GCSE Maths – Probability

Exhaustive and Mutually Exclusive Events

Notes

WORKSHEET

Exhaustive Events

Probabilities are usually written as **decimals**, often less than 1. This number represents the **likelihood** of an event occurring. For example, the probability of getting tails in a coin toss is 0.5, as there is a 1 in 2 (or $\frac{1}{2}$) chance.

$$Probability = \frac{Number\ of\ target\ events}{Total\ number\ of\ possible\ events}$$

In a coin toss, we can only get heads or tails. The probability of each of these is 0.5, and the sum of **all possible events** is 1. This is a consistent rule when dealing with probabilities - when we **add together** all the possible outcomes, called the **exhaustive events**, the sum must always be 1.

Example: There are 10 marbles in a bag, all of which are red or blue. The probability of picking out a blue marble is 0.35. What is the probability of picking out a red marble?

As all marbles in the bag are red or blue, we have to pick out one or the other. This means we know all possible outcomes.

The sum of exhaustive events equals 1, so we calculate the probability of picking a red marble:

$$Probability\ of\ red\ marble + Probability\ of\ blue\ marble = 1$$

$$Probability\ of\ red\ marble = 1 - Probability\ of\ blue\ marble = 1 - 0.35 = 0.65$$

The probability of picking out a red marble is $\mathbf{0.65}$.

Mutually Exclusive Events

Some events **cannot occur at the same time**. For example, a swimming athlete cannot win a medal and not win a medal at the same time. One of the events must happen (they win a medal or they do not). In this case, the occurrence of one event stops, or **excludes**, the other from happening. These types of events are called **mutually exclusive** events.

Although the mutually exclusive events cannot occur at the same time, the **sum** of probabilities of **all possible outcomes** must still be equal to 1.

Example: The probability of a sprinter winning a gold medal is 0.05, a silver medal is 0.2 and a bronze medal is 0.4. What is the probability of them not winning any medal?

These are mutually exclusive events – only one can occur – but they still add up to 1. To find the missing probability, take away all other probabilities from 1.

$$P(Win\ gold) + P(Win\ silver) + P(Win\ bronze) + P(No\ medal) = 1$$

$$P(No\ medal) = 1 - 0.05 - 0.2 - 0.4 = 0.35$$

The probability of the sprinter not winning any medal is $\mathbf{0.35}$.

Exhaustive and Mutually Exclusive Events - Practice Questions

1. Answer the following questions involving exhaustive events:

   a) The probability that a football player is going to score in the next game is 0.8. What is the probability that they will not score?

   b) In a raffle, 40 tickets were sold. Jack and Owen have 10 tickets each.

      i) Identify all exhaustive events in this scenario.
      ii) What is the probability that Owen wins the raffle prize?

2. Answer the following questions:

   a) In a bag of counters, there are 20 orange and 30 blue marbles. Vanessa picks out 2 marbles at a time.

      i) Are the events of picking out an orange marble and blue marble mutually exclusive?
      ii) What is the probability of picking out an orange marble?

   b) Louis picks out letters at random from the word LIGHTHOUSE.

      i) Are the events of picking a vowel and picking a letter in the first half of the word mutually exclusive?
      ii) Find the probability of picking a consonant.

3. A bag contains blue and red marbles, which come in sizes small and large. 80% of the marbles in the bag are blue. 60% of the marbles are large. Explain why picking a large marble and a blue marble are not mutually exclusive events.

Worked solutions for the practice questions can be found amongst the worked solutions for the corresponding worksheet file.