GCSE Maths – Probability

Exhaustive and Mutually Exclusive Events

Worksheet

WORKED SOLUTIONS

This worksheet will show you how to work out questions relating to exhaustive and mutually exclusive events. Each section contains a worked example, a question with hints and then questions for you to work through on your own.

Section A

Worked Example

There are yellow and green counters in a bag. Lucy picks out counters at random, and then returns them. The probability that she will pick a yellow counter is 0.4. What is the probability that she will pick out a green counter?

Step 1: Identify all the exhaustive events in this scenario.

The only possible counters that Lucy can draw from the bag are yellow or green, so we know all exhaustive events (green or yellow). There are no other possibilities.

Step 2: Subtract the known probabilities from 1 to find the missing probability.

We know that the probability of drawing a yellow counter is 0.4. To find the probability of drawing a green counter, we perform the operation:

$$P(Green\ counter\ selected) = 1 - 0.4 = 0.6$$

The probability of picking out a green counter is 0.6.

Guided Example

The table below shows the probabilities of obtaining each number on a biased dice:

Value	1	2	3	4	5	6
Probability	0.15	0.15	0.3	0.24	0.06	

What is the probability of obtaining a 6 on this dice?

Step 1: Identify all the exhaustive events in this scenario.

The possible numbers are:

1, 2, 3, 4, 5 and 6

Step 2: Subtract the known probabilities from 1 to find the missing probability.

$1 - 0.15 - 0.15 - 0.3 - 0.24 - 0.06$

$= 1 - 0.9$

$= 0.1$

P(obtaining 6) = 0.1

Now it's your turn!
If you get stuck, look back at the worked and guided examples.

1. 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?

Exhaustive Events: Score and Not Score.

$1 - 0.8 = 0.2$

$P(\text{Not Score}) = 0.2$

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

   a) Identify all exhaustive events in this scenario.

Jack wins – 10
Owen wins – 10
Noone wins – 20

   b) What is the probability that Owen wins the raffle prize?

Out of 40 tickets, Owen has 10.

$P(\text{Owen wins}) = \frac{10}{40}$

$= \frac{1}{4}$

3. A letter is picked out at random from the word MISSISSIPPI.

a) Identify all the exhaustive events from this scenario.

Picking a:
- M
- I
- S
- P

b) What is the probability of picking the letter 'S'?

11 letters, 4 letters are S.

Probability = $\frac{\text{No of letters that are S}}{\text{Total No of letters}}$

P(picking S) = $\frac{4}{11}$

4. In a lottery, there are 30 balls numbered 1-30 inclusive. One ball is drawn at random.

a) How many exhaustive events are there?

There are 30 balls, one of these 30 can be drawn.

Therefore there are 30 exhaustive events.

b) Calculate the probability of picking a number larger than 20.

Events larger than 20:

21, 22, 23, 24, 25, 26, 27, 28, 29, 30 ← 10 events

P(larger than 20) = $\frac{10}{30}$ ← events larger than 20 / ← total events

= $\frac{1}{3}$

Section B

Worked Example

Steven rolls a fair die.

a) **Are the events of rolling an odd number and rolling a prime number mutually exclusive?**
b) **What is the probability of rolling an odd number?**

Step 1: For part a), consider whether the events are mutually exclusive.

*'Mutually exclusive' means the events **cannot** happen at the same time. To check whether these are mutually exclusive, we can look at each possible outcome:*

- *1 – odd, not a prime number*
- *2 – even, a prime number*
- *3 – odd, a prime number*
- *4 – even, not a prime number*
- *5 – odd, a prime number*
- *6 – even, not a prime number.*

*As 3 and 5 are both odd **and** prime numbers, this means that the events are **not** mutually exclusive, as they can both occur at the same time.*

Step 2: Calculate the probability for part b).

There are six possible numbers and amongst these six there are three odd numbers: 1, 3 *and* 5.

$$Probability(Rolling\ an\ odd\ number) = \frac{3}{6} = \frac{1}{2} = 0.5$$

The probability of rolling an odd number is 0.5.

Guided Example

Ryan picks out letters at random from the word LUXEMBOURG.

a) **Are the events of picking out a vowel and picking out a consonant mutually exclusive?**
b) **What is the probability of picking out a vowel?**

Step 1: For part a), consider whether the events are mutually exclusive.

Vowels are not consonants and Consonants are not vowels
Therefore, these events cannot happen at the same time
and are mutually exclusive.

Step 2: Calculate the probability for part b).

There are 10 letter of which 4 are vowels.

$$P(\text{vowel}) = \frac{4}{10} = \frac{2}{5}$$

Now it's your turn!
If you get stuck, look back at the worked and guided examples.

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

   a) Are the events of picking out an orange marble and blue marble mutually exclusive?

   As two marbles are picked out at the same time, 1 orange and 1 blue marble can be picked out at the same time. Hence not mutually exclusive.

   b) What is the probability of picking out an orange marble?

   Total Marbles: $20 + 30 = 50$

   Orange Marbles: 20

   $P(\text{orange}) = \frac{20}{50} = \frac{2}{5}$

6. Louis picks out letters at random from the word LIGHTHOUSE.

   a) Are the events of picking a vowel and picking a letter in the first half of the word mutually exclusive?

   The first half of the word is LIGHT, which contains the vowel I. This means the events can occur together, hence not mutually exclusive.

   b) Find the probability of picking a consonant.

   Total letters: 10

   Total Consonants: 6

   $P(\text{consonants}) = \frac{6}{10} = \frac{3}{5}$

7. A basketball team has a 0.7 chance of winning its next game.

   a) Explain why winning the next game and losing the next game are mutually exclusive events.

Because the team cannot win and lose the next game. The team could only win or lose or draw the next game. Therefore the events cannot occur at the same time and are mutually exclusive

   b) If the probabilities of losing the game or drawing the game are equal, what is the probability that they lose the next game?

P(lose or draw) = 1 − P(win)

= 1 − 0.7 = 0.3

As P(Lose) = P(Draw), we can divide by 2.

0.3 ÷ 2 = 0.15

P(Lose) = 0.15

8. 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.

We are not told any information about the size of the blue balls. However, as we know that more than half are blue and more than half are large, we can deduce there is some overlap. This means that the events will occur at the same time, hence not mutually exclusive.