10th Class NCERT
Chapter - 14
PROBABILITY

Introduction

EXERCISE 14.1

Introduction

Probability is a mathematical theory of great interest and practical importance.

Probability of all events just lie between 0 to 1.

Probability measures the chance of an event happening and is equal to the number of favorable events divided by the total number of events.

Examples:

- **Coin Flip:** The probability of flipping heads is 1/2 (or 0.5) because there are two equally likely outcomes (heads or tails).

- **Rolling a Dice:** The probability of rolling a 6 is 1/6.

- **Drawing a Card:** The probability of drawing an Ace from a standard deck of 52 cards is 4/52 (or 1/13).

EXERCISE 14.1

(i) Probability of an event E + Probability of the event 'not E' = 1.

(ii) The probability of an event that cannot happen is 0. Such an event is called an impossible event.

(iii) The probability of an event that is certain to happen is 1. Such an event is called sure event.

(iv) The sum of the probabilities of all the elementary events of an experiment is 1.

(v) The probability of an event is greater than or equal to 0 and less than or equal to 1.

EXERCISE 14.1

2. **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.

Solution:- It is not an equally likely outcome because the probability of it depends on many factors.

(ii) A player attempts to shoot a basketball. She/he shoots or misses the shot.

Solution:- It is not an equally likely outcome because the probability depends on the ability of the player.

(iii) A trial is made to answer a true-false question. The answer is right or wrong.

Solution:- It is an equally likely outcome because the probability is equal in both cases, it can be either true or false.

(iv) A baby is born. It is a boy or a girl.

Solution:- It is an equally likely outcome because the probability is equal in both cases, it can either be a boy or a girl.

EXERCISE 14.1

3. Why is tossing a coin considered to be a fair way of deciding which team should get the ball at the beginning of a football game?

Solution:-

We will use the basic concepts of probability to answer the given question.

Tossing a coin is considered to be a fair way of deciding which team should get the ball at the beginning of a football game

because it is an equally likely event, that is, the probability of getting heads is 1/2 which is the same as the probability of getting tails 1/2; hence, the probability for both the teams are equal.

EXERCISE 14.1

4. Which of the following cannot be the probability of an event?
(A) 2/3 (B) –1.5 (C) 15% (D) 0.7

Solution:

We will use the basic concepts of probability in order to answer the given question.

We know that the probability of an event E lies in between 0 and 1, that is, $0 \leq P(E) \leq 1$ and it cannot be less than 0 and greater than 1.

So, option (B) - 1.5 cannot be the probability of an event because it is negative.

EXERCISE 14.1

5. If P(E) = 0.05, what is the probability of ‘not E’?

Solution:

We will use the basic concepts and formulae of probability to solve the problem.

Probability of (E) = 0.05

We know that,

Probability of (E) + Probability of (not E) = 1

0.05 + Probability of (not E) = 1

Probability of (not E) = 1 - 0.05

Probability of (not E) = 0.95

Therefore, the probability of 'not E' is equal to 0.95.

EXERCISE 14.1

6. A bag contains lemon flavoured candies only. Malini takes out one candy without looking into the bag. What is the probability that she takes out (i) an orange flavoured candy? (ii) a lemon flavoured candy?

Solution:-

We will use the basic formula of probability to solve the problem.

(i) A bag contains only lemon flavoured candy so there is no probability to take out orange flavoured candy. Therefore, the probability of taking out orange flavoured candy is 0.

(ii) As the bag has only lemon flavoured candy, so every time she takes out only lemon flavoured candy. Therefore, the event is sure event and the probability of taking out lemon flavoured candy is 1.

EXERCISE 14.1

7. It is given that in a group of 3 students, the probability of 2 students not having the same birthday is 0.992. What is the probability that the 2 students have the same birthday?

Solution:

We use the basic formula of probability to solve the problem.

We know that the sum of two complementary events is equal to 1.

P(E) + P (not E) = 1

By putting the given values in the above equation, we can find out the probability of not happening of the event.

The probability of 2 students not having the same birthday P(not E) = 0.992

Probability of 2 students having the same birthday P(E) = 1 - 0.992 = 0.008

Thus, the probability that 2 students have the same birthday is equal to 0.008.

EXERCISE 14.1

8. A bag contains 3 red balls and 5 black balls. A ball is drawn at random from the bag. What is the probability that the ball drawn is (i) red ? (ii) not red?

Solution:

We will use the basic concepts of probability to solve the problem.

This question can be solved by using two steps.

Step (i): First find out the probability of drawing a red ball by using the formula given below.

Probability of an event = Number of possible outcomes/total number of favourable outcomes

Step (ii): After that, by using the formula for the sum of complementary event, find the probability of not getting a red ball.

P (E) + P (not E) = 1

EXERCISE 14.1

8. A bag contains 3 red balls and 5 black balls. A ball is drawn at random from the bag. What is the probability that the ball drawn is (i) red ? (ii) not red?

Solution:

(i) Number of red balls in a bag = 3

Number of black balls in a bag = 5

Total number of balls = 3 + 5 = 8

Probability of drawing red ball P(E) = Number of possible outcomes/Total number of favorable outcomes

Probability of drawing red ball = 3/8

(ii) Probability of not getting red ball P(not E) = 1 - P (E) = 1 - 3/8 = 5/8

EXERCISE 14.1

9. 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:

Let's find out the probability of getting red, white, and green marble by using the formula

Probability = Number of possible outcomes/Total number of favorable outcomes.

Using the formula of the sum of complementary event, we will find out the probability of not getting the green ball.

P (E) + P (not E) = 1

Number of red balls in a bag = 5

Number of white balls in a bag = 8

Number of green balls in a bag = 4

Total number of balls = 5 + 8 + 4 = 17

EXERCISE 14.1

9. 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:

(i) Probability of drawing red ball = 5/17

(ii) Probability of drawing white ball = 8/17

(iii) Probability of drawing a green ball = 4/17

Let the probability of not getting a green ball be P (not E)

P (not E) = 1 - P (E)

= 1 - 4/17

= 13/17

EXERCISE 14.1

10. 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 50 p coin ? (ii) will not be a ` 5 coin?

Solution:

We know that,

Probability = Number of possible outcomes/Total number of favorable outcomes.

Total number of coins = 100 + 50 + 20 + 10 = 180

Number of 50 p coins = 100

Number of Re 1 coins = 50

Number of Rs 2 coins = 20

Number of Rs 5 coins = 10

(i) Probability of drawing 50 p coin = 100/180

(ii) Probability of getting a Rs 5 coin = 10/180 = 1/18

Probability of not getting a 5 rupee coin is 1 - 1/18 = 17/18 [Since, P(E) + P(not E) = 1]

EXERCISE 14.1

11. 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 (see Fig. 14.4). What is the probability that the fish taken out is a male fish?

Solution:

We know that,

Probability of = Number of possible outcomes/Total number of favorable outcomes

Number of male fish = 5

Number of female fish = 8

Total number of fishes = 5 + 8 = 13

The probability that the fish taken out is a male fish = Number of male fish/Total number of fishes

= 5/13

Thus, the probability that the fish that are taken out is a male fish, is 5/13.

EXERCISE 14.1

12. A game of chance consists of spinning an arrow which comes to rest pointing at one of the numbers 1, 2, 3, 4, 5, 6, 7, 8 (see Fig. 14.5), and these are equally likely outcomes. What is the probability that it will point at

(i) 8 ? (ii) an odd number? (iii) a number greater than 2? (iv) a number less than 9?

Solution:

We know that,

Probability = Number of possible outcomes/Total number of favorable outcomes.

Total possible outcomes = 8

(i) Probability of getting 8 = Probability of getting 8 / Total number of outcomes

Probability of getting 8 = 1/8

(ii) Total number of odd numbers = 1, 3, 5, 7 = 4

Probability of getting odd number = Total number of odd numbers/Total number of outcomes

= 4/8 = 1/2

EXERCISE 14.1

12. A game of chance consists of spinning an arrow which comes to rest pointing at one of the numbers 1, 2, 3, 4, 5, 6, 7, 8 (see Fig. 14.5), and these are equally likely outcomes. What is the probability that it will point at

(i) 8 ? (ii) an odd number? (iii) a number greater than 2? (iv) a number less than 9?

Solution:

We know that,

Probability = Number of possible outcomes/Total number of favorable outcomes.

Total possible outcomes = 8

(iii) The numbers that are greater than 2 are 3, 4, 5, 6, 7, 8 = 6

Probability of getting numbers greater than 2 = Numbers greater than 2/Total number of outcomes

= 6/8

= 3/4

(iv) The numbers less than 9 are 1, 2, 3, 4, 5, 6, 7, 8 = 8

Probability of getting numbers less than 9 = Numbers lesser than 9/Total number of outcomes

= 8/8 = 1

13. A die is thrown once. Find the probability of getting

(i) a prime number; (ii) a number lying between 2 and 6; (iii) an odd number.

Solution:

We use the basic formula of probability to solve the problem.

Number of outcomes on throwing a die is (1, 2, 3, 4, 5, 6) = 6

Number of prime numbers on dice are 1, 3 and 5 = 3

(i) Probability of getting a prime number = Number of prime numbers/total number of outcomes

= 3/6 = 1/2

(ii) Numbers lying between 2 and 6 are 3, 4, 5 = 3

Probability of getting a number lying between 2 and 6 = Number lying between 2 and 6/total number of outcomes

= 3/6 = 1/2

(iii) Total number of odd numbers are 1, 3 and 5 = 3

Probability of getting a odd number = Number of odd numbers/total number of outcomes

= 3/6 = 1/2

EXERCISE 14.1

14. One card is drawn from a well-shuffled deck of 52 cards. Find the probability of getting

(i) a king of red colour (ii) a face card (iii) a red face card (iv) the jack of hearts (v) a spade

(vi) the queen of diamonds

Solution:

We use the basic formula of probability to solve the problem.

Probability = Number of possible outcomes/Total number of favorable outcomes.

Total number of cards from a well-shuffled deck = 52

Number of spade cards = 13

Number of heart cards = 13

Number of diamond cards = 13

Number of club cards = 13

Total number of kings = 4

Total number of queens = 4

Total number of jacks = 4

Number of face cards = 12

EXERCISE 14.1

(i) Probability of getting a king of red colour = Number of red colour king/Total number of outcomes

We will have 2 red kings (Heart and Diamond) = 2/52 = 1/26

(ii) Probability of getting a face card = Number of face cards/Total number of outcomes

12/52 = 3/13

(iii) Probability of getting a red face card = Number of red face cards/Total number of outcomes

We will have 3 diamond face cards and 3 heart face cards that sum up to 6 red face cards.

= 6/52 = 3/26

(iv) Probability of getting the jack of hearts = Number of jack of hearts/Total number of outcomes

= 1/52

(v) Probability of getting a spade card = Number of spade cards/Total number of outcomes

= 13/52 = 1/4

(vi) Probability of getting the queen of diamonds = Number of possible outcomes/Total number of favourable outcomes

= 1/52

EXERCISE 14.1

15. 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?

Solution:

We use the basic formula for probability to solve the problem.

Total number of cards = 5

Number of queen cards = 1

(i) Probability that the card is the queen = Number of possible outcomes/Total number of favorable outcomes = 1/5

(ii) If the queen is drawn and put aside, then four cards are left the ten, jack, king and ace of diamonds

(a) Probability that the card an ace = Number of possible outcomes/Total number of favourable outcomes = 1/4

(b) Probability that the card is the queen = Number of possible outcomes/Total number of favourable outcomes = 0/4 = 0

EXERCISE 14.1

16. 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.

Solution:

We use the basic formula of probability to solve the question given.

Number of defective pens = 12

Number of good pens = 132

Total number of pens = 12 + 132

= 144

The probability that the pen that is taken out is a good one = Number of possible outcomes/Total number of favorable outcomes

= 132/144

= 11/12

Thus, the probability that the pen taken out is a good pen, is 11/12.

EXERCISE 14.1

17. (i) A lot of 20 bulbs contain 4 defective ones. One bulb is drawn at random from the lot. What is the probability that this bulb is defective?

(ii) Suppose the bulb drawn in (i) is not defective and is not replaced. Now one bulb is drawn at random from the rest. What is the probability that this bulb is not defective ?

Solution:

Total number of bulbs = 20

Number of defective pieces = 4

(i) Probability that the bulb is defective = Number of possible outcomes/Number of favourable outcomes

= 4/20 = 1/5

(ii) Suppose the bulb drawn in (i) is not defective and is not replaced.

Remaining number of bulbs = 20 - 1 = 19

Remaining number of non-defective bulbs = 16 - 1 = 15

The probability that this bulb is not defective = Number of possible outcomes/Total number of favourable outcomes

= 15/19

EXERCISE 14.1

18. 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:

Total number of discs = 90

Total number of 2 digit numbers between 1 to 90 = 81

Total number of perfect square numbers between1 to 90 are 1, 4, 9, 16, 25, 36, 49, 64, 81 = 9

Total numbers that are divisible by 5 are 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85, 90 = 18

EXERCISE 14.1

18. 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) Probability of getting a two digit number = Number of possible outcomes/Total number of favourable outcomes

= 81/90

= 9/10

(ii) Probability of getting a perfect square number = Number of possible outcomes/Total number of favorable outcomes

= 9/90

= 1/10

(iii) Probability of getting a number divisible by 5 = Number of possible outcomes/Total number of favorable outcomes

= 18/90

= 1/5

EXERCISE 14.1

19. A child has a die whose six faces show the letters as given below: ABCDEA

A	B	C	D	E	A

The die is thrown once. What is the probability of getting (i) A? (ii) D?

Solution:

We use the basic concepts of probability to solve the question.

Total number of outcomes = 6

(i) Probability of getting A = Number of possible outcomes/Total number of favourable outcomes

Number of possible outcomes for the letter A = 2

= 2/6

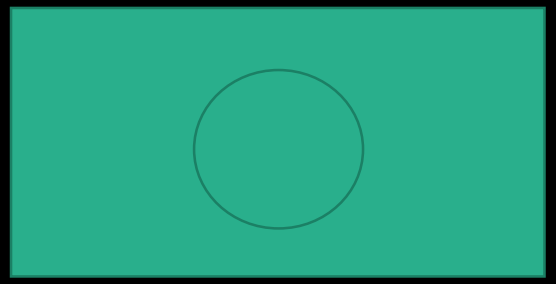
(ii) Probability of getting D = Number of possible outcomes/Total number of favourable outcomes

= 1/6

The probability of getting A and D is 2/6 and 1/6.

EXERCISE 14.1

20*. Suppose you drop a die at random on the rectangular region shown in Fig. 14.6. What is the probability that it will land inside the circle with diameter 1m?



Solution:

We use the concepts of areas of circles and squares and also the basic concepts of probability.

Length of rectangular region = 3 m

Breadth of rectangular region = 2 m

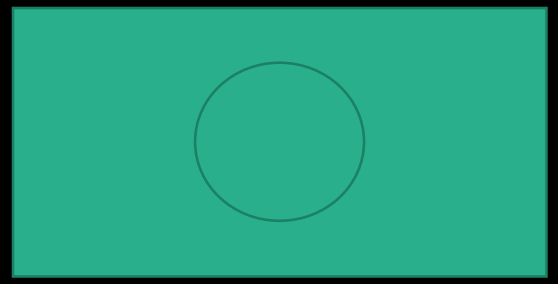
Area of rectangular region = Length × Breadth

= 3 × 2

= 6 m^2

EXERCISE 14.1

20*. Suppose you drop a die at random on the rectangular region shown in Fig. 14.6. What is the probability that it will land inside the circle with diameter 1m?



Diameter of circular region = 1 m

Radius of circular region = 1/2 m

Area of circular region = πr^2

= $\pi \times (1/2)^2$

= $\pi/4$

The probability that it will land inside the circle = Number of possible outcomes/Total number of favourable outcomes

= Area of circular region/Area of the rectangular region

= $(\pi/4)/6$

= $\pi/24$

The probability that it will land inside the circle is $\pi/24$.

Check out more in terms of probability

EXERCISE 14.1

21. A lot consists of 144 ball pens of which 20 are defective and the others are good. Nuri will buy a pen if it is good, but will not buy if it is defective. The shopkeeper draws one pen at random and gives it to her. What is the probability that

(i) She will buy it ? (ii) She will not buy it ?

Solution:

We use the basic formula of probability and favourable outcomes.

Total number of ball pens = 144

Number of defective ball pens = 20

Number of good ball pens = 144 - 20 = 124

(i) Probability that she will buy it = Number of possible outcomes/Total number of favourable outcomes

= 124/144

= 31/36

ii) Probability that she will not buy it = Number of possible outcomes/Total number of favourable outcomes

= 20/144

= 5/36

EXERCISE 14.1

22. Refer to Example 13.

(i) Complete the following table: Event :

Sum on 2 dice	2	3	4	5	6	7	8	9	10	11	12
Probability	1/36						5/36				1/36

- **Solution:**
- We use the basic concepts of probability to solve the problem.
- (i) Number of possible outcomes to get the sum as 2 = (1,1) = 2
- Number of possible outcomes to get the sum as 3 = (2,1), (1, 2) = 2
- Number of possible outcomes to get the sum as 4 = (2, 2), (1, 3), (3,1) = 3
- Number of possible outcomes to get the sum as 5 = (3, 2), (2, 3), (4,1), (1, 4) = 4
- Number of possible outcomes to get the sum as 6 = (5,1), (1, 5), (3, 3), (4, 2), (2, 4) = 5
- Number of possible outcomes to get the sum as 7 = (4, 3), (3, 4), (6,1), (1, 6), (5, 2), (2, 5) = 6
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EXERCISE 14.1

- Number of possible outcomes to get the sum as 8 = (4, 4), (6, 2), (2, 6), (5, 3), (3, 5) = 5
- Number of possible outcomes to get the sum as 9 = (5, 4), (4, 5), (6, 3), (3, 6) = 4
- Number of possible outcomes to get the sum as 10 = (5, 5), (6, 4), (4, 6) = 3
- Number of possible outcomes to get the sum as 11 = (6, 5), (5, 6) = 11
- Number of possible outcomes to get the sum as 12 = (6, 6) = 1
- Thus, the table is:

Sum on 2 dice	2	3	4	5	6	7	8	9	10	11	12
Probability	1/36	2/36	3/36	4/36	5/36	6/36	5/36	4/36	3/36	2/36	1/36

(ii) A student argues that 'there are 11 possible outcomes 2, 3, 4, 5, 6, 7, 8, 9, 10, 11 and 12. Therefore, each of them has a probability 1/11. Do you agree with this argument? Justify your answer

(ii) Probability of each of them is not 1/11 as these are not equally likely.

EXERCISE 14.1

23. 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 i.e., three heads or three tails, and loses otherwise. Calculate the probability that Hanif will lose the game.

Solution:

We use the basic formula of favorable outcomes to solve the problem.

Total possible outcomes are ={HHH, TTT, HTH, HHT, THH, THT, TTH, HTT} = 8

Number of possible outcomes to get three heads or three tails is 2

The probability that Hanif will win the game = Number of possible outcomes/Total number of favourable outcomes

= 2/8

= 1/4

The probability that Hanif will lose the game is 1 - 1/4

= 3/4

The probability that Hanif will lose the game is 3/4.

EXERCISE 14.1

24. 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?

[Hint : Throwing a die twice and throwing two dice simultaneously are treated as the same experimentt]

Solution:

Total number of outcomes when die is thrown twice = 6 × 6 = 36.

(i) Number of possible outcomes when 5 will come up either time = (5, 1), (5, 2), (5, 3), (5, 4), (5, 5), (5, 6), (1, 5), (2, 5), (3, 5), (4, 5), (6, 5) = 11

Probability that 5 will come up either time = Number of possible outcomes/Total number of favourable outcomes

= 11/36

The probability that 5 will not come up either time = 1 - 11/36

= 25/36

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EXERCISE 14.1

24. 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?

[Hint : Throwing a die twice and throwing two dice simultaneously are treated as the same experimentt]

Solution:

(ii) Number of possible outcomes when 5 will come up at least once = 11

The probability that 5 comes up at least once = Number of possible outcomes/Total number of favourable outcomes

= 11/36

The probability that 5 will not come up either time is 25/36 and the probability that 5 will come up is 11/36.

EXERCISE 14.1

25. Which of the following arguments are correct and which are not correct? Give reasons for your answer.

(i) If two coins are tossed simultaneously there are three possible outcomes—two heads, two tails or one of each. Therefore, for each of these outcomes, the probability is 1 3

(ii) If a die is thrown, there are two possible outcomes—an odd number or an even number. Therefore, the probability of getting an odd number is 1 2 .

Solution:

We use the basic concepts of probability to find the required outcomes.

(i) Incorrect

If two coins are tossed simultaneously then,

Total possible outcomes are (H, H), (T, T), (H, T), (T, H) = 4

Number of outcomes to get two heads = (H, H) = 1

Number of outcomes to get two tails = (T, T) = 1

Number of outcomes to get any one of each = (H, T), (T, H) = 2

probability of getting two heads = Number of possible outcomes/Total number of favourable outcomes

= 1/4

EXERCISE 14.1

probability of getting two tails = Number of possible outcomes/Total number of favourable outcomes

= 1/4

probability of getting one of each = Number of possible outcomes/Total number of favourable outcomes

= 2/4 = 1/2

It can be observed that the probability of each of the outcomes is not 1/3.

(ii) Correct

Total number of possible outcomes when a die is thrown = (1, 2, 3, 4, 5, 6)

Number of possible outcomes to get an odd number (1, 3, 5) = 3

Number of possible outcomes to get an even number (2, 4, 6) = 3

probability of getting odd number = Number of possible outcomes/Number of favourable outcomes

= 3/6 = 1/2

Thus, the probability of getting an odd number is 1/2.