

Chapter 21

Probability

REMEMBER

Before beginning this chapter, you should be able to:

- Learn some basic concepts related to probability.
- Apply the concept in daily life and solve problems.

KEY IDEAS

After completing this chapter, you would be able to:

- Understand about Random experiments, events occurring.
- Learn Probability of an event and probability of non-occurrence of an event.

INTRODUCTION

In nature, there are two kinds of phenomena—deterministic and in-deterministic. Examples of deterministic phenomena are:

1. The sun rises in the east.
2. If an object is dropped, it falls to the ground.
3. Every organism which takes birth dies.

Examples of in-deterministic phenomena are:

1. The next vehicle that we see on a road going west to east may be headed east or west.
2. If a gas molecule is released in a container, it may head in any direction.
3. A person selected from a population may die before attaining the age of 75 years, when he attains the age of 75 or after he attains the age of 75.

Probability theory is the study of in-deterministic phenomena. While the theory has widespread applications in all walks of life, it is best to confine ourselves to certain simple kind of in-deterministic phenomena in the initial stage. Examples are tossing of coins, rolling dice, picking cards from well-shuffled decks and drawing objects from different containers, containing different objects. All these are examples of **random experiments**—situations in which we do something and we are not sure of the outcome, because there is more than one possible outcome.

Example: Tossing a coin, rolling a dice or drawing a card from a deck.

Sample Space

The set of all possible outcomes of an experiment is called its sample space. It is usually denoted by S .

Examples:

1. Consider a cubical dice with numbers 1, 2, 3, 4, 5 and 6 on its faces.
When we roll the dice, it can fall with any of its faces facing up. So, the number on each of its faces is a possible outcome.
Hence, the sample space(S) = {1, 2, 3, 4, 5, 6}.
2. When we toss an unbiased coin, the result can be a head(H) or a tail(T). So the sample space(S) = {H, T}.

Event

The outcomes or a combination of the outcomes is called an event. The probability of an event (E) is a measure of our belief that the event will occur. This may be zero, i.e., we don't expect the event to occur at all. E.g., If two dice are rolled, the probability that the sum of the numbers which will come up is 1 is zero. The probability may be 1, i.e., we are absolutely certain that the event will occur. For Example, If a coin is tossed the probability that we get a head or a tail is 1. But in general, we may believe that the event may occur but we are not absolutely certain, i.e., $0 < p < 1$.

Examples:

1. In rolling a dice, getting an even number is an event.
2. In tossing a coin, getting a head(H) is an event.

In the general case, when we are not sure of either the occurrence or non-occurrence of an event, how do we assign a number to the strength of our belief?

Consider the case of rolling a dice. It will show up one of the numbers-1, 2, 3, 4, 5 or 6. Each of these outcomes is equally likely, if the dice is an unbiased dice, i.e., well-balanced. So, when a dice is rolled once, there is only one way of getting the outcome 5, out of the six possible outcomes 1, 2, 3, 4, 5 or 6. Therefore, the probability of the number 5 showing up is 1 in 6. In

other words, we say that the probability of getting 5 is $\frac{1}{6}$.

We write this as, $P(5) = \frac{1}{6}$.

Also, the probability of getting each of the other numbers is equal to $\frac{1}{6}$.

Similarly, in tossing an unbiased coin, we can say that the probability of getting a head or the probability of getting a tail is $\frac{1}{2}$.

Probability of an Event

Let E be an event of a certain experiment whose outcomes are equally likely. Then, the probability of the event E , denoted by $P(E)$, is defined as

$$P(E) = \frac{\text{Number of outcomes favourable to } E}{\text{Total number of possible outcomes}}.$$

Notes

1. For any event E , $0 \leq P(E) \leq 1$.
2. If $P(E) = 0$, then E is said to be an impossible event.
3. If $P(E) = 1$, then E is said to be a certain or a sure event.

EXAMPLE 21.1

Find the probability of getting an even number when an unbiased dice is rolled once.

SOLUTION

When a dice is rolled, the total number of possible outcomes is 6.

Let E be the event of getting an even number. Then, the outcomes favourable to E are 2, 4 and 6, i.e., 3 outcomes are favourable.

$$\text{Hence, } P(E) = \frac{3}{6} = \frac{1}{2}.$$

EXAMPLE 21.2

When an unbiased dice is rolled once, what is the probability of getting a multiple of 3?

SOLUTION

When an unbiased dice is rolled, the total number of possible outcomes is 6.

Let E be the event of getting a multiple of 3.

Then, the outcomes favourable to E are 3 and 6, i.e., 2 outcomes are favourable.

$$\text{Hence, } P(E) = \frac{2}{6} = \frac{1}{3}.$$

Probability of Non-occurrence of an Event E

Let a random experiment have n possible outcomes – all equally likely. Say m of these are favourable for an event E . Then, there are $(n - m)$ outcomes which are not favourable to the event E .

Let $\bar{E}$ denote the non-occurrence of E .

$$\text{Then, } P(\bar{E}) = \frac{n - m}{n},$$

$$\text{That is, } P(\text{non-occurrence of } E) = \frac{n - m}{n}.$$

$$\text{Now, } P(E) + P(\bar{E})$$

$$= \frac{m}{n} + \frac{n - m}{n} = \frac{m + (n - m)}{n} = \frac{n}{n} = 1.$$

$$\text{That is, } P(E) + P(\bar{E}) = 1.$$

Classification of a Pack (or Deck) of Cards

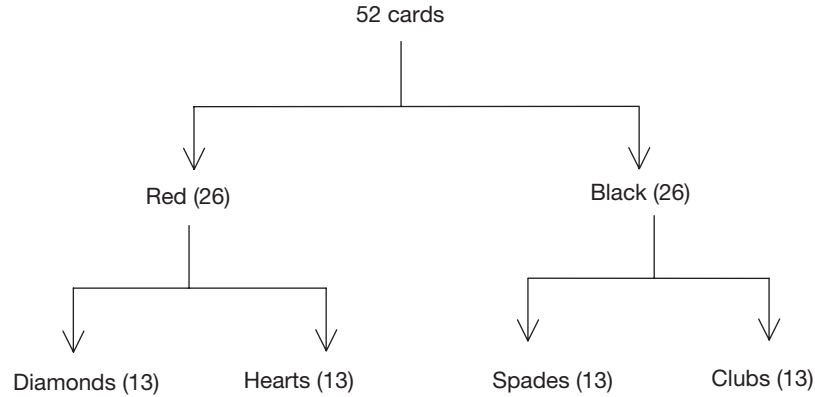


Figure 21.1

The cards in each suit are ace(A), king(K), queen(Q), Jack(J), 10, 9, 8, 7, 6, 5, 4, 3 and 2.

The cards A, J, Q and K are called honours and the cards 2, 3, 4, 5, 6, 7, 8, 9 and 10 are called numbered cards. The cards J, Q and K are called face cards.

EXAMPLE 21.3

When a fair dice is rolled, what is the probability of getting a number less than 5?

SOLUTION

When a fair dice is rolled, the total number of possible outcomes is 6.

Let E be the required event. Then, the outcomes favourable to E are 1, 2, 3 and 4, i.e., 4 favourable outcomes.

$$\Rightarrow P(E) = \frac{4}{6} = \frac{2}{3}.$$

Hence, the probability of getting a number less than 5 is $\frac{2}{3}$.

EXAMPLE 21.4

When a dice is rolled, what is the probability of getting a number 2 or 3?

SOLUTION

Total number of possible outcomes = 6.

Favourable outcomes are 2 and 3.

That is, 2 favourable outcomes.

$$\therefore \text{ Required probability} = \frac{2}{6} = \frac{1}{3}.$$

EXAMPLE 21.5

A number is chosen randomly from the set of integers from 1 to 20. What is the probability that it will be divisible by 5?

SOLUTION

There are 20 integers from 1 to 20.

So, an integer can be selected from 1 to 20 in 20 ways.

Let E be the required event. Then, the numbers favourable to E are 5, 10, 15 and 20, i.e., 4 favourable numbers.

$$\Rightarrow P(E) = \frac{4}{20} = \frac{1}{5}.$$

Hence, the probability that the number selected is divisible by 5 is $\frac{1}{5}$.

EXAMPLE 21.6

A card is selected at random from a pack of cards. What is the probability that it will be a red card?

SOLUTION

There are 52 cards in a pack of cards.

So, a card can be selected from it in 52 ways.

Out of the 52 cards, 26 cards are red coloured.

So, a red card can be selected in 26 ways.

$$\text{Hence, required probability} = \frac{26}{52} = \frac{1}{2}.$$

EXAMPLE 21.7

When a card is selected at random from a pack of cards, find the probability that it is a king.

SOLUTION

There are 52 cards in a pack of cards.

So, a card can be selected in 52 ways.

Now, there are 4 kings (one in each suit) in the pack.

So, a king can be selected in 4 ways.

$$\therefore \text{The required Probability} = \frac{4}{52} = \frac{1}{13}.$$

EXAMPLE 21.8

A number is selected from the numbers 1 to 20. What is the probability that it will be a prime number.

SOLUTION

Total number of ways of selecting a number from 1 to 20 is 20.

Let E be the event that the number selected is a prime number.

Then the numbers favourable to E are 2, 3, 5, 7, 11, 13, 17 and 19.

That is, 8 favourable numbers.

$$\therefore P(E) = \frac{8}{20} = \frac{2}{5}.$$

Hence, the probability that the number selected will be a prime number is $\frac{2}{5}$.

EXAMPLE 21.9

A bag contains 3 blue and 7 red balls. Find the probability that a ball selected at random from the bag will be a blue ball.

SOLUTION

Total number of balls in the bag = $3 + 7 = 10$.

So, a ball can be selected from the bag in 10 ways.

Now, there are 3 blue balls in the bag.

So, a blue ball can be selected from the bag in 3 ways.

$$\text{Hence, the required probability} = \frac{3}{10}.$$

EXAMPLE 21.10

Find the probability of a card that is selected at random from a pack of cards will be a red honour.

SOLUTION

Total number of ways of selecting a card = 52.

There are 8 honours in the 26 red cards.

So, a red honour can be selected in 8 ways.

$$\therefore \text{The required probability} = \frac{8}{52} = \frac{2}{13}.$$

EXAMPLE 21.11

There is a bunch of 10 keys out of which any one of the 4 keys can unlock a door. If a key is selected at random from the bunch and tried on the door, find the probability that the door will be unlocked.

SOLUTION

Total number of ways of selecting a key = 10.

4 keys can unlock the door.

$\Rightarrow$ Favourable outcomes = 4

$\therefore$ The required probability = $\frac{4}{10} = \frac{2}{5}$.

EXAMPLE 21.12

When two unbiased coins are tossed, what is the probability that both will show a head?

SOLUTION

When two coins are tossed together, the possible outcomes are HH, HT, TH or TT,

That is, 4 possible outcomes.

Also, there is only one case where both the coins show heads.

$\therefore$ The required probability = $\frac{1}{4}$.

TEST YOUR CONCEPTS

Very Short Answer Type Questions

1. An experiment in which all the outcomes of the experiment are known in advance and the exact outcome is not known in advance is called a _____.
2. A set of events which have no pair in common are called _____.
3. When a coin is tossed, the probability of getting neither head nor tail is called _____ event.
4. When a dice is thrown, the events $\{1\}$, $\{2\}$, $\{3\}$, $\{4\}$, $\{5\}$ and $\{6\}$ are called _____ events.
5. When a number is selected from a set of natural numbers, the probability of getting a number which is a multiple of 1 is _____.
6. The set of all possible outcomes of an experiment is called the _____.
7. When a dice is thrown, the probability of getting any one of the numbers from 1 to 6 on the upper face is called _____ event.
8. The probability of any event of a random experiment cannot exceed _____.
9. If the probability of an event of a random experiment is $P(E) = 0$, then the event is called _____.
10. If A is any event in a sample space, then $P(A^1) =$ _____.
11. The probability of getting multiples of 3 when a dice is thrown is _____.
12. The range of probability of any event of a random experiment is _____.
13. If A is an event of a random experiment, then A^c or $\bar{A}$ or A' is called the _____ of the event.
14. The probability of getting 5 when a fair dice is thrown is _____.
15. A dice is thrown once. What is the probability of getting a multiple of 2?
16. If a card is drawn from a well-shuffled pack of 52 cards, then what is the probability of getting either a spade or a diamond?
17. If a dice is thrown once, then find the probability of getting an odd prime number.
18. If one card is drawn from a well-shuffled pack of 52 cards, then what is the probability of getting either a red 6 or a red 8?
19. If two coins are tossed, then find the probability of getting two tails.
20. If three coins are tossed, then find the probability of getting three tails.
21. A bag contains 8 red balls, 4 blue balls and some green balls. The probability of drawing a green ball is the sum of the probabilities of drawing a red ball and a blue ball. Find the number of green balls.
22. If a coin is tossed three times, find the probability that no two successive tosses will show the same face.
23. If two dice are rolled, find the probability that numbers coming up on both the dice will be multiples of 3.
24. Each of two persons a single throw with a dice. What is the probability of getting the same number on both the dice?
25. A cubical die is rolled. Find the probability of getting a composite number.
26. A set contains numbers from 40 to 60. Krishna chooses a number from the set. Find the probability that the number chosen is a prime number.
27. A college offers 8 subjects, including Mathematics, to its intermediate students. Each student has to opt for 3 subjects. If Anand opts for Mathematics, then what is the probability that he will opt for 2 other specified subjects?
28. If n coins are tossed, then find the probability of getting either all heads or all tails.
29. If 8 boys are arranged in a row, what is the probability that 3 particular boys always sit together?
30. If a 5-digit number is formed by using the digits 1, 2, ..., 9 (without repetitions), then what is the probability that it will be an even number?



Short Answer Type Questions

31. A bag contains 30 balls out of which 15 are red balls, w are white balls and g are green balls. The probability of getting a white ball is two times that of getting a green ball. Find the number of white balls and green balls.
32. A card is selected at random from a pack of cards. What is the probability that it will be an ace?
33. A number is selected from the set of integers from 1 to 20. What is the probability that it will be divisible by both 2 and 3?
34. A number is selected at random from the set of integers 1 to 100. What is the probability that it will be a multiple of 10.
35. What is the probability of arranging the letters of the word 'CHEMISTRY' such that the arrangements start with C and end with Y?
36. When two cards are drawn from a pack of cards, find the probability that both will be diamonds.
37. A number is selected at random from the set $\{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$. What is the probability that it will be a root of the equation $x^2 - 2x + 1 = 0$?
38. A speaks truth in 70% cases. What is the probability that A will lie in stating a fact?
39. An urn contains 5 red, 3 blue and 2 green balls. What is the probability of selecting a green or a red ball?
40. A card is selected at random from a pack of cards. What is the probability that it is a numbered card?
41. When a die is rolled, what is the probability of getting a number which is a multiple of both 2 and 3?
42. 50 cards marked with numbers 1 to 50 are placed in a box. If a card is selected randomly from the box, then the probability that the number on the card selected will be a perfect cube is _____.
43. The probability of A winning a game is 0.7. Then the probability of A losing the game is _____.
44. For a cricket team, 11 persons have to be selected out of 20 aspirants. If 6 of the aspirants are definitely selected, and the other are selected at random, then what is the probability that 5 particular aspirants of the remaining 14 will be selected?
45. When two dice are rolled together, what is the probability of getting the same faces on them?

Essay Type Questions

46. What is the probability that date of birth of a person is in the month of January?
47. A card is selected from a pack of cards, what is the probability that it is either spade or diamond?
48. In a six faced dice, two of the faces are painted red, two of the faces are painted black and the other two faces are painted blue. Such two dice are rolled. The probability that both the dice shows same colour is _____.
49. One number is selected from the first 50 natural numbers. What is the probability that it is a root of the inequation?

$$x + \frac{256}{x} > 40?$$
50. A card is drawn from a well shuffled pack of cards, what is the probability that it is either king or heart?

CONCEPT APPLICATION

Level 1

1. What is the probability that a non-leap year has 53 Sundays?
 (a) $\frac{6}{7}$ (b) $\frac{1}{7}$
 (c) $\frac{5}{7}$ (d) None of these
2. A number is selected at random from the integers 1 to 100. What is the probability that it will be a multiple of 4 or 6?
 (a) $\frac{8}{25}$ (b) $\frac{33}{100}$ (c) $\frac{17}{50}$ (d) $\frac{41}{100}$



3. Two numbers are selected at once from the set of integers 1 to 20. Find the probability that the product of the numbers will be 24.
- (a) $\frac{3}{190}$ (b) $\frac{3}{380}$
(c) $\frac{4}{95}$ (d) $\frac{3}{95}$
4. An urn contains 4 red and 6 green balls. A ball is selected at random from the urn and is replaced back into the urn. Now a ball is drawn again from the bag. What is the probability that the first ball is a red ball and the second is a green ball?
- (a) $\frac{6}{25}$ (b) $\frac{8}{25}$
(c) $\frac{5}{6}$ (d) $\frac{4}{15}$
5. A box contains 5 apples, 6 oranges and 'x' bananas. If the probability of selecting an apple from the box is $\frac{1}{3}$, then the number of bananas in the box is
- (a) 4 (b) 6
(c) 8 (d) 5
6. Two dice are rolled simultaneously. Find the probability that they show different faces.
- (a) $\frac{2}{3}$ (b) $\frac{1}{6}$
(c) $\frac{1}{3}$ (d) $\frac{5}{6}$
7. A number is selected from first 50 natural numbers. What is the probability that it is a multiple of 3 or 5?
- (a) $\frac{13}{25}$ (b) $\frac{21}{50}$
(c) $\frac{12}{25}$ (d) $\frac{23}{50}$
8. Two numbers are selected from the set of integers 1 to 25. What is the probability that the product of the numbers will be 36.
- (a) $\frac{1}{200}$ (b) $\frac{1}{100}$
(c) $\frac{1}{50}$ (d) $\frac{1}{75}$
9. Tom sold 100 lottery tickets in which 5 tickets carry prizes. If Jerry purchased a ticket, what is the probability of Jerry winning a prize?
- (a) $\frac{19}{20}$ (b) $\frac{1}{25}$
(c) $\frac{1}{20}$ (d) $\frac{17}{20}$
10. When two coins are tossed together, what is the probability that neither of them shows up head?
- (a) $\frac{1}{3}$ (b) $\frac{1}{2}$
(c) 0 (d) $\frac{1}{4}$
11. When two cards are drawn from a well-shuffled pack of cards, what is the probability that both will be aces?
- (a) $\frac{1}{221}$ (b) $\frac{2}{221}$
(c) $\frac{1}{13}$ (d) $\frac{1}{231}$
12. Two cards are drawn from a pack of cards one after another so that the first card is replaced before drawing the second card. What is the probability that the first card is an ace and the second is a number card?
- (a) $\frac{9}{169}$ (b) $\frac{1}{52}$
(c) $\frac{1}{4}$ (d) $\frac{17}{52}$
13. Two numbers 'a' and 'b' are selected (successively without replacement in that order) from the integers 1 to 10. What is the probability that $\frac{a}{b}$ will be an integer?
- (a) $\frac{17}{45}$ (b) $\frac{1}{5}$
(c) $\frac{19}{90}$ (d) $\frac{8}{45}$
14. There are 4 different mathematics books, 5 different physical science books and 3 different biological science books on a shelf. What is the probability of selecting a mathematics book from the shelf?

- (a) $\frac{1}{3}$ (b) $\frac{1}{2}$
 (c) $\frac{1}{4}$ (d) $\frac{5}{12}$

15. A number is selected at random from the integers 1 to 100. What is the probability that it is an even number?

- (a) $\frac{1}{2}$ (b) $\frac{1}{50}$
 (c) $\frac{1}{3}$ (d) $\frac{49}{100}$

16. A three digit number is to be formed using the digits 3, 4, 7, 8 and 2 without repetition. What is the probability that it is an odd number?

- (a) $\frac{2}{5}$ (b) $\frac{1}{5}$
 (c) $\frac{4}{5}$ (d) $\frac{3}{5}$

17. Two cards are drawn from a pack, what is the probability that the two cards are of different colours?

- (a) $\frac{8}{17}$ (b) $\frac{1}{12}$
 (c) $\frac{26}{51}$ (d) $\frac{27}{52}$

18. Two numbers 'a' and 'b' are selected successively one after another without replacement from the integers 1 to 15. What is the probability that $\frac{a}{b}$ will be an integer?

- (a) $\frac{5}{7}$ (b) $\frac{3}{7}$
 (c) $\frac{2}{7}$ (d) $\frac{1}{7}$

19. A card is drawn at random from a pack of cards. What is the probability that it is a face card of spades?

- (a) $\frac{1}{13}$ (b) $\frac{1}{26}$
 (c) $\frac{3}{52}$ (d) $\frac{3}{13}$

20. Two numbers are selected simultaneously from the first 20 natural numbers. What is the probability that the sum of the numbers is odd?

- (a) $\frac{10}{19}$ (b) $\frac{1}{19}$
 (c) $\frac{1}{10}$ (d) $\frac{19}{20}$

21. Two dice are rolled together, what is the probability that the total score on the two dice is greater than 10?

- (a) $\frac{5}{6}$ (b) $\frac{1}{4}$
 (c) $\frac{1}{6}$ (d) $\frac{1}{12}$

22. Two numbers are selected simultaneously from the first 25 natural numbers, what is the probability that the sum of the numbers is even?

- (a) $\frac{6}{25}$ (b) $\frac{12}{25}$
 (c) $\frac{4}{25}$ (d) $\frac{8}{25}$

23. A bag contains 7 red and 7 black coloured balls. A person drawn two balls from the bag, what is the probability that the two balls are the same in colour?

- (a) $\frac{6}{13}$ (b) $\frac{2}{7}$
 (c) $\frac{4}{13}$ (d) $\frac{1}{13}$

24. Two dice are rolled together, what is the probability that the total score on the two dice is a prime number?

- (a) $\frac{5}{12}$ (b) $\frac{1}{3}$
 (c) $\frac{1}{2}$ (d) $\frac{13}{36}$

25. A committee of 4 persons is to be formed from 6 men and 4 women. What is the probability that the committee consists of equal number of men and women?

- (a) $\frac{4}{7}$ (b) $\frac{3}{7}$
 (c) $\frac{1}{7}$ (d) $\frac{6}{7}$

26. All the cards in an ordinary deck of 52 cards are numbered from 1 to 52. If a card is drawn at



random from the deck, then what is the probability that it will have a prime number?

- (a) $\frac{7}{26}$ (b) $\frac{15}{52}$
(c) $\frac{5}{17}$ (d) $\frac{4}{13}$

27. A bag contains 5 pens and 6 pencils. If a boy selects 2 articles from the bag, then what is the probability that the selected articles will be a pen and a pencil?

- (a) $\frac{2}{11}$ (b) $\frac{3}{11}$
(c) $\frac{6}{11}$ (d) $\frac{5}{11}$

28. An urn contains 5 red, 3 black and 2 white. If three balls are chosen at random, then what is the probability that they will be of different colours?

- (a) $\frac{1}{4}$ (b) $\frac{3}{4}$
(c) $\frac{1}{2}$ (d) $\frac{5}{6}$

29. What is the probability that a leap year has 52 Mondays?

- (a) $\frac{2}{7}$ (b) $\frac{4}{7}$
(c) $\frac{5}{7}$ (d) $\frac{6}{7}$

30. If a letter is selected at random from the letters of the word 'FOUNDATION', what is the probability of the letter selected being a repeated letter?

- (a) $\frac{1}{10}$ (b) $\frac{1}{5}$
(c) $\frac{2}{5}$ (d) $\frac{1}{2}$

Level 2

31. Sunny and Bunny go to an ice cream parlour where they find 5 different varieties of icecreams. If they order one ice cream each, what is the probability that they both order the same variety of icecreams?

- (a) $\frac{1}{5}$ (b) $\frac{4}{5}$
(c) $\frac{1}{2}$ (d) $\frac{1}{10}$

32. There are five ₹1 coins, two ₹2 coins and three ₹5 coins. If two coins are selected simultaneously at random, what is the probability of yielding the maximum amount?

- (a) $\frac{3}{10}$ (b) $\frac{1}{5}$
(c) $\frac{1}{15}$ (d) $\frac{3}{10}$

33. A dice rolled twice, what is the probability that the two dice show a different number?

- (a) $\frac{2}{3}$ (b) $\frac{1}{6}$
(c) $\frac{5}{6}$ (d) $\frac{1}{2}$

34. A bag contains 3 red, 5 blue and 7 green coloured balls. Find the probability of selecting a blue ball from the bag.

- (a) $\frac{3}{15}$ (b) $\frac{1}{3}$
(c) $\frac{1}{4}$ (d) $\frac{2}{3}$

35. 7 coins are tossed simultaneously, what is the probability of getting at least two heads?

- (a) $\frac{3}{18}$ (b) $\frac{15}{16}$
(c) $\frac{1}{16}$ (d) $\frac{3}{16}$

36. A bag contains 5 white balls, and 6 green balls. Two balls are drawn from the bag one after another, what is the probability that both the balls are white? (the first ball is replaced before drawing the second ball)

- (a) $\frac{2}{11}$ (b) $\frac{1}{11}$
(c) $\frac{3}{121}$ (d) $\frac{25}{121}$



37. A basket contains 12 fruits, of which 7 are not rotten. When one fruit is drawn at random, the probability that it is a rotten fruit is _____.
- (a) $\frac{1}{3}$ (b) $\frac{7}{12}$
(c) $\frac{5}{12}$ (d) $\frac{2}{3}$
38. One card is selected from a well shuffled pack of cards, what is the probability that it is a red hono-red card?
- (a) $\frac{2}{13}$ (b) $\frac{3}{13}$
(c) $\frac{11}{13}$ (d) $\frac{9}{13}$
39. A bag contains 5 black balls, and 7 green balls. Two balls are drawn simultaneously at random, what is the probability that both are different in colour?
- (a) $\frac{17}{33}$ (b) $\frac{35}{132}$
(c) $\frac{5}{66}$ (d) $\frac{35}{66}$
40. The probability that the month of April has exactly 5 Mondays is
- (a) $\frac{4}{7}$ (b) $\frac{5}{7}$
(c) $\frac{3}{7}$ (d) $\frac{2}{7}$
41. Hundred cards marked with numbers 1 to 100 are placed in a box. If a card is selected randomly from the box, then the probability that the number on the card selected will be a perfect square is
- (a) $\frac{1}{100}$ (b) $\frac{1}{25}$
(c) $\frac{1}{10}$ (d) $\frac{9}{10}$
42. 20 cards are numbered 1 to 20. If a card is selected at random, then what is the probability that the selected number will be an odd prime?
- (a) $\frac{2}{5}$ (b) $\frac{3}{5}$
(c) $\frac{3}{10}$ (d) $\frac{7}{20}$
43. A four digit number is formed by using the digits 1, 2, 5, 6 and 8 without repetition. What is the probability that it will be an even number?
- (a) $\frac{3}{5}$ (b) $\frac{2}{5}$
(c) $\frac{1}{2}$ (d) $\frac{3}{10}$
44. A basket contains 10 fruits of which 3 are rotten. If one fruit is drawn from the basket, then the probability that the fruit drawn is not rotten is _____.
- (a) $\frac{4}{5}$ (b) $\frac{4}{5}$
(c) $\frac{7}{10}$ (d) $\frac{3}{10}$
45. An urn contains 6 blue and 'a' green balls. If the probability of drawing a green ball is double that of drawing a blue ball, then 'a' is equal to
- (a) 6 (b) 18
(c) 24 (d) 12
46. A card is drawn from a well shuffled pack of cards. What is the probability that it will be a black queen?
- (a) $\frac{1}{52}$ (b) $\frac{1}{13}$
(c) $\frac{1}{26}$ (d) $\frac{1}{32}$
47. A box contains 30 balls. Among them 10 are black, 12 are blue and the rest are orange. What is the probability that a ball drawn from the box will not be blue?
- (a) $\frac{1}{3}$ (b) $\frac{3}{5}$
(c) $\frac{5}{6}$ (d) $\frac{1}{6}$
48. When an unbiased dice is thrown, the probability of getting a prime number is _____.
- (a) $\frac{1}{3}$ (b) $\frac{1}{2}$
(c) $\frac{1}{4}$ (d) $\frac{2}{3}$



49. If a letter is selected at random from the letters of the word TRIANGLE, then what is the probability that it will be a consonant?

- (a) $\frac{2}{7}$ (b) $\frac{3}{8}$
(c) $\frac{5}{8}$ (d) $\frac{1}{8}$

50. If a letter is selected at random from the letters of the word LOGARITHMS, then what is the probability that it will be a consonant?

- (a) $\frac{3}{10}$ (b) $\frac{7}{10}$
(c) $\frac{1}{10}$ (d) $\frac{4}{10}$

Level 3

51. If one number is selected from the first 70 natural numbers, the probability that the number is a solution of $x^2 + 2x > 4$ is

- (a) $\frac{69}{70}$ (b) $\frac{1}{70}$
(c) 1 (d) 0

52. A man's pocket has seven ₹1 coins, three ₹2 coins and four ₹5 coins. If two coins are selected simultaneously, what is the probability of yielding the minimum amount?

- (a) $\frac{3}{13}$ (b) $\frac{6}{13}$
(c) $\frac{3}{26}$ (d) $\frac{6}{43}$

53. Mr Balaram picked a prime number between the integers 1 and 20. What is the probability that it will be number 13?

- (a) $\frac{7}{8}$ (b) $\frac{1}{20}$
(c) $\frac{1}{8}$ (d) $\frac{13}{20}$

54. Chandu picks up a letter from the English alphabet and finds it to be a vowel. Find the probability that it is either e or i.

- (a) $\frac{2}{5}$ (b) $\frac{3}{5}$
(c) $\frac{1}{5}$ (d) $\frac{4}{5}$

55. A committee of 5 persons is to be formed from 7 men and 3 women. What is the probability that the committee contains 3 men?

- (a) $\frac{5}{36}$ (b) $\frac{7}{12}$
(c) $\frac{5}{12}$ (d) $\frac{1}{3}$

56. A purse contains four fifty-paise coins, three two-rupee coins and three five-rupee coins. If three coins are selected at random, then what is the probability of getting the minimum amount?

- (a) $\frac{1}{15}$ (b) $\frac{1}{10}$
(c) $\frac{1}{30}$ (d) $\frac{1}{5}$

57. A number is selected from the set $\{1, 2, 3, 4, 5, 6, 7, 8\}$. What is the probability that it will be a root of the equation $x^2 - 6x + 8 = 0$?

- (a) $\frac{1}{3}$ (b) $\frac{2}{3}$
(c) $\frac{3}{4}$ (d) $\frac{1}{4}$

58. An urn contains 9 red balls and p green balls. If the probability of picking a red ball is thrice that of picking a green ball, then p is equal to _____.

- (a) 6 (b) 7
(c) 2 (d) 3

59. If two dice are thrown, then find the probability that the total score on the two dice is 5.

- (a) $\frac{2}{9}$ (b) $\frac{3}{8}$
(c) $\frac{1}{6}$ (d) $\frac{1}{9}$

60. A bag contains 8 balls numbered 1 to 8. If 2 balls are picked at random, then find the probability of the two balls being 2 and 3.

- (a) $\frac{1}{28}$ (b) $\frac{2}{27}$
(c) $\frac{1}{14}$ (d) $\frac{1}{7}$

61. A four-digit number is formed by using the digits 1, 2, 4, 8 and 9 without repetition. If one number

is selected from those numbers, then what is the probability that it will be an odd number?

(a) $\frac{1}{5}$ (b) $\frac{2}{5}$

(c) $\frac{3}{5}$ (d) $\frac{4}{5}$

62. If two dice are rolled together, then find the probability that the sum of the numbers on the two dice is less than or equal to 10.

(a) $\frac{11}{12}$ (b) $\frac{1}{12}$

(c) $\frac{7}{12}$ (d) $\frac{1}{9}$

63. Three numbers are chosen from 1 to 15. Find the probability that they are consecutive.

(a) $\frac{1}{35}$ (b) $\frac{1}{13}$

(c) $\frac{2}{13}$ (d) $\frac{3}{35}$

64. One ticket is drawn from a bag containing 70 tickets numbered 1 to 70. Find the probability that it is a multiple of 5 or 7.

(a) $\frac{1}{10}$ (b) $\frac{1}{70}$

(c) $\frac{6}{70}$ (d) $\frac{11}{35}$

65. If a coin is tossed two times, then what is the probability of getting a head at least once?

(a) $\frac{1}{4}$ (b) $\frac{3}{4}$

(c) $\frac{1}{2}$ (d) 1



TEST YOUR CONCEPTS

Very Short Answer Type Questions

- | | |
|-----------------------------|-------------------------------|
| 1. random experiment. | 19. $\frac{1}{4}$ |
| 2. mutually exclusive. | 20. $\frac{1}{8}$ |
| 3. impossible event | 21. 12 |
| 4. simple or equally likely | 22. $\frac{1}{4}$ |
| 5. 1 | 23. $\frac{1}{9}$ |
| 6. sample space | 24. $\frac{1}{6}$ |
| 7. sure event | 25. $\frac{1}{3}$ |
| 8. 1 | 26. $\frac{5}{21}$ |
| 9. impossible event | 27. $\frac{{}^7C_2}{{}^8C_3}$ |
| 10. $1 - P(A)$ | 28. $\frac{1}{2^n - 1}$ |
| 11. $\frac{1}{3}$ | 29. $\frac{3}{28}$ |
| 12. $[0, 1]$ | 30. $\frac{4}{9}$ |
| 13. complement | |
| 14. $\frac{1}{6}$ | |
| 15. $\frac{1}{2}$ | |
| 16. $\frac{1}{2}$ | |
| 17. $\frac{1}{3}$ | |
| 18. $\frac{1}{13}$ | |

Short Answer Type Questions

- | | |
|--------------------|--------------------|
| 31. $\frac{1}{3}$ | 36. $\frac{1}{17}$ |
| 32. $\frac{1}{13}$ | 37. $\frac{1}{10}$ |
| 33. $\frac{3}{20}$ | 38. $\frac{3}{10}$ |
| 34. $\frac{1}{10}$ | 39. $\frac{7}{10}$ |
| 35. $\frac{1}{72}$ | 40. $\frac{9}{13}$ |



41. $\frac{1}{6}$

42. $\frac{3}{50}$

43. 0.3

44. $\frac{1}{2002}$

45. $\frac{1}{6}$

Essay Type Questions

46. $\frac{1}{12}$

47. $\frac{1}{2}$

48. $\frac{1}{3}$

49. $\frac{1}{2}$

50. $\frac{4}{13}$

CONCEPT APPLICATION**Level 1**

- | | | | | | | | | | |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| 1. (b) | 2. (b) | 3. (a) | 4. (a) | 5. (a) | 6. (d) | 7. (d) | 8. (b) | 9. (c) | 10. (d) |
| 11. (a) | 12. (a) | 13. (c) | 14. (a) | 15. (a) | 16. (a) | 17. (c) | 18. (d) | 19. (c) | 20. (a) |
| 21. (d) | 22. (b) | 23. (a) | 24. (a) | 25. (b) | 26. (b) | 27. (c) | 28. (a) | 29. (c) | 30. (b) |

Level 2

- | | | | | | | | | | |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| 31. (a) | 32. (c) | 33. (c) | 34. (b) | 35. (b) | 36. (d) | 37. (c) | 38. (a) | 39. (d) | 40. (d) |
| 41. (c) | 42. (d) | 43. (a) | 44. (c) | 45. (d) | 46. (c) | 47. (b) | 48. (b) | 49. (c) | 50. (b) |

Level 3

- | | | | | | | | | | |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| 51. (a) | 52. (a) | 53. (c) | 54. (a) | 55. (c) | 56. (c) | 57. (d) | 58. (d) | 59. (d) | 60. (a) |
| 61. (b) | 62. (a) | 63. (a) | 64. (d) | 65. (b) | | | | | |



CONCEPT APPLICATION

Level 1

1. (i) A non-leap year contains 365 days and there is only one odd day.
(ii) 52 weeks contains 52 Sundays. Find the probability that odd day is Sunday.
2. $P(\text{either multiple of 4 or 6}) = P(\text{multiple of 4}) + P(\text{multiple of 6}) - P(\text{multiple of both 4 and 6})$.
3. (i) Find the number of pairs a and b such that $a \times b = 24$ and $1 \leq a, b \leq 20$.
(ii) Probability of the required event

$$= \frac{\text{Number of favourable outcomes}}{\text{Total number of outcomes}}.$$
4. $P(R \text{ and } G) = P(R) \cdot P(G)$.
5. $P(\text{selection apple}) = \frac{5}{5+6+x} = \frac{1}{3}$, and find x .
6. (i) Find the probability that they show the same faces.
(ii) $P(\text{Showing different faces}) = 1 - P(\text{showing same faces})$.
7. $P(\text{either multiple of 3 or of 5}) = P(\text{multiple of 3}) + P(\text{multiple of 5}) - P(\text{multiple 3 and 5})$.
8. (i) Find the number of pairs (a, b) , such that $a \times b = 36$ and $1 \leq (a, b) \leq 25$.
(ii) Total number of outcomes $= {}^{25}C_2$.
9. Find the number of favourable outcomes.
10. Both coins should show up tail.
11. There are 4 ace cards in pack of cards.
12. (i) There are 4 ace cards and 36 numbered cards.
(ii) $P(\text{ace and number card}) = P(\text{ace card}) \times P(\text{number card})$.
13. $b = 1, a = 2, 3, \dots, 10$.
 $b = 2, a = 4, 6, \dots, 10$.
In this way, find the number of favourable events such that a/b is an integer.
14. (i) Number of favourable outcomes $= 4$.
(ii) Required probability

$$= \frac{\text{Number of mathematics books}}{\text{Total number of books in the shelf}}.$$
15. There are 50 even numbers from 1 to 100.
16. (i) If a number ends with an odd number then it is odd number.
(ii) Find the number of 3 digit odd numbers formed by using the digits 3, 4, 7, 8 and 2.
(iii) Find the total number of 3 digit numbers formed by using the digits 3, 4, 7, 8 and 2.
17. (i) There are 26 red colour and 26 black colour cards.
(ii) Select one red card and one black card.
(iii) Total number of outcomes $= {}^{52}C_2$
18. Let $b = 1$, then $a = 2$ to 15.
Let $b = 2$, then $a = 4, 6, \dots, 14$.
In this way, find numbers a and b such that $\frac{a}{b}$ is the integer.
19. Jack, Queen and King are the face cards.
20. (i) One number is odd and other is even then sum is odd.
(ii) Two numbers from 20 can be selected in ${}^{20}C_2$ ways.
(iii) There are 10 even numbers and 10 odd numbers.
21. $P(\text{greater than 10}) = P(\text{sum be 11}) + P(\text{sum be 12})$.
22. (i) (odd + odd) = (even + even) = even.
(ii) There are a total of 13 odd numbers and 12 even numbers.
(iii) $P(\text{sum even}) = P(\text{selecting 2 odd numbers}) + P(\text{selecting 2 even numbers})$.
23. (i) Number of ways of drawing 2 red balls $= {}^7C_2$, similarly number of ways of drawing 2 black-balls $= {}^7C_2$.
(ii) Total number of ways of drawing 2 balls out of 14 balls $= {}^{14}C_2$.
24. $P(\text{sum is prime}) = P(\text{sum 2}) + P(\text{sum 3}) + P(\text{sum 5}) + P(\text{sum 7}) + P(\text{sum 11})$.
25. (i) Committee should be formed with 2 men and 2 women.
(ii) Total number of ways in which the committee be selected is $(6+4)c_4$ ways.
26. (i) Find the numbers which are prime from 1 to 52.
(ii) In total we have to select 1 card out of 52 cards.

27. (i) Find the number of ways of selecting one pen and one pencil from the bag.
 (ii) In total, the boy has to select 2 out of 11 articles.
28. (i) Choose one ball from each colour.
 (ii) In total, we have to select 3 out of 10 balls.
29. (i) Leap year contains 52 weeks and 2 odd days.
 (ii) Find the probability that the odd days should not be Monday.
30. Find the number of repeated letters in the given word.

Level 2

31. (i) Let the five different ice creams be a, b, c, d and e .
 (ii) Favourable outcomes are $(a, a), (b, b), (c, c), (d, d)$ and (e, e) .
 (iii) Total number of outcomes = 25.
32. (i) Maximum amount will be yielded, if the selected two coins are of ₹5.
 (ii) Required probability

$$= \frac{\text{Number of ways of selecting two ₹5 coins}}{\text{Total number of ways of selecting two coins}}.$$
41. Find the number of favourable outcomes.
42. (i) Find the numbers which are odd primes from 1 to 20.
 (ii) In total, we have to select 1 card out of 20.
43. (i) Find the number of 4-digit even numbers by filling the units digit by 2, 6 and 8.
 (ii) Find the total number of 4 digit numbers.
 Required probability

$$= \frac{\text{Number of 4-digit even numbers}}{\text{Total number of 4-digit numbers}}.$$
44. (i) To yield minimum amount, select ₹1 coins.
 (ii) Required probability

$$= \frac{\text{Number of ways of selecting two ₹1 coins}}{\text{Total number of ways of selecting two coins}}.$$
45. (i) Total number of balls in the urn = $6 + a$.
 (ii) $P(\text{Drawing a green ball}) = 2 P(\text{Drawing a blue ball})$.
 (iii) Using above condition find the value of a .
46. The total number of cards is 52.
 There are two queen cards which are black.
 Required probability = $\frac{2}{52} = \frac{1}{26}$.
47. The total number of balls is 30, of them 10 are black, 12 are blue and 8 are orange.
 There are 18 balls, which are not blue.
 The required probability = $\frac{18}{30} = \frac{3}{5}$.
48. The sample space = $\{1, 2, 3, 4, 5, 6\}$.
 The favourable outcomes = $\{2, 3, 5\}$.
 Required probability = $\frac{3}{6} = \frac{1}{2}$.
49. There are 8 letters in the word TRIANGLE, of these 5 are consonants.
 $\therefore$ Required probability = $\frac{5}{8}$.
50. The total number of letters is 10.
 The number of consonants = 7
 $\therefore$ Required probability = $\frac{7}{10}$.

Level 3

51. $P(\text{blue ball}) = \frac{\text{Number of blue balls in the bag}}{\text{Total number of balls in the bag}}.$
53. (i) Number of favourable events = 1.
 (ii) There are 8 prime numbers from 1 to 20.
54. (i) $P(\text{either } e \text{ or } i) = P(e) + P(i)$.
 (ii) Total outcomes = 5, i.e., (a, e, i, o, u) .
55. (i) Committee should consists of 3 men and 2 women.
 (ii) $P(\text{committee of 5 persons}) = \frac{\text{number of ways of selecting 3 men and 2 women}}{\text{number of ways of selecting 5 persons}}.$
56. Total number of coins in the purse = $4 + 3 + 3 = 10$.
 The total number of ways of selecting 3 coins from 10 coins is ${}^{10}C_3 = 120$.



To get the minimum amount, these three coins must be 50 paise coins. This can be done in 4C_3 ways = 4 ways.

$$\therefore \text{Required probability} = \frac{4}{120} = \frac{1}{30}.$$

57. There are 8 numbers

The roots of the equation $x^2 - 6x + 8 = 0$ are 2 and 4.

$\therefore$ The number of favourable outcomes is 2.

$$\therefore \text{The required probability} = \frac{2}{8} = \frac{1}{4}.$$

58. Probability of picking a red ball = $\frac{9}{9+p}$

$$\text{Probability of picking a green ball} = \frac{p}{9+p}$$

$$\text{Given } \frac{9}{9+p} = \frac{3p}{9+p}$$

$$\Rightarrow 3p = 9 \Rightarrow p = 3.$$

59. If two dice are rolled together, then the total number of outcomes = $6^2 = 36$.

Favourable outcomes that the sum of the numbers is 5: (4, 1), (1, 4), (2, 3), (3, 2).

$$\therefore \text{The required probability} = \frac{4}{36} = \frac{1}{9}.$$

60. The total number of ways of selecting two balls from 8 balls = ${}^8C_2 = 28$.

Number of favourable cases that one ball is 2 and other is 3, is 1.

$$\text{Required probability} = \frac{1}{28}.$$

61. Total number of outcomes = $5 \times 4 \times 3 \times 2 = 120$

The number of favourable cases = $2(4 \times 3 \times 2) = 48$ (i.e., odd numbers)

$$\text{The required probability} = \frac{48}{120} = \frac{2}{5}.$$

62. If two dice are rolled together, then total number of outcomes = $6^2 = 36$.

Required probability = $1 -$ (the probability of getting the sum of the numbers on the two dice is greater than 10)

Favourable cases to get the sum greater than 10: (5, 6), (6, 5) and (6, 6).

Probability of getting the sum of the numbers on the two dice is greater than 10 = $\frac{3}{36} = \frac{1}{12}$.

$$\text{The required probability} = 1 - \frac{1}{12} = \frac{11}{12}.$$

63. The total number of ways of selecting three numbers from 15 numbers is = ${}^{15}C_3 = 455$.

The favourable outcomes are

(1, 2, 3), (2, 3, 4)... (13, 14, 15).

$$\text{The required probability} = \frac{13}{455} = \frac{1}{35}.$$

64. Total number of tickets are 70.

Multiples of 5 are 5, 10, 15...70.

There are 14 numbers, which are multiples of 5.

Multiples of 7 are 7, 14...70, i.e.,

There are 10 numbers, which are multiples of 7.

There are two numbers, which are multiple of both 7 and 5. Total number of numbers which are multiples of 5 or 7 = $14 + 10 - 2$.

$$\text{The required probability} = \frac{22}{70} = \frac{11}{35}.$$

65. If two coins are tossed, then the total outcomes: {HH, HT, TH, TT}

The favourable outcomes of getting at least one head: {HH, HT, TH}

$$\therefore \text{The required probability} = \frac{3}{4}.$$

