Unit 10 – Higher Knowledge Organiser
PROBABILITY

Combined events:

$$\text{Probability} = \frac{\text{number of successful outcomes}}{\text{total number of possible outcomes}}$$

Mutually exclusive events:

Two events are **mutually exclusive** if they cannot happen at the same time. For example, when you roll an ordinary dice, you cannot get a 3 and an even number at the same time.

When events are mutually exclusive you can add their probabilities.
For mutually exclusive events P(A or B) = P(A) + P(B)

For mutually exclusive events A and not A, P(not A) = 1 – P(A). A and not A are always mutually exclusive.

Example

A bag contains 20 counters. 7 of the counters are red. A counter is taken at random from the bag. Work out the probability that the counter will be

a red b not red.

a $P(red) = \frac{7}{20}$

b $P(\text{not red}) = 1 - P(red)$

$= 1 - \frac{7}{20}$

$= \frac{13}{20}$

$P(A) = \frac{\text{number of successful outcomes}}{\text{total number of possible outcomes}}$

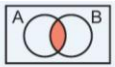
P(not A) = 1 – P(A)

Venn diagrams:

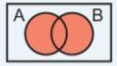
A ∩ B ∩ C means the **intersection** of A, B and C.
A ∪ B ∪ C means the **union** of A, B and C.
P(A ∩ B | B) means the probability of A and B given B.

Curly brackets { } show a set of values.
∈ means 'is an element of'.

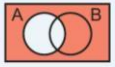
A ∩ B means 'A intersection B'. This is all the elements that are in A *and* in B.



A ∪ B means 'A union B'. This is all the elements that are in A *or* B *or* both.



A' means the elements *not* in A.



ℰ means the universal set – all elements being considered.

Probabilities add up to 1

Independent event = one event does not affect the probability of the other.
Example – Flipping heads on a coin has no effect on rolling a 3 on a dice
Dependent events = one outcome affects another
Example – choosing one red card reduces the chance of choosing another red card

To find the probability of two independent events, multiply their probabilities
P(A and B) = P(A) x P(B)

Communication Hint:

P(two tails) means the probability of getting two tails.

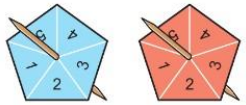
Sample space diagram:

A **sample space diagram** shows all the possible outcomes of two events.

Example 1

Two fair five-sided spinners are spun and the results are added together.

a Draw the sample space diagram to show all the possible outcomes.
b Work out the probability of getting a total of 2.
c Work out the probability of getting a total of 6.
d Work out the probability of getting a total that is a prime number.



a

Blue spinner \ Red spinner	1	2	3	4	5
1	2	3	4	5	6
2	3	4	5	6	7
3	4	5	6	7	8
4	5	6	7	8	9
5	6	7	8	9	10

Add the number on the red spinner to the number on the blue spinner.

b $P(2) = \frac{1}{25}$

c $P(6) = \frac{5}{25} = \frac{1}{5}$

d $P(\text{prime}) = \frac{11}{25}$

$\frac{\text{number of ways of scoring 2}}{\text{total number of scores}}$

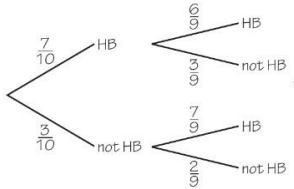
The outcomes that are prime numbers are 2, 3, 5 and 7.

Tree Diagrams:

There are 10 pencils in Toby's pencil case.
Seven of the pencils are HB pencils.
Toby takes two pencils out of his pencil case.

a Draw a tree diagram to show all the possible outcomes.
b Work out the probability that he picks out at least one HB pencil.

a



Taking two pencils from the pencil case at the same time is the same as taking one pencil, then another (without replacement).

b $P(\text{at least 1 HB}) = 1 - P(\text{no HB})$

$P(\text{not HB, not HB}) = \frac{3}{10} \times \frac{2}{9} = \frac{6}{90} = \frac{1}{15}$

$P(\text{at least 1 HB}) = 1 - \frac{1}{15} = \frac{14}{15}$

You don't need to simplify probability fractions, but sometimes it makes calculations easier.