UNIT 10: Probability	Teaching Time
	9–11 hours

SPECIFICATION REFERENCES

N5   apply systematic listing strategies, **including use of the product rule for counting** …

P1   record, describe and analyse the frequency of outcomes of probability experiments using tables and frequency trees

P2   apply ideas of randomness, fairness and equally likely events to calculate expected outcomes of multiple future experiments

P3   relate relative expected frequencies to theoretical probability, using appropriate language and the 0–1 probability scale

P4   apply the property that the probabilities of an exhaustive set of outcomes sum to one; apply the property that the probabilities of an exhaustive set of mutually exclusive events sum to one

P5   understand that empirical unbiased samples tend towards theoretical probability distributions, with increasing sample size

P6   enumerate sets and combinations of sets systematically, using tables, grids, Venn diagrams and tree diagrams

P7   construct theoretical possibility spaces for single and combined experiments with equally likely outcomes and use these to calculate theoretical probabilities

P8   calculate the probability of independent and dependent combined events, including using tree diagrams and other representations, and know the underlying assumptions

P9   **calculate and interpret conditional probabilities through representation using expected frequencies with two-way tables, tree diagrams and Venn diagrams**

PRIOR KNOWLEDGE

Students should understand that a probability is a number between 0 and 1, and distinguish between events which are impossible, unlikely, even chance, likely, and certain to occur.

Students should be able to mark events and/or probabilities on a probability scale of 0 to 1.

Students should know how to add and multiply fractions and decimals.

Students should have experience of expressing one number as a fraction of another number.

KEYWORDS

<u>Tier 2</u>

Conditional, outcomes, theoretical, experimental, fairness

<u>Tier 3</u>

Probability, mutually exclusive, tree diagrams, sample space, relative frequency, Venn diagram

OBJECTIVES

By the end of the unit, students should be able to:
· Write probabilities using fractions, percentages or decimals;
· Understand and use experimental and theoretical measures of probability, including relative frequency to include outcomes using dice, spinners, coins, etc;
· Estimate the number of times an event will occur, given the probability and the number of trials;
· Find the probability of successive events, such as several throws of a single dice;
· List all outcomes for single events, and combined events, systematically;
· Draw sample space diagrams and use them for adding simple probabilities;
· Know that the sum of the probabilities of all outcomes is 1;
· Use $1 - p$ as the probability of an event not occurring where p is the probability of the event occurring;
· Work out probabilities from Venn diagrams to represent real-life situations and also 'abstract' sets of numbers/values;
· Use union and intersection notation;
· Find a missing probability from a list or two-way table, including algebraic terms;
· Understand conditional probabilities and decide if two events are independent;
· Draw a probability tree diagram based on given information, and use this to find probability and expected number of outcome;
· Understand selection with or without replacement;
· Calculate the probability of independent and dependent combined events;
· Use a two-way table to calculate conditional probability;
· Use a tree diagram to calculate conditional probability;
· Use a Venn diagram to calculate conditional probability;
· Compare experimental data and theoretical probabilities;
· Compare relative frequencies from samples of different sizes.

POSSIBLE SUCCESS CRITERIA/EXAM QUESTIONS

If the probability of outcomes are x, $2x$, $4x$, $3x$, calculate x.

Draw a Venn diagram of students studying French, German or both, and then calculate the probability that a student studies French given that they also study German.

John has an empty box.
He puts some red counters and some blue counters into the box.

The ratio of the number of red counters to the number of blue counters is 1 : 4

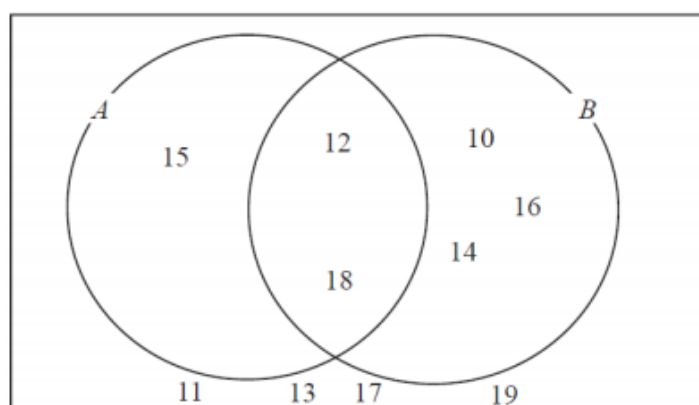Linda takes at random 2 counters from the box.

The probability that she takes 2 red counters is $\dfrac{6}{155}$

How many red counters did John put into the box?

Here is a Venn diagram.

(a) Write down the numbers that are in set

   (i) $A \cup B$

   (ii) $A \cap B$

(2)

One of the numbers in the diagram is chosen at random.

(b) Find the probability that the number is in set A'

(2)

Sami asked 50 people which drinks they liked from tea, coffee and milk.

All 50 people like at least one of the drinks.
19 people like all three drinks.
16 people like tea and coffee but do **not** like milk.
21 people like coffee and milk.
24 people like tea and milk.
40 people like coffee.
1 person likes only milk.
Sami selects at random one of the 50 people.

(*a*) Work out the probability that this person likes tea.

(4)

(*b*) Given that the person selected at random from the 50 people likes tea,
find the probability that this person also likes exactly one other drink.

(2)

(Total 6 marks)
New SAMs Paper 3H qu.12 (P8, P9 – AO1/AO2/AO3)
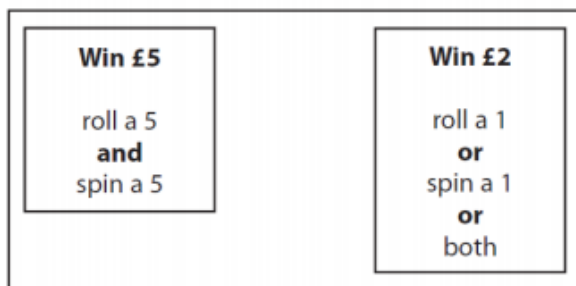

David has designed a game.
He uses a fair 6-sided dice and a fair 5-sided spinner.
The dice is numbered 1 to 6.
The spinner is numbered 1 to 5.

Each player rolls the dice once and spins the spinner once.
A player can win £5 or win £2.

Win £5	**Win £2**
roll a 5 **and** spin a 5	roll a 1 **or** spin a 1 **or** both

David expects 30 people will play his game.
Each person will pay David £1 to play the game.

(*a*) Work out how much profit David can expect to make.

(4)

(*b*) Give a reason why David's actual profit may be different to the profit he expects to make.

(1)

(Total 5 marks)
Specimen Papers Set 2, Paper 1F qu.21 / 1H qu.3 (P2, P5, P8 – AO1/AO3)

OPPORTUNITIES FOR REASONING/PROBLEM SOLVING

Students should be given the opportunity to justify the probability of events happening or not happening in real-life and abstract contexts.

COMMON MISCONCEPTIONS

Probability without replacement is best illustrated visually and by initially working out probability 'with' replacement.

Not using fractions or decimals when working with probability trees.

NOTES

Encourage students to work 'across' the branches, working out the probability of each successive event. The probability of the combinations of outcomes should = 1.

Use problems involving ratio and percentage, similar to:
- A bag contains balls in the ratio 2 : 3 : 4. A ball is taken at random. Work out the probability that the ball will be … ;
- In a group of students 55% are boys, 65% prefer to watch film A, 10% are girls who prefer to watch film B. One student picked at random. Find the probability that this is a boy who prefers to watch film A (P6).

Emphasise that, were an experiment repeated, it will usually lead to different outcomes, and that increasing sample size generally leads to better estimates of probability and population characteristics.