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CHAPTER NOTES

Probability Class 10 Notes | CBSE Maths Chapter 14

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Ask me anything from this chapter. A concept, a numerical, or that one doubt you did not want to raise in class. Pick one to start:

Explain Probability simply

What can the board exam ask?

Most important formulas

Quiz me on this chapter

Ask Ira anything...



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Probability Class 10 Notes | CBSE Maths

Chapter 14

Probability is Chapter 14 of CBSE Class 10 Maths. In Class 9 you found experimental probability by repeating an experiment many times and counting. This chapter moves to theoretical (classical) probability, where you work out the chance of an event directly by counting outcomes, on the assumption that all outcomes are equally likely. It covers equally likely outcomes, the formula $P(E) = \text{favourable outcomes} / \text{all possible outcomes}$, elementary events, sure and impossible events, complementary events, and problems on coins, dice, playing cards, balls, marbles and defective items.

For board exams the chapter is short and very scoring when the counting is done carefully. Almost every question comes down to two numbers: how many outcomes are possible, and how many of them suit the event. Questions range from one-line checks (which value cannot be a probability, or $P(\text{not } E)$ from $P(E)$) to longer questions involving two draws together, or a second draw after one item

Quick Answer - Probability in 30 s

When all outcomes of an experiment are equally likely, the probability of an event E is **$P(E) = (\text{number of outcomes favourable to } E) / (\text{number of all possible outcomes})$** . A **sure event** has probability always **$0 \leq P(E) \leq 1$** . An event with exact probabilities of all elementary events add up to 1. A standard deck of cards has 52 cards, two coins give 4 outcomes.



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All Key Formulas at a Glance

Idea	Formula or fact	Use it when
Theoretical probability	$P(E) = \text{favourable outcomes} / \text{all possible outcomes}$	Outcomes are equally likely and can be counted
Experimental probability (Class 9)	$P(E) = \text{trials in which E happened} / \text{total trials}$	Results come from actual repeated trials
Range of probability	$0 \leq P(E) \leq 1$	Checking whether a value can be a probability
Sure event	$P(\text{sure event}) = 1$	Every outcome suits the event
Impossible event	$P(\text{impossible event}) = 0$	Event cannot happen
Complementary events	$P(E) + P(\text{not } E) = 1$ $P(\text{not } E) = 1 - P(E)$	When two events are complementary, their probabilities add up to 1
Elementary events	Sum of probabilities of elementary events = 1	When all possible outcomes are listed, their probabilities add up to 1
One coin / two coins / three coins	2 / 4 / 8 equally likely outcomes	
One die / two dice	6 / $6 \times 6 = 36$ equally likely outcomes	
Deck of cards	52 cards, 4 suits, 13 cards in each suit	



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Key Concepts

1. Experiments, Outcomes and Equally Likely Outcomes

An **experiment** here means an action which can be repeated under the same conditions. Examples: throwing a die, drawing a card or picking a ball from a bag.

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is a collection of one or more outcomes that we are interested in, such as “getting an even number” when a die is thrown.

NCERT starts with a coin that is **fair** or **unbiased**: it is symmetrical, so there is no reason for it to fall more often on one side than the other. A **random toss** means the coin falls freely, with no bias or interference. The coin lands head up or tail up (landing on its edge is ignored), and each of these is as likely as the other. We say the outcomes head and tail are **equally likely**.

In this chapter a die always means a **fair die**. When it is thrown once, the outcomes are 1, 2, 3, 4, 5 and 6, and each number has the same chance of showing up.

Outcomes that are not equally likely

A bag has 4 red balls and 1 blue ball. If you draw one ball without looking, “red” and “blue” are the two colours you can get, but red is more likely because there are four red balls. So the outcomes “a red ball” and “a blue ball” are **not equally likely**. Each individual ball, though, is equally likely to be drawn. The trick in many situations is to think of the individual balls as the outcomes, because those are

Some everyday “two-way” results are not equally likely. For example, whether a car starts depends on the car’s condition, so the two outcomes “starts” and “does not start” are not equally likely. Similarly, whether a basketball player makes a shot depends on the player’s skill, so the two outcomes “makes” and “misses” are not equally likely. This chapter assumes that all experiments in the chapter are fair.

Experimental probability versus theoretical probability

In Class 9 you met the **experimental (empirical) probability**.

$P(E)$ = (number of trials in which the event E occurs) / (total number of trials)

This needs the experiment to be repeated many times. It is often expensive or impossible for some situations, such as waiting for a rare event, or often it fails, or waiting for repeated earthquakes. When we can make certain assumptions, we can calculate the **theoretical probability** without repeating the experiment.

Experimental probability is based on what actually happens. Theoretical probability is based on what will happen from assumptions. NCEP says that as the number of trials increases, we may expect the experimental probability to get closer to the theoretical probability.



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2. Theoretical (Classical) Probability

The **theoretical probability** (also called **classical probability**) of an event E, written $P(E)$, is

$P(E) = (\text{number of outcomes favourable to E}) / (\text{number of all possible outcomes of the experiment})$

where the outcomes of the experiment are assumed to be equally likely. In this chapter "probability" means theoretical probability. This definition was given by **Pierre Simon Laplace in 1795**.

Probability theory began in the 16th century with **J. Cardan's** *The Book on Games of Chance*, the first book on the subject.

A three-step method for every question

1. **List or count all possible outcomes.** Make sure they are equally likely. For a bag of balls, count every ball.
2. **Count the outcomes favourable to the** examiner can see them.
3. **Divide and simplify.** Give the answer as (uses decimals).

Illustration: a die is thrown once. Find the 1, 2, 3, 4, 5, 6, so 6 outcomes. Favourable:

Elementary events

An event that has **only one outcome** of the tossed, "head" and "tail" are elementary events. If a bag contains one red, one blue and one yellow ball, the three outcomes are elementary events, each with probability $1/3$.

"A number greater than 4" on a die is **not** an elementary event. It has two outcomes (5 and 6).

Key fact: the sum of the probabilities of all elementary events is 1. For a coin, $1/2 + 1/2 = 1$. For one die, six elementary events, $1/6 + 1/6 + 1/6 + 1/6 + 1/6 + 1/6 = 1$. Check on your working: if a bag has 3 blue balls and 6 red balls, $P(\text{red}) = 2/9 + 3/9 + 4/9 = 1$.



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3. Sure Events, Impossible Events and the Range 0 to 1

Impossible event: an event that cannot happen. No outcome is favourable, so its probability is 0. Getting 8 on a single throw of a die is impossible, and $P(\text{getting } 8) = 0/6 = 0$.

Sure (certain) event: an event that is certain to happen. Every outcome is favourable, so its probability is 1. Every face of a die shows a number less than 7, so $P(\text{number less than } 7) = 6/6 = 1$.

In the formula, the number of favourable outcomes can never be more than the total number of outcomes, and it can never be negative. So for every event E:

$0 \leq P(E) \leq 1$

Value	Can it be a probability?	Reason
2/3	Yes	
-1.5	No	
15%	Yes	
0.7	Yes	
5/4	No	

NCERT Exercise 14.1 Q4 asks exactly this v
-1.5.

Illustration: a bag contains lemon flavoured
looking. $P(\text{orange flavoured}) = 0$, an impos

4. Complementary Events

The event "not E" is written $\bar{E}$ (E with a bar
E and not E are called **complementary ev**

Every outcome belongs to exactly one of f
total. That gives:



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$$P(E) + P(\text{not } E) = 1, \text{ so } P(\text{not } E) = 1 - P(E)$$

Checks from NCERT examples:

- Coin: $P(\text{head}) + P(\text{tail}) = 1/2 + 1/2 = 1$. Tail is "not head".
- Die: $P(\text{number} > 4) + P(\text{number} \leq 4) = 1/3 + 2/3 = 1$. "Not greater than 4" means "less than or equal to 4".
- Cards: $P(\text{ace}) = 4/52 = 1/13$, so $P(\text{not an ace}) = 1 - 1/13 = 12/13$.

When to use the complement

Use $1 - P(E)$ when the event you want is long to count and its opposite is short. The classic signal is the phrase "**at least one**".

Illustration: two coins are tossed. $P(\text{at least one head}) = 1 - P(\text{no head}) = 1 - P(TT) = 1 - 1/4 = 3/4$. Counting directly gives the same result: HH, HT, TH are 3 of the 4 outcomes.

Illustration with a given probability: if the probability of Reshma winning against Reshma is 0.62, then Reshma's probability of winning against the two must win and the events are complementary.

5. Playing Cards and Drawing at Random

The deck of 52 cards

A deck has **52 cards** in **4 suits of 13 cards**. Spades and clubs are **black**; hearts and diamonds are **red**. There are 13 cards in each suit: Ace, King, Queen, Jack, 10, 9, 8, 7, 6, 5, 4, 3 and 2. **Kings, queens and jacks** are called **face cards**. All outcomes are equally likely.



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Type of card	Number in the deck	Probability of drawing one
Any one suit (e.g. spades)	13	$13/52 = 1/4$
Red cards (or black cards)	26	$26/52 = 1/2$
Aces (or kings, or queens, or jacks)	4	$4/52 = 1/13$
Face cards (K, Q, J of all suits)	12	$12/52 = 3/13$
Red kings	2	$2/52 = 1/26$

Aces are **not** face cards in the NCERT convention. Miscounting the face cards is a frequent slip: there are 12.

Balls, marbles, coins and defective items

“Drawn at random” is a short way of saying that the number of outcomes is the total number of

In quality problems, read the acceptance criteria carefully. For example, if a batch of 100 shirts: 88 good, 8 with minor defects and 4 with major defects, so his favourable count is 88. Sujatha rejects the batch if more than 10 shirts are defective. $88 - 10 = 78$ = 96.

A second draw after one item is removed

When an item is drawn and **not replaced**, the total number of items and the favourable count changes if the removed item was favourable or not.

Illustration (NCERT Exercise 14.1 Q17): a lot contains 10 bulbs, 4 of which are defective and 6 are not defective and is kept aside. Now 19 bulbs are drawn (10 defective, 9 not defective) = 15/19.

Illustration (NCERT Exercise 14.1 Q15): the 52 cards are shuffled face down. $P(\text{queen}) = 1/5$. If the 4 queens are removed, $P(\text{queen}) = 0/4 = 0$.



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6. Two Coins, Two Dice and Repeated Tosses

When two things happen together, list the outcomes as **ordered pairs** so that each listed outcome is equally likely.

Two coins

Tossing two different coins (say a ₹1 and a ₹2 coin) gives **4 equally likely outcomes**: (H, H), (H, T), (T, H), (T, T). (H, T) and (T, H) are different outcomes: head on the first coin and tail on the second is different from tail on the first and head on the second.

Event	Favourable outcomes	Probability
Two heads	HH	$1/4$
Exactly one head	HT, TH	$2/4 = 1/2$
At least one head	HH, HT, TH	$3/4$
No head	TT	$1/4$

A common wrong argument says there are three outcomes: two heads, one head, and no head, each with probability $1/3$. These three are not equally likely. There are two ways. NCERT Exercise 14.1 Q25(i) asks you to list the outcomes.

Three tosses of a coin

Tossing one coin 3 times gives $2 \times 2 \times 2 = 8$ outcomes: TTT. Exactly one head: HTT, THT, TTH, probability $3/8$. Two heads: HHT, HTH, THH, probability $3/8$. Three heads: HHH, probability $1/8$.

Two dice

When two dice (say one blue and one grey) are rolled, the first die pairs with each of the 6 numbers on the second die. There are **36 equally likely outcomes**, from (1, 1) to (6, 6). (1, 4) and (4, 1) are two different outcomes. Rolling two dice is the same as rolling **one die twice** as the same experiment as rolling two dice.

The six outcomes (1, 1), (2, 2), (3, 3), (4, 4), (5, 5), (6, 6) where both dice show the same number (both dice) = $6/36 = 1/6$.

Sums on two dice: count the pairs for each sum.



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Sum	Favourable pairs	Number	Probability
2	(1, 1)	1	$1/36$
3	(1, 2), (2, 1)	2	$2/36 = 1/18$
4	(1, 3), (2, 2), (3, 1)	3	$3/36 = 1/12$
5	(1, 4), (2, 3), (3, 2), (4, 1)	4	$4/36 = 1/9$
6	(1, 5), (2, 4), (3, 3), (4, 2), (5, 1)	5	$5/36$
7	(1, 6), (2, 5), (3, 4), (4, 3), (5, 2), (6, 1)	6	$6/36 = 1/6$
8	(2, 6), (3, 5), (4, 4), (5, 3), (6, 2)	5	$5/36$
9	(3, 6), (4, 5), (5, 4), (6, 3)		
10	(4, 6), (5, 5), (6, 4)		
11	(5, 6), (6, 5)		
12	(6, 6)		

The counts $1 + 2 + 3 + 4 + 5 + 6 + 5 + 4 + 3 + 2 + 1$ show that the most likely sum is 7. A sum of 13 is impossible (probability 0).

The 11 possible sums (2 to 12) are **not** equally likely. NCERT Exercise 14.1 Q22(ii) asks you to find the probability of getting a sum of 7 or 11.

7. Probability with Lengths and Areas

All the experiments so far had a finite number of outcomes, such as any number between 1 and 6. If the number of outcomes cannot be counted there, so NCERT uses continuous random variables. Examples with a star as **not from the exam** are given for understanding only.



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Length: music may stop at any time within 2 minutes. $P(\text{it stops within the first half-minute}) = (\text{favourable length}) / (\text{total length}) = (1/2) / 2 = 1/4$.

Area: a missing helicopter is equally likely to have crashed anywhere in a rectangular region of 4.5 km by 9 km, which is 40.5 km^2 . A lake inside it measures 2.5 km by 3 km, which is 7.5 km^2 . $P(\text{crashed in the lake}) = 7.5/40.5 = 75/405 = 5/27$.



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Formula and Theorem Sheet

Result	Statement	Remember
Theoretical probability	$P(E) = (\text{outcomes favourable to } E) / (\text{all possible outcomes})$	Only when outcomes are equally likely
Range	$0 \leq P(E) \leq 1$	No negative value, nothing above 1
Sure event	$P = 1$	Number less than 7 on a die
Impossible event	$P = 0$	Number 8 on a die, sum 13 on two dice
Elementary events	Sum of their prob	
Complement	$P(E) + P(\text{not } E) = 1$	
Coins	n coins (or n tosses)	
Dice	One die: 6 outcomes	
Cards	52 cards, 26 red, 26 black 12 face cards, 40 non-face cards	
Without replacement	Second draw: total outcomes change	



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Important Definitions

- **Experiment:** an action with results that can be observed.
a die.
- **Outcome:** one possible result of an experiment.

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- **Event:** a collection of one or more outcomes of an experiment.
- **Fair (unbiased) coin:** a coin that is symmetrical, so there is no reason for it to fall more often on one side than the other.
- **Random toss or random draw:** the coin falls freely, or the item is picked without looking, so there is no bias or interference and every outcome is equally likely.
- **Equally likely outcomes:** outcomes that each have the same chance of occurring.
- **Experimental (empirical) probability:** the number of trials in which the event happened divided by the total number of trials.
- **Theoretical (classical) probability:** $P(E)$ = number of outcomes favourable to E divided by the number of all possible outcomes, assuming the outcomes are equally likely.
- **Favourable outcomes:** the outcomes of an experiment for which the event E happens.
- **Elementary event:** an event having only one outcome of the experiment.
- **Sure (certain) event:** an event that is certain to happen: its probability is 1.
- **Impossible event:** an event that cannot
- **Complementary event:** the event "not" $P(\bar{E}) = 1 - P(E)$.
- **Face cards:** the kings, queens and jacks



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Solved Examples (NCERT)

Example 1: Complete the statement

Solution:

1. Probability of an event E + Probability of
2. The probability of an event that cannot **event**.
3. The probability of an event that is certain **certain event**.
4. The sum of the probabilities of all the e
5. The probability of an event is greater th

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Example 2: Which experiments have equally likely outcomes? (NCERT Exercise 14.1 Q2)

Which of the following experiments have equally likely outcomes? Explain. (i) A driver attempts to start a car. The car starts or does not start. (ii) A player attempts to shoot a basketball. She/he shoots or misses the shot. (iii) A trial is made to answer a true-false question. The answer is right or wrong. (iv) A baby is born. It is a boy or a girl.

Solution:

1. **Not equally likely.** Whether the car starts depends on its condition, such as the battery and fuel.
2. **Not equally likely.** Whether the shot goes in depends on the player's skill.
3. **Equally likely.** With two choices and a guess, right and wrong each have the same chance.
4. **Equally likely.** The baby is either a boy or a girl, and the chapter takes each of the two outcomes to have the same chance.

Q3 of the same exercise: tossing a coin is because the outcomes head and tail are $1/2$, of winning the toss.

Example 3: A die is thrown once (I

A die is thrown once. Find the probability between 2 and 6; (iii) an odd number.

Solution: Possible outcomes: 1, 2, 3, 4, 5,

1. Primes: 2, 3, 5 (1 is not prime). 3 favourable
2. Between 2 and 6: 3, 4, 5 (2 and 6 are excluded)
3. Odd: 1, 3, 5. 3 favourable. $P = 3/6 = 1/2$.

Example 4: One card from a deck (I

One card is drawn from a well-shuffled deck of 52 cards. Find the probability (i) a king of red colour (ii) a face card (iii) a red queen of diamonds.

Solution: A well-shuffled deck has 52 equally likely outcomes.



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1. Red kings: king of hearts and king of diamonds, so 2. $P = 2/52 = 1/26$.
2. Face cards: 3 in each suit $\times$ 4 suits = 12. $P = 12/52 = 3/13$.
3. Red face cards: 3 in hearts + 3 in diamonds = 6. $P = 6/52 = 3/26$.
4. Jack of hearts: 1 card. $P = 1/52$.
5. Spades: 13. $P = 13/52 = 1/4$.
6. Queen of diamonds: 1 card. $P = 1/52$.

Example 5: Marbles in a box (NCERT Exercise 14.1 Q9)

A box contains 5 red marbles, 8 white marbles and 4 green marbles. One marble is taken out of the box at random. What is the probability that the marble taken out will be (i) red? (ii) white? (iii) not green?

Solution: Total marbles = $5 + 8 + 4 = 17$, so 17 equally likely outcomes.

1. $P(\text{red}) = 5/17$.
2. $P(\text{white}) = 8/17$.
3. $P(\text{green}) = 4/17$, so $P(\text{not green}) = 1 - 4/17 = 13/17$.

Example 6: Probability of “not E” (NCERT Exercise 14.1 Q5 and Q7)

(a) If $P(E) = 0.05$, what is the probability of not E?

$P(\text{not } E) = 1 - P(E) = 1 - 0.05 = 0.95$.

(b) It is given that in a group of 3 students the probability that at least two have the same birthday is 0.992. What is the probability that no two have the same birthday?

“Same birthday” and “not the same birthday” are complementary events.
 $P(\text{not the same birthday}) = 1 - P(\text{same birthday}) = 1 - 0.992 = 0.008$.

Example 7: The spinning arrow (NCERT Exercise 14.1 Q10)

A game of chance consists of spinning an arrow which points to one of the numbers 1, 2, 3, 4, 5, 6, 7, 8, and these are equally likely to occur. What is the probability that it will point at (i) 8? (ii) an odd number? (iii) a number less than 9?



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Solution: 8 equally likely outcomes.

1. Only one 8. $P = 1/8$.
2. Odd numbers: 1, 3, 5, 7, so 4. $P = 4/8 = 1/2$.
3. Greater than 2: 3, 4, 5, 6, 7, 8, so 6. $P = 6/8 = 3/4$.
4. Less than 9: all 8 numbers. $P = 8/8 = 1$, a sure event.

Example 8: Defective pens and the shop (NCERT Exercise 14.1 Q16 and Q21)

(a) 12 defective pens are accidentally mixed with 132 good ones. It is not possible to just look at a pen and tell whether or not it is defective. One pen is taken out at random from this lot. Determine the probability that the pen taken out is a good one.

Total pens = $12 + 132 = 144$. $P(\text{good}) = 132/144 = 11/12$.

(b) A lot consists of 144 ball pens of which 20 are defective. A shopkeeper will buy a pen if it is good, but will not buy if it is defective. One pen is taken out at random and gives it to her. What is the probability that she will buy it?

Good pens = $144 - 20 = 124$.

1. $P(\text{she buys it}) = 124/144 = 31/36$.
2. $P(\text{she does not buy it}) = 20/144 = 5/36$.

Example 9: Bulbs without replacement

(i) A lot of 20 bulbs contain 4 defective ones. One bulb is drawn at random and is the probability that this bulb is defective and is not replaced. Now one bulb is drawn again. What is the probability that this bulb is not defective?

Solution:

1. $P(\text{defective}) = 4/20 = 1/5$.
2. Good bulbs at the start = $20 - 4 = 16$. C
15 are good. $P(\text{not defective}) = 15/19$.



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Example 10: Discs numbered 1 to 90 (NCERT Exercise 14.1 Q18)

A box contains 90 discs which are numbered from 1 to 90. If one disc is drawn at random from the box, find the probability that it bears (i) a two-digit number (ii) a perfect square number (iii) a number divisible by 5.

Solution: 90 equally likely outcomes.

1. One-digit numbers are 1 to 9, which is 9 numbers. Two-digit numbers = $90 - 9 = 81$. $P = 81/90 = 9/10$.
2. Perfect squares up to 90: 1, 4, 9, 16, 25, 36, 49, 64, 81, which is 9 numbers ($10^2 = 100$ is too big). $P = 9/90 = 1/10$.
3. Multiples of 5 up to 90: 5, 10, ..., 90, which is $90 \div 5 = 18$ numbers. $P = 18/90 = 1/5$.

Example 11: The lettered die (NCERT Exercise 14.1 Q19)

A child has a die whose six faces show the letters A through F. What is the probability of getting (i) A? (ii) D?

Solution: The die has 6 faces, so 6 equally likely outcomes.

1. $P(A) = 2/6 = 1/3$.
2. $P(D) = 1/6$.

Example 12: Sum on two dice (NCERT Exercise 14.1 Q20)

Two dice, one blue and one grey, are thrown at the same time. List all the possible outcomes. What is the probability that the sum of the numbers on the top of the dice is (i) 8? (ii) 13? (iii) less than or equal to 12?

Solution: Each die shows 1 to 6, so the number of possible outcomes is $6 \times 6 = 36$. The possible outcomes are (1, 1) to (6, 6), with the blue die first; each outcome has a sum of at most 12.

1. Sum 8: (2, 6), (3, 5), (4, 4), (5, 3), (6, 2).
2. The largest possible sum is $6 + 6 = 12$, so the probability of getting a sum of 13 is 0.
3. Every outcome has a sum of at most 12, so the probability of getting a sum less than or equal to 12 is 1.



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Example 13: A die thrown twice (NCERT Exercise 14.1 Q24)

A die is thrown twice. What is the probability that (i) 5 will not come up either time? (ii) 5 will come up at least once?

Solution: Throwing a die twice is the same experiment as throwing two dice, so there are 36 outcomes.

1. 5 does not come up either time: each throw has 5 choices (1, 2, 3, 4, 6), so $5 \times 5 = 25$ outcomes. $P = 25/36$.
2. "At least once" is the complement of "not either time". $P = 1 - 25/36 = 11/36$. Direct count: (5, 1) to (5, 6) gives 6, (1, 5) to (6, 5) gives 6, and (5, 5) was counted twice, so $6 + 6 - 1 = 11$.

Example 14: Hanif's coin game (NCERT Exercise 14.1 Q23)

A game consists of tossing a one rupee coin 3 times and noting its outcome each time. Hanif wins if all the tosses give the same result. Calculate the probability that Hanif will lose.

Solution: Outcomes: HHH, HHT, HTH, THH, THT, THT, TTH, TTT

Hanif wins on HHH and TTT: $P(\text{win}) = 2/8$

$P(\text{lose}) = 1 - 1/4 = 3/4$. The 6 losing outcomes are HHT, HTH, THH, THT, THT, TTH. $3/4$ agrees.



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Competency-Based Questions

1. Case-based: The class representative

A Class X section has 40 students: 25 girls and 15 boys. Each student has an identical card, stirs the cards in a bag and draws one card.

(a) What is the probability that a girl is chosen?

(b) What is the probability that a boy is chosen?

(c) Before the draw, 5 girls are absent and 5 boys are absent. What is the probability that a girl is chosen. Cards left = 35, girls = 20, boys = 10.

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2. Case-based: The school fair game

At a fair stall, a player throws two dice together. The player wins a prize if the sum is 7 or 11, and wins a small sticker if both dice show the same number.

(a) How many outcomes are possible? $6 \times 6 = 36$.

(b) Find P(prize). Sum 7: 6 pairs. Sum 11: (5, 6), (6, 5), 2 pairs. Total 8. $P = 8/36 = 2/9$.

(c) Find P(sticker). Doublets: (1, 1) to (6, 6), 6 outcomes. $P = 6/36 = 1/6$.

3. Case-based: Shirts in a carton (NCERT Example 12)

A carton has 100 shirts: 88 good, 8 with minor defects and 4 with major defects. Jimmy accepts only good shirts. Sujatha rejects only shirts with major defects. One shirt is drawn at random.

(a) P(acceptable to Jimmy)? $88/100 = 0.88$

(b) P(acceptable to Sujatha)? $(88 + 8)/100 = 0.96$

(c) P(rejected by both)? Only a shirt with major defects is rejected by both. $P = 4/100 = 0.04$.

4. Source-based: Laplace's definition

The chapter states: "The theoretical probability of an event, written as $P(E)$, is defined as $P(E) = \frac{\text{Number of favourable outcomes}}{\text{Total number of outcomes}}$, where we assume all outcomes of the experiment are equally likely." It also says the definition was given by Laplace.

(a) State the assumption on which the definition of probability is based.

(b) Explain why this definition cannot give the probability of drawing a red and 1 blue ball by treating "red" and "blue" as equally likely. Treating the 5 balls as the sample space is not equally likely. Treating the 5 balls as the sample space is not equally likely.

(c) Name the earlier type of probability that was used to define probability.



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5. Assertion-Reason

Assertion (A): The probability of getting a number less than 7 in a single throw of a die is 1.

Reason (R): The probability of a sure event is 1.

Choose: (a) Both A and R are true and R is the correct explanation of A. (b) Both A and R are true but R is not the correct explanation of A. (c) A is true but R is false. (d) A is false but R is true.

Answer: (a). Every face shows a number less than 7, so the event is sure and its probability is $6/6 = 1$. R explains A.

6. Assertion-Reason

Assertion (A): When two coins are tossed, the probability of getting one head and one tail is $1/3$.

Reason (R): When two coins are tossed, the possible results are two heads, two tails, and one of each.

Choose: (a) Both A and R are true and R is the correct explanation of A. (b) Both A and R are true but R is not the correct explanation of A. (c) A is true but R is false. (d) A is false but R is true.

Answer: (d). R correctly names the three equally likely outcomes are HH, HT, TH, TT.

7. Assertion-Reason

Assertion (A): If $P(E) = 0.05$, then $P(\text{not } E) = 0.95$.

Reason (R): For any event E, $P(E) + P(\text{not } E) = 1$.

Choose: (a) Both A and R are true and R is the correct explanation of A. (b) Both A and R are true but R is not the correct explanation of A. (c) A is true but R is false. (d) A is false but R is true.

Answer: (a). R is the complement rule, which states that $P(E) + P(\text{not } E) = 1$. So $1 - 0.05 = 0.95$, so A is true and R explains A.

8. Error analysis: The eleven sums

A student argues: "When two dice are thrown, the possible sums are 2, 3, 4, 5, 6, 7, 8, 9, 10, 11 and 12. Therefore, each of them has a probability of $1/11$. Do you agree? Justify."

Answer: No. The 11 sums are not equally likely. Sum 2 arises only from (1, 1), so $P(2) = 1/36$, while sum 7 arises from 6 pairs, so $P(7) = 6/36 = 1/6$.



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$6/36 = 1/6$. The probabilities of the sums are $1/36, 2/36, 3/36, 4/36, 5/36, 6/36, 5/36, 4/36, 3/36, 2/36, 1/36$.

9. Competency MCQ: The second card

From the five cards ten, jack, queen, king and ace of diamonds, the king is drawn and put aside. A second card is drawn at random. The probability that it is the king is:

(a) $1/5$ (b) $1/4$ (c) 0 (d) 1

Answer: (c). The only king has been removed, so the event is impossible and its probability is $0/4 = 0$.

Important Questions for Board Exams

1-Mark Questions

1. Which of the following cannot be the probability? (A) 0.7 (B) -1.5 , because a probability cannot be negative.
2. If $P(E) = 0.05$, what is the probability of the event not occurring?
3. A bag contains lemon flavoured candies only. A candy is taken out of the bag. What is the probability that it is an orange flavoured candy? (An impossible event.)
4. One card is drawn from a well-shuffled deck of 52 cards. What is the probability that the card is an ace? $4/52 = 1/13$.
5. Two coins are tossed simultaneously. What is the probability of getting two heads? (Favourable, so $1/4$.)

2-Mark Questions

1. A bag contains 3 red balls and 5 black balls. A ball is drawn at random. What is the probability that the ball drawn is (i) red? (ii) black?
2. Gopi buys a fish from a shop for his aquarium. The shopkeeper takes out one fish at random from a tank containing 5 male fish and 8 female fish. What is the probability that the fish taken out is a male fish? Total probability = 1.



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3. **Savita and Hamida are friends. What is the probability that both will have (i) different birthdays? (ii) the same birthday? (ignoring a leap year).** Hamida's birthday can be any of 365 equally likely days. (i) Different: 364 favourable days, $P = 364/365$. (ii) Same: $1 - 364/365 = 1/365$.
4. **Harpreet tosses two different coins simultaneously. What is the probability that she gets at least one head?** Outcomes HH, HT, TH, TT. At least one head: HH, HT, TH. $P = 3/4$.

3-Mark Questions

1. **A piggy bank contains hundred 50p coins, fifty ₹1 coins, twenty ₹2 coins and ten ₹5 coins. If it is equally likely that one of the coins will fall out when the bank is turned upside down, what is the probability that the coin (i) will be a 50p coin? (ii) will not be a ₹5 coin?** Total = $100 + 50 + 20 + 10 = 180$. (i) $100/180 = 5/9$. (ii) $(180 - 10)/180 = 170/180 = 17/18$.
2. **Five cards, the ten, jack, queen, king and ace of diamonds, are well-shuffled with their face downwards. One card is then picked up at random. (i) What is the probability that the card is the queen? (ii) If the queen is drawn and put aside, what is the probability that the second card picked up is (a) an ace? (b) a queen?** queen is left.
3. **A box contains 3 blue, 2 white, and 4 red balls. If a ball is drawn at random from the box, what is the probability that it will be (i) blue? (ii) white? (iii) red?** Total = $3 + 2 + 4 = 9$. (i) $3/9 = 1/3$. (ii) $2/9$. (iii) $4/9$. Check: $2/9 + 3/9 + 4/9 = 1$.
4. **Which of the following arguments are correct? (i) If two coins are tossed simultaneously there are three possible outcomes one head, two heads or no head; therefore, P(head) = 1/3. (ii) If a die is thrown, there are two possible outcomes an odd number or an even number; therefore, P(odd) = 1/2. (iii) The probability of getting an odd number when a die is thrown is 1/2. (iv) If a die is thrown, the probability of getting a number less than 4 is 1/2. (v) If a die is thrown, the probability of getting a number greater than 4 is 1/2.** HH, HT, TH, TT, so $P(\text{two heads}) = 1/4$, Correct: odd (1, 3, 5) and even (2, 4, 6)



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5-Mark Questions

1. **Two dice are thrown at the same time. Find the probability that (i) the sum is a prime number (ii) the sum is an even number (iii) the sum is at least 10.** Total outcomes = 36.
 (i) (2, 6), (3, 5), (4, 4), (5, 3), (6, 2): $5/36$
 (ii) Prime sums 2, 3, 5, 7, 11 have $1 + 2 + 2 + 3 + 2 = 10$ outcomes.
 (iii) Doublets: $6/36 = 1/6$.
 (iv) Product 6: (1, 6), (6, 1), (2, 3), (3, 2): $4/36 = 1/9$.
 (v) Sum 10, 11 or 12: $3 + 2 + 1 = 6$ pairs: $6/36 = 1/6$.

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2. A card is drawn at random from a well-shuffled deck of 52 cards. Find the probability that it is (i) a red king (ii) a face card (iii) a red face card (iv) a black card that is not a face card (v) neither a heart nor a king.

(i) $\frac{2}{52} = \frac{1}{26}$.

(ii) $\frac{12}{52} = \frac{3}{13}$.

(iii) $\frac{6}{52} = \frac{3}{26}$.

(iv) Black cards 26, black face cards 6, so 20. $P = \frac{20}{52} = \frac{5}{13}$.

(v) Hearts 13, kings not in hearts 3, so "heart or king" covers 16 cards. Neither: $52 - 16 = 36$. $P = \frac{36}{52} = \frac{9}{13}$.

Common Mistakes and Examiner Tips

1. **Treating unequal results as equally likely.** Two coins do not give "three outcomes each $\frac{1}{3}$ ", and two dice do not give "eleven sums each $\frac{1}{11}$ ". Fix: always list the basic ordered outcomes (HH, HT, TH, TT; the 36 pairs) and count.

2. **Writing (1, 4) and (4, 1) as the same outcome.** Always always the first die or coin. (1, 4) and (4, 1) are different.

3. **Counting 16 face cards.** Fix: face cards are Jacks, Queens, Kings. Aces are not face cards.

4. **Using the number of colours as the total number of outcomes.** Fix: the total is the number of items, not 2. Fix: the total is the number of items, not 2.

5. **Forgetting to reduce both counts after replacement.** Fix: if without replacement, reduce the total by 1, and was of that kind (20 bulbs, 16 good $\rightarrow$ 16 good $\rightarrow$ 16 good).

6. **Including the end numbers in "between".** Fix: "between", "less than", "at most" and "at least" are different.

7. **Counting 1 as a prime.** Primes on a die are 2, 3, 5. 1 is composite.

8. **Giving an answer above 1 or below 0.** Fix: probabilities are between 0 and 1. Counts are swapped or wrong. Check the question.

9. **Counting "at least one" the long way.** Fix: $P(\text{at least one}) = 1 - P(\text{none})$. For a die thrown twice, $P(5 \text{ at least once}) = 1 - P(\text{not 5})^2$.

10. **Counting a double outcome twice.** When two events are the same, it appears in both lists. Fix: subtract it once.



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Quick Revision Points

- Theoretical probability: $P(E) = \text{favourable outcomes} / \text{all possible outcomes}$, with equally likely outcomes.
- Experimental probability: trials in which E happened / total trials.
- Laplace gave the classical definition in 1795; J. Cardan wrote the first book on probability.
- In a bag of 4 red and 1 blue ball, "red" and "blue" are not equally likely; each ball is.
- Sure event: probability 1. Impossible event: probability 0.
- $0 \leq P(E) \leq 1$ for every event. Negative values and values above 1 are never probabilities.
- An elementary event has exactly one outcome.
- Probabilities of all elementary events of an experiment add up to 1.
- $P(E) + P(\text{not } E) = 1$, so $P(\text{not } E) = 1 - P(E)$.
- "At least one" = $1 - P(\text{none})$.
- One coin: 2 outcomes. Two coins: 4. Three coins: 8.
- One die: 6 outcomes. Two dice, or one die twice: 36.
- Most likely sum on two dice is 7 (probability $\frac{6}{36} = \frac{1}{6}$).
- Doublets on two dice: 6 of 36, probability $\frac{6}{36} = \frac{1}{6}$.
- Deck: 52 cards, 4 suits of 13; hearts and spades are red, clubs and diamonds are black.
- Face cards: kings, queens, jacks, so 12; aces are not face cards.
- Without replacement: the total drops by 1 each time.
- Probability by lengths or areas is for uniform distribution.
- Probability from the examination point of view.



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Weightage in Board Exams

Check the current CBSE Class 10 Maths chapter weightage. The way it is assessed is predictable.

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Question type	What is usually asked
MCQ and Assertion-Reason	Which value cannot be a probability; $P(\text{not } E)$ from $P(E)$; sure and impossible events; the two-coin or eleven-sums fallacy
Short answers	Balls, marbles, coins or pens in a bag; one card from a deck; one die with primes, odd numbers or "between"
Longer answers	Two dice with several parts (sums, doublets, products); cards with several parts; numbered discs or tickets
Case-based	A real setting such as choosing a representative, a fair game or quality checking, split into two or three parts

The skills that decide the marks are writing the total number of outcomes correctly, listing the favourable ones, and simplifying the fraction. Work through some questions of NCERT Exercise 14.1 (Q20 is starred as not from the examination). Try to solve the case-based and longer questions with several parts.



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