Year 9 Probability – Revision Notes

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Year 9 · Maths · Probability · Key ideas and worked examples

For grown-ups and learners: read each part and try the worked example. Then work through the sheets: Foundation, Developing, Challenge, then Mixed Practice to revise everything. Show your working: it earns marks in tests and helps you spot mistakes.

1. Mutually exclusive events

Events are **mutually exclusive** if they cannot happen at the same time, such as a spinner landing on red and landing on blue. For mutually exclusive events, **add**: P(red or blue) = P(red) + P(blue). The probabilities of **all** the mutually exclusive outcomes add up to **1**, so a missing probability is 1 minus the others. In a table with x and 2x, write an equation: 0.4 + 0.3 + x + 2x = 1, so 3x = 0.3 and x = 0.1.

Example: A counter is taken at random from a bag of red, white, blue and black counters. P(red) = 0.6, P(white) = 0.2, P(blue) = 0.15. Find P(black) and P(blue or black).
→ All four add up to 1: 1 − 0.6 − 0.2 − 0.15 = 0.05
→ P(blue or black) = 0.15 + 0.05 = 0.2
Answer: P(black) = 0.05; P(blue or black) = 0.2

2. Independent events

Two events are **independent** if one does not change the probability of the other: flipping a coin and rolling a dice, or taking a counter and **putting it back** before taking another. For independent events, **multiply**: P(A and B) = P(A) × P(B). Taking a counter **without replacement** changes what is left, so the second choice is **not independent** of the first. With 5 red and 3 blue counters, P(red, red) = 5/8 × 4/7 = 20/56 = 5/14.

Example: The probability that a traffic light is red when Lina reaches it is 0.1. The probability that the lift is working when she gets to the office is 0.45. The two events are independent. Find the probability that neither event happens.
→ P(not A) = 1 − 0.1 = 0.9; P(not B) = 1 − 0.45 = 0.55
→ 0.9 × 0.55 = 0.495
Answer: 0.495

3. Combined events

For two spinners or dice, a **sample space diagram** (a grid) lists every equally likely outcome: spinners numbered 1 to 4 and 1 to 5 give 4 × 5 = 20 outcomes. Then P(event) = successful outcomes ÷ total outcomes. Two-way tables and Venn diagrams also give probabilities: divide the number in the right cell or region by the total. When an event can happen in two orders (red then blue, or blue then red), find each and add them.

Example: A pot holds 4 blue and 2 green pens. Two pens are taken at random, one after the other, without replacement. Find the probability that one is blue and one is green. Are the two choices independent?
→ blue then green: 4/6 × 2/5; green then blue: 2/6 × 4/5; each is 4/15
→ Add the two orders (mutually exclusive): 8/15
Answer: 8/15. The events are not independent: the first choice changes the second probability.

4. Expected frequency and experiments

The **expected frequency** = probability × number of trials: if P(seed grows) = 0.85, then from 200 seeds expect 0.85 × 200 = 170 to grow. Run an experiment or a **simulation** (for example with random numbers) and compare the observed results with the expected ones. With a **small** number of trials the results can be far from expected just by chance. After a **large** number of trials, the experimental probability usually gets close to the theoretical one, so a large difference suggests bias.

Example: A footballer scores from 60% of penalties. How many goals would you expect from 60 penalties?
→ 60% = 0.6
→ 0.6 × 60 = 36
Answer: 36 goals

Think like a mathematician: test a few cases (**specialising**), look for the rule that always works (**generalising**), and explain why you are sure (**convincing**). When you check someone's working, say what is wrong and how to **improve** it.

Common mistakes: adding probabilities of events that can happen together, which counts the overlap twice. Adding instead of multiplying for 'A and B'. Treating choices without replacement as independent. Probabilities of all the outcomes that do not add up to 1. Judging a dice from very few rolls.