# Worksheet - Probability: sample spaces and Venn diagrams

Year: Year 9 · 20

Show your working.

## Question 1

**Question 1 – The spinner** *(Section A · Skills practice)*

A fair spinner has eight equal sections numbered 1 to 8. It is spun once. Write each probability as a fraction in its simplest form.

a. $P(5)$
b. $P(\text{even number})$
c. $P(\text{prime number})$
d. $P(\text{greater than } 6)$

## Question 2

**Question 2 – Probabilities that add to 1** *(Section A · Skills practice)*

The probabilities of all the possible outcomes add up to 1, so $P(\text{not } A) = 1 - P(A)$. Find the missing probabilities.

a. $P(\text{rain}) = 0.35$. Find $P(\text{no rain})$.
b. A bag has $P(\text{red}) = \dfrac{3}{8}$. Find $P(\text{not red})$.
c. $P(\text{win}) = 0.2$. Find $P(\text{lose})$.
d. $P(\text{late}) = \dfrac{7}{40}$. Find $P(\text{not late})$.

## Question 3

**Question 3 – Mutually exclusive events** *(Section A · Skills practice)*

A spinner has four colours. $P(\text{red}) = 0.3$, $P(\text{blue}) = 0.45$, $P(\text{green}) = 0.15$ and $P(\text{yellow}) = x$.

a. Find $x$.
b. Find $P(\text{red or blue})$.
c. Find $P(\text{not green})$.
d. Find $P(\text{blue or yellow})$.

## Question 4

**Question 4 – Two dice** *(Section A · Skills practice)*

Two fair dice are rolled and the scores are added. A table of all 36 outcomes is useful. Find each probability.

| + | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| 6 | 7 | 8 | 9 | 10 | 11 | 12 |

a. $P(\text{total } 7)$
b. $P(\text{a double})$
c. $P(\text{total greater than } 10)$
d. $P(\text{total less than } 4)$

## Question 5

**Question 5 – A coin and a spinner** *(Section A · Skills practice)*

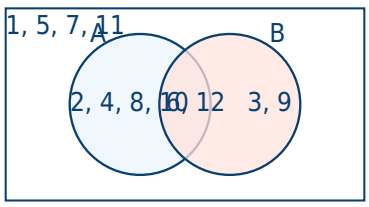
A coin is flipped and a spinner numbered 1, 2, 3 is spun.

a. List all the outcomes in a sample space.
b. How many outcomes are there?
c. Find $P(\text{head and } 2)$.
d. Find $P(\text{tail and an odd number})$.

## Question 6

**Question 6 – Sets and Venn diagrams** *(Section A · Skills practice)*

The universal set is $\xi = \{1, 2, 3, \ldots, 12\}$. Set $A$ is the even numbers and set $B$ is the multiples of 3.




a. List $A \cap B$ and $A \cup B$.
b. Find $P(A)$ and $P(A \cap B)$.
c. Find the probability of being in neither set.

d. Check that $n(A \cup B) = n(A) + n(B) - n(A \cap B)$.

## Question 7

**Question 7 – The school raffle** *(Section B · Real-life practice)*

200 raffle tickets were sold at the school fair. Maya bought 5 tickets, Ali bought 12 tickets and nobody else bought more than one. One winning ticket is chosen at random.

a. Find the probability that Maya wins.
b. Find the probability that Ali wins.
c. Find the probability that either Maya or Ali wins. Why can you add?
d. Find the probability that someone else wins.
e. The prize is £50 and tickets cost £1. How much does the school make?

## Question 8

**Question 8 – The weather forecast** *(Section B · Real-life practice)*

The weather forecaster says the probability of a sunny Saturday in June is 0.6. The school sports day is on a Saturday.

a. Find the probability that it is not sunny.
b. In 20 Saturdays in the summer, how many sunny Saturdays are expected?
c. The forecaster also gives the probability of rain as 0.25 on a day that is not sunny. Is that possible? Explain.
d. Find the expected number of days that are not sunny in 50 Saturdays.

## Question 9

**Question 9 – A bag of sweets** *(Section B · Real-life practice)*

A bag has 20 sweets: 8 red, 6 green, 4 yellow and 2 orange. Daniel takes one sweet without looking.

| Colour | Red | Green | Yellow | Orange |
|---|---|---|---|---|
| Number | 8 | 6 | 4 | 2 |

a. Find $P(\text{red})$ and $P(\text{orange})$.
b. Find $P(\text{red or green})$.
c. Find $P(\text{not orange})$.
d. Daniel eats two red sweets. Find the new probability of choosing a red sweet.

## Question 10

**Question 10 – The board game** *(Section B · Real-life practice)*

In a board game players roll two dice. Rolling a double gives an extra turn. A total of 9 or more moves the counter into a bonus zone.

a. Find the probability of rolling a double.
b. Find the probability of a total of at least 9. (Use the table in Question 4 if you want.)
c. Find the probability of a product of 12 (one score multiplied by the other).
d. In 72 rolls, how many extra turns are expected?

## Question 11

**Question 11 – Choosing lunch** *(Section B · Real-life practice)*

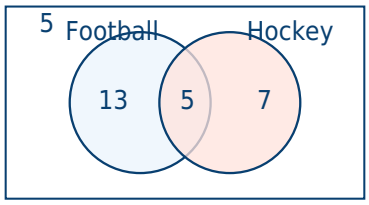
The canteen offers three main courses (pizza, pasta or salad) and two drinks (juice or water). Priya picks one of each at random.

a. Write out a sample space of all possible lunches.
b. How many outcomes are there?
c. Find $P(\text{pizza and water})$.
d. Find $P(\text{salad})$.
e. Find $P(\text{pasta or juice})$ by counting the outcomes.

## Question 12

**Question 12 – Sports survey** *(Section B · Real-life practice)*

In Year 9, a class of 30 pupils were asked about sport. 18 play football, 12 play hockey and 5 play both.




a. Find the number who play football only and hockey only.
b. Find the number who play neither.
c. Find the probability that a pupil chosen at random plays both.
d. Find the probability that a pupil plays football or hockey (or both).
e. Find the probability that a pupil plays exactly one sport.

## Question 13

**Question 13 – The prize wheel** *(Section B · Real-life practice)*

At the summer fair a prize wheel costs £1 per spin. The probability of winning a prize is 0.15 and each prize is worth £4.

a. Find the probability of not winning.

b. In 200 spins, how many prizes are expected?
c. Find the total prize money expected to be paid out.
d. Find the expected profit for the fair.
e. The organiser wants a profit of at least £100. Is it likely with 200 spins?

## Question 14

**Question 14 – A pack of cards** *(Section B · Real-life practice)*

A standard pack has 52 cards in four suits (hearts, diamonds, spades, clubs) with 13 cards in each suit. One card is picked at random.

a. Find $P(\text{heart})$.
b. Find $P(\text{king})$.
c. Find $P(\text{king or queen})$.
d. Find $P(\text{not a spade})$.
e. The card is replaced and the pack shuffled. If this is done 104 times, how many hearts are expected?

## Question 15

**Question 15 – How pupils travel to school** *(Section C · Problem solving)*

A school surveyed 100 pupils about how they travel to school.

| | Walk | Bus | Car | Total |
|---|---|---|---|---|
| Boys | 22 | 18 | 10 | ? |
| Girls | 16 | 24 | 10 | ? |
| Total | ? | ? | ? | 100 |

a. Complete the table.
b. A pupil is chosen at random. Find $P(\text{walks})$.
c. Find the probability that the pupil is a girl who takes the bus.
d. A girl is chosen at random from the girls. Find the probability that she walks.
e. The school has 1 200 pupils. Estimate how many travel by car.

## Question 16

**Question 16 – Two spinners** *(Section C · Problem solving)*

Spinner A has the numbers 1, 2 and 3. Spinner B has the numbers 1, 2, 3 and 4. Both are spun and the scores are added.

| + | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
| 2 | 3 | 4 | 5 | 6 |

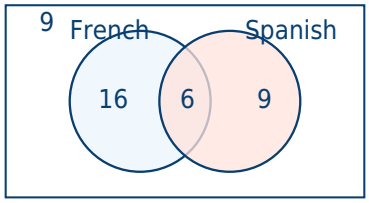
| + | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| 3 | 4 | 5 | 6 | 7 |

a. How many outcomes are there?
b. Find $P(\text{total } 5)$.
c. Find $P(\text{total is even})$.
d. Find $P(\text{total greater than } 5)$.
e. In 120 spins, how many totals of 5 are expected?

## Question 17

**Question 17 – Languages at school** *(Section C · Problem solving)*

In a group of 40 students, 22 study French, 15 study Spanish and 6 study both.




a. Complete the Venn diagram: find the number in each region.
b. Find $P(\text{neither language})$.
c. Find $P(\text{exactly one language})$.
d. A student who studies French is chosen. Find the probability that they also study Spanish.
e. Estimate the number of students studying neither language in a year group of 200.

## Question 18

**Question 18 – Is the game fair?** *(Section C · Problem solving)*

At a fair a player pays £1 and rolls two dice. If the total is 7 they win £4. If the dice show a double they win £2. Otherwise they win nothing.

a. Find the probability of each of the two winning outcomes. Explain why they cannot happen together.
b. Find the expected winnings per play.
c. Is the game fair? Compare with the £1 cost.
d. The game is played 360 times. How much is taken and how much is expected to be paid out?

## Question 19

**Question 19 – Three coins** *(Section C · Problem solving)*

Three fair coins are flipped.

| Outcome | Heads |
|---|---|
| HHH | 3 |
| HHT, HTH, THH | 2 |
| HTT, THT, TTH | 1 |
| TTT | 0 |

a. How many outcomes are there altogether?
b. Find $P(\text{exactly 2 heads})$.
c. Find $P(\text{at least one tail})$.
d. Find $P(\text{all coins the same})$.
e. In 80 trials, how many times is exactly 2 heads expected?

## Question 20

**Question 20 – Challenge: unknown in a Venn diagram** *(Section D · Challenge)*

In a class of 30 pupils, 18 like pizza and 20 like pasta. Everyone likes at least one of the foods apart from 2 pupils. Let $x$ be the number who like both.

a. Write an expression for the number who like pizza only, and the number who like pasta only.
b. Write an equation using all four regions that add to 30.
c. Solve it to find $x$.
d. Find $P(\text{pizza only})$.
e. A pupil who likes pasta is chosen. Find the probability that they also like pizza.