly one activity. [2 marks]
d. A pupil who does drama is chosen. Find the probability that they also do music. [2 marks]

Question 16

Question 16 – A frequency tree about cars *(Section C · Problem solving)*

There are 250 cars in a car park. 60% are petrol and the rest are diesel or electric. 30%

of the petrol cars are more than 5 years old and 20% of the other cars are more than 5 years old.

a. Complete a frequency tree. [4 marks]
b. How many cars are more than 5 years old? [2 marks]
c. A car older than 5 years is chosen. Find the probability that it is petrol. [2 marks]
d. Is a randomly chosen car more likely to be an old petrol car or a new non-petrol car? [2 marks]

Question 17

Question 17 – Finding the number of counters *(Section C · Problem solving)*

A bag has 5 counters, of which n are red. A counter is taken, replaced and a second counter taken. The probability of two reds is 0.16.

a. Write an equation using n. [2 marks]
b. Solve it to find n. [3 marks]
c. Find the probability that the two counters are different colours. [3 marks]

Question 18

Question 18 – Is the coin biased? *(Section C · Problem solving)*

A coin is tossed 400 times and lands on heads 232 times.

a. Work out the relative frequency of heads. [1 mark]
b. How many heads would you expect if the coin is fair? [1 mark]
c. Compare the two and say whether the coin might be biased. [3 marks]
d. Use the relative frequency to estimate the number of heads in 1 000 tosses. [2 marks]
e. How could you test the coin further? [2 marks]

Question 19

Question 19 – Three flavours of sweets *(Section C · Problem solving)*

A bag contains 12 sweets: 5 mint, 4 toffee and 3 fruit. Two sweets are taken at random without replacement.

a. Find the probability that both are the same flavour. [4 marks]
b. Find the probability that at least one is fruit. [3 marks]
c. Find the probability that the second sweet is fruit given that the first was mint. [2 marks]

Question 20

Question 20 – Challenge: three coins *(Section D · Challenge)*

Three fair coins are tossed.

a. List all eight equally likely outcomes. [2 marks]
b. Find the probability of at least two heads. [2 marks]
c. You are told that at least one coin shows heads. Find the probability that all three show heads. [3 marks]
d. Explain why the answer to (c) is not $\frac{1}{8}$. [2 marks]