# 19 Probability

## INTRODUCTION

In class IX, we have studied the concept of empirical probability. Since empirical probability is based on experiments, we also call it *experimental probability.*

Suppose we toss a coin 500 times and get a head, say, 240 times and tail 260 times. Then, we would say that in a single throw of a coin, the probability of getting a head is $\frac{240}{500}$, i.e., $\frac{12}{25}$.

Again, suppose we toss a coin 1000 times and get a head, say, 530 times and tail 470 times. Then, we would say that in a single throw of a coin, the probability of getting a head is $\frac{530}{1000}$, i.e., $\frac{53}{100}$.

Thus, in various experiments, we would get different probabilities for the same event.

However, theoretical probability overcomes the above problem. In this chapter, by probability, we shall mean theoretical probability.

## PROBABILITY

*Probability is a concept which numerically measures the degree of certainty of the occurrence of events.*

Before defining probability, we shall define certain concepts used therein.

**EXPERIMENT** *An operation which can produce some well-defined outcomes is called an experiment.*

**RANDOM EXPERIMENT** *An experiment in which all possible outcomes are known, and the exact outcome cannot be predicted in advance, is called a random experiment.*

By a *trial*, we mean 'performing a random experiment'.

*Examples* (i) Tossing a fair coin

(ii) Rolling an unbiased die

(iii) Drawing a card from a pack of well-shuffled cards

(iv) Picking up a ball from a bag of balls of different colours

These are all examples of a random experiment.

**SOME DETAILS ABOUT THESE EXPERIMENTS**

I. *Tossing a coin* When we throw a coin, either a *head* ($H$) or a *tail* ($T$) appears on the upper face.

II. *Throwing a die* A die is a solid cube, having 6 faces, marked 1, 2, 3, 4, 5 and 6, or having 1, 2, 3, 4, 5 and 6 dots.

In throwing a die, the outcome is the number or number of dots appearing on the uppermost face.

The plural of die is *dice*.

III. *Drawing a card from a well-shuffled deck of* 52 *cards.*

A deck of playing cards has in all 52 cards.

(i) It has 13 cards each of four suits, namely

***spades, clubs, hearts*** and ***diamonds.***

(a) Cards of *spades* and *clubs* are *black cards.*

(b) Cards of *hearts* and *diamonds* are *red cards.*

Spades Clubs Hearts Diamonds

(ii) Kings, queens and jacks (or knaves) are known as *face cards*.

Thus, there are in all 12 face cards.

King Queen Jack

**LOOKING AT ALL POSSIBLE OUTCOMES IN VARIOUS EXPERIMENTS**

I. When we toss a coin, we get either a head ($H$) or a tail ($T$).

Thus, all possible outcomes are $H, T$.

II. Suppose two coins are tossed simultaneously.

Then, all possible outcomes are $HH, HT, TH, TT$.

REMARKS $HH$ means head on first coin and head on second coin.

$HT$ means head on first coin and tail on second coin, etc.

III. On rolling a die, the number on the upper face is the outcome.

Thus, all possible outcomes are 1, 2, 3, 4, 5, 6.

IV. In drawing a card from a well-shuffled deck of 52 cards, total number of possible outcomes is 52.

**EVENT** *The collection of all or some of the possible outcomes is called an event.*

*Examples* (i) In throwing a coin, $H$ is the event of getting a head.

(ii) Suppose we throw two coins simultaneously and let $E$ be the event of getting at least one head. Then, $E$ contains $HT$, $TH$, $HH$.

**EQUALLY LIKELY EVENTS** *A given number of events are said to be equally likely if none of them is expected to occur in preference to the others.*

For example, if we roll an unbiased die, each number is equally likely to occur. If, however, a die is so formed that a particular face occurs most often then the die is biased. In this case, the outcomes are not equally likely to happen.

### PROBABILITY OF OCCURRENCE OF AN EVENT

Probability of occurrence of an event $E$, denoted by $P(E)$ is defined as:

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

### SURE EVENT

It is evident that in a single toss of die, we will always get a number less than 7.

So, getting a number less than 7 is a *sure event.*

$$P(\textit{getting a number less than } 7) = \frac{6}{6} = 1.$$

Thus, the probability of a sure event is 1.

### IMPOSSIBLE EVENT

In a single toss of a die, what is the probability of getting a number 8?

We know that in tossing a coin, 8 will never come up.

So, getting 8 is an impossible event.

$$P(\textit{getting } 8 \textit{ in a single throw of a die}) = \frac{0}{6} = 0.$$

Thus, *the probability of an impossible event is zero.*

**COMPLEMENTARY EVENT**

Let $E$ be an event and (not $E$) be an event which occurs only when $E$ does not occur. We denote (not $E$) by $E'$, or $\overline{E}$, called complement of event $E$.

The event (not $E$) is called the complementary event of $E$.

Clearly, $P(E) + P(\text{not } E) = 1$.

$\therefore \quad P(E) = 1 - P(\text{not } E)$.

**SUMMARY**

(i) For some event $E$, we have $0 \le P(E) \le 1$.

(ii) $P(E) = 0$, when $E$ is an impossible event.

(iii) $P(E) = 1$, when $E$ is a sure event.

(iv) $P(\text{not } E) = 1 - P(E)$. Thus, $P(\overline{E}) = 1 - P(E)$.

## SOLVED EXAMPLES

EXAMPLE 1 *A coin is tossed once. What is the probability of getting a head?*

SOLUTION When a coin is tossed once, all possible outcomes are $H$ and $T$.

Total number of possible outcomes = 2.

The favourable outcome is $H$.

Number of favourable outcomes = 1.

$\therefore \quad P(\text{getting a head})$

$$= P(H) = \frac{\text{number of favourable outcomes}}{\text{total number of possible outcomes}} = \frac{1}{2}.$$

EXAMPLE 2 *A die is thrown once. What is the probability of getting a prime number?*

SOLUTION In a single throw of a die, all possible outcomes are 1, 2, 3, 4, 5, 6.

Total number of possible outcomes = 6.

Let $E$ be the event of getting a prime number.

Then, the favourable outcomes are 2, 3, 5.

Number of favourable outcomes = 3.

$$\therefore \quad P(\text{getting a prime number}) = P(E) = \frac{3}{6} = \frac{1}{2}.$$

EXAMPLE 3 *A die is thrown once. What is the probability that it shows (i) a '3', (ii) a '5', (iii) an odd number, (iv) a number greater than 4?*

SOLUTION When a die is thrown, all possible outcomes are 1, 2, 3, 4, 5, 6.
Total number of possible outcomes = 6.

(i) Let $E_1$ be the event of getting a 3.

Then, the number of favourable outcomes = 1.

$\therefore \quad P(getting\ a\ 3) = P(E_1) = \frac{1}{6}\cdot$

(ii) Let $E_2$ be the event of getting a 5.

Then, the number of favourable outcomes = 1.

$\therefore \quad P(getting\ a\ 5) = P(E_2) = \frac{1}{6}\cdot$

(iii) Let $E_3$ be the event of getting an odd number.

Then, the favourable outcomes are 1, 3, 5.

Number of favourable outcomes = 3.

$\therefore \quad P(getting\ an\ odd\ number) = P(E_3) = \frac{3}{6} = \frac{1}{2}\cdot$

(iv) Let $E_4$ be the event of getting a number greater than 4.

Then, the favourable outcomes are 5, 6.

Number of favourable outcomes = 2.

$\therefore \quad P(getting\ a\ number\ greater\ than\ 4) = P(E_4) = \frac{2}{6} = \frac{1}{3}\cdot$

EXAMPLE 4 *A die is thrown once. Find the probability of getting (i) an even prime number, (ii) a multiple of* 3. [CBSE 2012]

SOLUTION When a die is thrown, all possible outcomes are 1, 2, 3, 4, 5, 6.
Total number of possible outcomes = 6.

(i) Let $E_1$ be the event of getting an even prime number.

Then, the favourable outcome is 2 only.

Number of favourable outcomes = 1 .

$\therefore \quad P(getting\ an\ even\ prime\ number) = P(E_1) = \frac{1}{6}\cdot$

(ii) Let $E_2$ be the event of getting a multiple of 3.

Then, the favourable outcomes are 3 and 6.

Number of favourable outcomes = 2.

$\therefore \quad P(getting\ a\ multiple\ of\ 3) = P(E_2) = \frac{2}{6} = \frac{1}{3}\cdot$

EXAMPLE 5 *Two coins are tossed simultaneously. What is the probability of getting at least one head?* [CBSE 2014]

SOLUTION When two coins are tossed simultaneously, all possible outcomes are *HH, HT, TH, TT.*
Total number of possible outcomes = 4.
Let $E$ be the event of getting at least one head.

Then, $E$ is the event of getting 1 head or 2 heads.

So, the favourable outcomes are $HT$, $TH$, $HH$.

Number of favourable outcomes = 3.

$\therefore \quad P(\text{getting at least one head}) = P(E) = \frac{3}{4}\cdot$

EXAMPLE 6 *Three unbiased coins are tossed simultaneously. Find the probability of getting (i) exactly 2 heads, (ii) at least 2 heads, (iii) at most 2 heads.* [CBSE 2015]

SOLUTION When 3 coins are tossed simultaneously, all possible outcomes are $HHH$, $HHT$, $HTH$, $THH$, $HTT$, $THT$, $TTH$, $TTT$.

Total number of possible outcomes = 8.

(i) Let $E_1$ be the event of getting exactly 2 heads.

Then, the favourable outcomes are $HHT$, $HTH$, $THH$.

Number of favourable outcomes = 3.

$\therefore \quad P(\text{getting exactly 2 heads}) = P(E_1) = \frac{3}{8}\cdot$

(ii) Let $E_2$ be the event of getting at least 2 heads.

Then, $E_2$ is the event of getting 2 or 3 heads.

So, the favourable outcomes are

$HHT$, $HTH$, $THH$, $HHH$.

Number of favourable outcomes = 4.

$\therefore \quad P(\text{getting at least 2 heads}) = P(E_2) = \frac{4}{8} = \frac{1}{2}\cdot$

(iii) Let $E_3$ be the event of getting at most 2 heads.

Then, $E_3$ is the event of getting 0 or 1 head or 2 heads.

So, the favourable outcomes are

$TTT$, $HTT$, $THT$, $TTH$, $HHT$, $HTH$, $THH$.

Number of favourable outcomes = 7.

$\therefore \quad P(\text{getting at most 2 heads}) = P(E_3) = \frac{7}{8}\cdot$

EXAMPLE 7 *Cards numbered 11 to 60 are kept in a box. If a card is drawn at random from the box, find the probability that the number on the drawn card is (i) an odd number, (ii) a perfect square number, (iii) divisible by 5, (iv) a prime number less than 20.* [CBSE 2014]

SOLUTION All possible outcomes are 11, 12, 13, ... , 60.

Number of all possible outcomes = (60 − 10) = 50.

(i) Let $E_1$ be the event that the number on the drawn card is an odd number.

Then, the favourable outcomes are 11, 13, 15, ..., 59.

Clearly, these numbers form an AP with $a = 11$ and $d = 2$.

Let the number of these numbers be $n$. Then,

$$T_n = 59 \Rightarrow 11 + (n-1) \times 2 = 59 \Rightarrow (n-1) \times 2 = 48$$
$$\Rightarrow (n-1) = 24 \Rightarrow n = 25.$$

So, the number of favourable outcomes = 25.

$\therefore$ $P(\text{getting an odd number}) = P(E_1) = \frac{25}{50} = \frac{1}{2}\cdot$

(ii) Let $E_2$ be the event that the number on the drawn card is a perfect square number.

Then, the favourable outcomes are 16, 25, 36, 49.

So, the numbr of favourable outcomes = 4.

$\therefore$ $P(\text{getting a perfect square number}) = P(E_2) = \frac{4}{50} = \frac{2}{25}\cdot$

(iii) Let $E_3$ be the event that the number on the drawn card is divisible by 5.

Then, the favourable outcomes are 15, 20, 25, ... , 60.

Clearly, these numbers form an AP with $a = 15$ and $d = 5$.

Let the number of these terms be $m$. Then,

$$T_m = 60 \Rightarrow 15 + (m-1) \times 5 = 60 \Rightarrow (m-1) \times 5 = 45$$
$$\Rightarrow m - 1 = 9 \Rightarrow m = 10.$$

So, the number of favourable outcomes = 10.

$\therefore$ $P(\text{getting a number divisible by } 5) = P(E_3) = \frac{10}{50} = \frac{1}{5}\cdot$

(iv) Let $E_4$ be the event that the number on the drawn card is a prime number less than 20.

Then, the favourable outcomes are 11, 13, 17, 19.

So, the number of favourable outcomes = 4.

$\therefore$ $P(\text{getting a prime number less than } 20) = P(E_4) = \frac{4}{50} = \frac{2}{25}\cdot$

EXAMPLE 8 *A box contains 100 red balls, 200 yellow balls and 50 blue balls. If a ball is drawn at random from the box, then find the probability that it will be (i) a blue ball, (ii) not a yellow ball, (iii) neither yellow nor a blue ball.* [CBSE 2012]

SOLUTION Total number of all possible outcomes = total number of balls

$$= 100 + 200 + 50 = 350.$$

(i) Number of blue balls = 50.

$\therefore \quad P(\textit{getting a blue ball}) = \dfrac{50}{350} = \dfrac{1}{7}\cdot$

(ii) Number of balls which are not yellow $= 100 + 50 = 150$.

$\therefore \quad P(\textit{getting a ball which is not yellow}) = \dfrac{150}{350} = \dfrac{3}{7}\cdot$

(iii) Number of balls which are neither yellow nor blue $= 100$.

$\therefore \quad P(\textit{getting a ball which is neither yellow nor blue})$

$= \dfrac{100}{350} = \dfrac{2}{7}\cdot$

EXAMPLE 9 *A bag contains 5 red balls and some blue balls. If the probability of drawing a blue ball from the bag is thrice that of a red ball, find the number of blue balls in the bag.* [CBSE 2007]

SOLUTION Let the number of blue balls in the bag be $x$.

Then, total number of balls $= (5 + x)$.

Given, $P(\textit{a blue ball}) = 3 \times P(\textit{a red ball})$

$\therefore \quad \dfrac{x}{(5+x)} = 3 \times \dfrac{5}{(5+x)} \quad \Rightarrow \quad x = 15.$

Hence, the number of blue balls in the bag is 15.

EXAMPLE 10 *A bag contains white, black and red balls only. A ball is drawn at random from the bag. If the probability of getting a white ball is $3/10$ and that of a black ball is $2/5$ then find the probability of getting a red ball. If the bag contains 20 black balls then find the total number of balls in the bag.* [CBSE 2015]

SOLUTION Let $E$ be the event of getting a red ball. Then,

$P(\textit{getting a white ball}) + P(\textit{getting a black ball}) + P(E) = 1$

$\Rightarrow \quad \dfrac{3}{10} + \dfrac{2}{5} + P(E) = 1 \Rightarrow \dfrac{7}{10} + P(E) = 1$

$\Rightarrow \quad P(E) = 1 - \dfrac{7}{10} = \dfrac{3}{10}$

$\Rightarrow \quad P(\textit{getting a red ball}) = \dfrac{3}{10}\cdot$

Since $P(\textit{getting a white ball}) = P(\textit{getting a red ball})$, so the number of white balls is equal to the number of red balls, say $x$.

$\therefore \quad P(\textit{geting a red ball}) = \dfrac{x}{x + 20 + x} = \dfrac{x}{2x + 20}\cdot$

$\therefore \quad \dfrac{x}{2x+20} = \dfrac{3}{10} \Rightarrow 10x = 6x + 60 \Rightarrow 4x = 60 \Rightarrow x = 15.$

Hence, the total number of balls in the bag

$= 2x + 20 = 2 \times 15 + 20 = 50.$

EXAMPLE 11 *Two different dice are rolled together. Find the probability of getting (i) the sum of numbers on two dice to be* 5*, (ii) even number on both dice, (iii) a doublet.* [CBSE 2015]

SOLUTION When two dice are thrown simultaneously, all possible outcomes are

| | | | | | |
|---|---|---|---|---|---|
| (1, 1), | (1, 2), | (1, 3), | (1, 4), | (1, 5), | (1, 6), |
| (2, 1), | (2, 2), | (2, 3), | (2, 4), | (2, 5), | (2, 6), |
| (3, 1), | (3, 2), | (3, 3), | (3, 4), | (3, 5), | (3, 6), |
| (4, 1), | (4, 2), | (4, 3), | (4, 4), | (4, 5), | (4, 6), |
| (5, 1), | (5, 2), | (5, 3), | (5, 4), | (5, 5), | (5, 6), |
| (6, 1), | (6, 2), | (6, 3), | (6, 4), | (6, 5), | (6, 6). |

Number of all possible outcomes = 36.

(i) Let $E_1$ be the event of getting two numbers whose sum is 5.

Then, the favourable outcomes are (1, 4) (2, 3), (3, 2), (4, 1).

Number of favourable outcomes = 4.

$\therefore\ P(\textit{getting two numbers whose sum is } 5) = P(E_1) = \frac{4}{36} = \frac{1}{9}\cdot$

(ii) Let $E_2$ be the event of getting a even numbers on both dice.

Then, the favourable outcomes are

(2, 2), (2, 4), (2, 6), (4, 2), (4, 4), (4, 6), (6, 2), (6, 4), (6, 6).

Number of favourable outcomes = 9.

$\therefore\quad P(\textit{getting even number on both dice}) = P(E_2) = \frac{9}{36} = \frac{1}{4}\cdot$

(iii) Let $E_3$ be the event of getting a doublet.

Then, the favourable outcomes are

(1, 1), (2, 2), (3, 3), (4, 4), (5, 5), (6, 6).

Number of favourable outcomes = 6.

$\therefore\quad P(\textit{getting a doublet}) = P(E_3) = \frac{6}{36} = \frac{1}{6}\cdot$

EXAMPLE 12 *Two dice are thrown at the same time. Find the probability that the sum of the two numbers appearing on the top of the dice is more than* 9*.* [CBSE 2009C]

SOLUTION We know that when two dice are thrown the same time, then the number of all possible outcomes is 36.

Let $E$ be the event that the sum of the numbers appearing on the top of the two dice is more than 9.

The favourable outcomes are

(4, 6), (5, 5), (5, 6), (6, 4), (6, 5), (6, 6).

Number of favourable outcomes = 6.

$\therefore \quad P(\textit{getting a sum more than } 9) = P(E) = \frac{6}{36} = \frac{1}{6}\cdot$

EXAMPLE 13 *A piggy bank contains hundred* 50-p *coins, fifty* ₹ 1 *coins, twenty* ₹ 2 *and ten* ₹ 5 *coins. If it is equally likely that one of the coins will fall out when the bank is turned upside down, find the probability the coin falling out will be (i) a* 50-p *coin, (ii) of value more than* ₹ 1, *(iii) of value less than* ₹ 5 *(iv) a* ₹ 1 *or* ₹ 2 *coin.* [CBSE 2014]

SOLUTION Total number of coins = $(100 + 50 + 20 + 10) = 180$.

So, the number of all possible outcomes is 180.

(i) Let $E_1$ be the event of getting a 50-p coin.

Then, the number of favourable outcomes = 100.

$\therefore \quad P(\textit{getting a } 50\text{-p } \textit{coin}) = P(E_1) = \frac{100}{180} = \frac{5}{9}\cdot$

(ii) Let $E_2$ be the event of getting a coin of value more than ₹ 1.

Then, it can be ₹ 2 or ₹ 5 coin.

Number of all such coins = 20 + 10 = 30.

$\therefore \quad P(\textit{getting a coin of value more than } ₹\ 1)$

$= P(E_2) = \frac{30}{180} = \frac{1}{6}\cdot$

(iii) Let $E_3$ be the event of getting a coin of value less than ₹ 5.

Then, it can be 50-p or ₹ 1 or ₹ 2 coin.

Number of favourable outcomes

= number of all coins of 50-p, ₹ 1 and ₹ 2

= (100 + 50 + 20 = 170.

$\therefore \quad P(\textit{getting a coin of value less than } ₹\ 5)$

$= P(E_3) = \frac{170}{180} = \frac{17}{18}\cdot$

(iv) Let $E_4$ be the event of getting a ₹ 1 or ₹ 2 coin.

Number of all such coins = 50 + 20 = 70.

Number of favourable outcomes = 70.

$$\therefore \quad P(getting\ a\ ₹\ 1\ or\ ₹\ 2\ coin) = P(E_4) = \frac{70}{180} = \frac{7}{18}\cdot$$

EXAMPLE 14 *A game consists of tossing a one-rupee coin three 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.* [CBSE 2009C, '11, '17]

SOLUTION In tossing a one-rupee coin three times, all possible outcomes are $HHH, HHT, HTH, THH, HTT, THT, TTH, TTT$.

Total number of all possible outcomes = 8.

Let $E$ be the event of getting 3 heads or 3 tails.

Then, $E$ consists of $HHH, TTT$.

Number of favourable outcomes of $E$ = 2.

$$P(that\ Hanif\ wins\ the\ game) = P(getting\ 3\ heads\ or\ 3\ tails)$$

$$= P(E) = \frac{2}{8} = \frac{1}{4}\cdot$$

$$P(that\ Hanif\ loses\ the\ game) = 1 - P(E) = \left(1 - \frac{1}{4}\right) = \frac{3}{4}\cdot$$

**FACTS ABOUT PLAYING CARDS**

1. A deck of playing cards has 52 cards.
2. There are 4 suits, namely (i) spades, (ii) clubs, (iii) hearts and (iv) diamonds. There are 13 cards of each suit.
   I. Spades and clubs are black cards.
   II. Hearts and diamonds are red cards.
3. There are 12 face cards, namely 4 kings, 4 queens and 4 jacks.

EXAMPLE 15 *One card is drawn at random from a well-shuffled deck of 52 cards. Find the probability that the card drawn is (i) a king, (ii) a red eight, (iii) a spade, (iv) a red card, (v) the six of the clubs and (vi) a face card.*

SOLUTION Total number of all possible outcomes = 52.

(i) There are 4 kings in all.

$$\therefore \quad P(drawing\ a\ king) = \frac{4}{52} = \frac{1}{13}\cdot$$

(ii) There are 2 red eights in all.

$$\therefore \quad P(drawing\ a\ red\ eight) = \frac{2}{52} = \frac{1}{26}\cdot$$

(iii) There are 13 cards of spades.

$$\therefore \quad P(drawing\ a\ spade) = \frac{13}{52} = \frac{1}{4}\cdot$$

(iv) There are 26 red cards.

$\therefore \quad P(\textit{drawing a red card}) = \frac{26}{52} = \frac{1}{2}.$

(v) There is one six of the clubs.

$\therefore \quad P(\textit{drawing the six of the clubs}) = \frac{1}{52}.$

(vi) There are 12 face cards.

$\therefore \quad P(\textit{drawing a face card}) = \frac{12}{52} = \frac{3}{13}.$

EXAMPLE 16 *One card is drawn from a well-shuffled deck of 52 cards. Find the probability of getting (i) a king of red suit, (ii) a queen of black suit, (iii) a jack of hearts, (iv) a red face card.* [CBSE 2010]

SOLUTION Total number of possible outcomes = 52.

(i) Number of kings of red suit = 2.

$\therefore \quad P(\textit{getting a king of red suit}) = \frac{2}{52} = \frac{1}{26}.$

(ii) Number of queens of black suit = 2.

$\therefore \quad P(\textit{getting a queen of black suit}) = \frac{2}{52} = \frac{1}{26}.$

(iii) Number of jacks of hearts = 1.

$\therefore \quad P(\textit{getting a jack of hearts}) = \frac{1}{52}.$

(iv) Red face cards are 2 kings, 2 queens, 2 jacks.

Number of red face cards = 6.

$\therefore \quad P(\textit{getting a red face card}) = \frac{6}{52} = \frac{3}{26}.$

EXAMPLE 17 *A card is drawn at random from a well-shuffled deck of 52 playing cards. Find the probability that the card drawn is (i) a card of spades or an ace, (ii) a black king, (iii) neither a jack nor a king, (iv) either a king or a queen.* [CBSE 2015]

SOLUTION Total number of all possible outcomes = 52.

(i) There are 13 cards of spades including one ace and there are 3 more aces.

So, the number of favourable cases = 13 + 3 = 16.

$\therefore \quad P(\textit{getting a card of spades or an ace}) = \frac{16}{52} = \frac{4}{13}.$

(ii) There are 2 black kings.

$\therefore$ $P(\textit{getting a black king}) = \frac{2}{52} = \frac{1}{26}\cdot$

(iii) There are 4 jacks and 4 kings.

So, the number of cards which are neither jacks nor kings

$= \{52 - (4+4)\} = 44.$

$\therefore$ $P(\textit{getting a card which is neither a jack nor a king})$

$= \frac{44}{52} = \frac{11}{13}\cdot$

(iv) There are 4 kings and 4 queens.

So, the number of cards which are either kings or queens

$= 4 + 4 = 8.$

$\therefore$ $P(\textit{getting a card which is either a king or a queen})$

$= \frac{8}{52} = \frac{2}{13}\cdot$

EXAMPLE 18 *One card is drawn at random from a well-shuffled deck of* 52 *playing cards. Find the probability that the card drawn is (i) either a red card or a king, (ii) neither a red card nor a queen.*

SOLUTION Total number of all possible outcomes = 52.

(i) Let $E_1$ be the event of getting a red card or a king.

There are 26 red cards (including 2 kings) and there are 2 more kings.

So, the number of favourable outcomes = 26 + 2 = 28.

$\therefore$ $P(\textit{getting a red card or a king}) = P(E_1) = \frac{28}{52} = \frac{7}{13}\cdot$

(ii) Let $E_1$ be the event of getting a card which is neither a red card nor a queen.

There are 26 red cards (including 2 queens) and there are 2 more queens.

So, the number of non-favourable outcomes = 26 + 2 = 28.

$\therefore$ the number of favourable outcomes = 52 – 28 = 24.

$\therefore$ $P(\textit{getting neither a red card nor a queen}) = \frac{24}{52} = \frac{6}{13}\cdot$

EXAMPLE 19 *From a pack of* 52 *playing cards jacks, queens, kings and aces of red colour are removed. From the remaining, a card is drawn at random. Find the probability that the card drawn is*

*(i) a black queen (ii) a red card (iii) a ten* [CBSE 2006C]

*(iv) a picture card (jacks, queens and kings are picture cards).*

SOLUTION Number of cards removed = 2 + 2 + 2 + 2 = 8.

Total number of remaining cards = 52 – 8 = 44.

Now, there are 2 jacks, 2 queens, 2 kings and 2 aces of black colour only.

(i) Number of black queens = 2.

$$\therefore \quad P(\textit{getting a black queen}) = \frac{2}{44} = \frac{1}{22}.$$

(ii) Remaining number of red cards = 26 – 8 = 18.

$$\therefore \quad P(\textit{getting a red card}) = \frac{18}{44} = \frac{9}{22}.$$

(iii) Number of tens = 4.

$$\therefore \quad P(\textit{getting a ten}) = \frac{4}{44} = \frac{1}{11}.$$

(iv) We know that jacks, queens and kings are picture cards. Out of 12 picture cards, it is given that 6 have been removed. So, the remaining number of picture cards = 12 – 6 = 6.

$$\therefore \quad P(\textit{getting a picture card}) = \frac{6}{44} = \frac{3}{22}.$$

EXAMPLE 20 *All the black face cards are removed from a pack of* 52 *playing cards. The remaining cards are well shuffled and then a card is drawn at random. Find the probability of getting a (i) face card, (ii) red card, (iii) black card, (iv) king.* [CBSE 2014]

SOLUTION Out of 52 playing cards; 2 black jacks, 2 black queens and 2 black kings have been removed.

Total number of remaining cards = (52 – 6) = 46.

(i) Now, there are 6 face cards in the remaining cards.

$$\therefore \quad P(\textit{getting a face card}) = \frac{6}{46} = \frac{3}{23}.$$

(ii) There are 26 red cards.

$$\therefore \quad P(\textit{getting a red card}) = \frac{26}{46} = \frac{13}{23}.$$

(iii) Out of 46 cards, number of black cards = 26 – 6 = 20.

$$\therefore \quad P(\textit{getting a black card}) = \frac{20}{46} = \frac{10}{23}.$$

(iv) Now, these 46 cards have 2 kings.

$$\therefore \quad P(\textit{getting a king}) = \frac{2}{46} = \frac{1}{23}.$$

EXAMPLE 21 *Red queens and black jacks are removed from a pack of 52 playing cards. A card is drawn at random from the remaining cards, after reshuffling them. Find the probability that the drawn card is (i) a king, (ii) of red colour, (iii) a face card, (iv) a queen.* [CBSE 2014]

SOLUTION After removing 2 red queens and 2 black jacks, the number of remaining cards = 52 – (2 + 2) = 48.

(i) Out of 48 cards, there are 4 kings.

$\therefore \quad P(getting\ a\ king) = \frac{4}{48} = \frac{1}{12}.$

(ii) Number of cards of red colour = 26 – 2 = 24.

Total number of cards = 48.

$\therefore \quad P(getting\ a\ card\ of\ red\ colour) = \frac{24}{48} = \frac{1}{2}.$

(iii) Number of face cards = 12 – (2 + 2) = 8.

Total number of cards = 48.

$\therefore \quad P(getting\ a\ face\ card) = \frac{8}{48} = \frac{1}{6}.$

(iv) Number of queens in 48 cards = 4 – 2 = 2.

$\therefore \quad P(getting\ a\ queen) = \frac{2}{48} = \frac{1}{24}.$

## EXERCISE 19A

*Very-Short-Answer Questions*

1. Fill in the blanks:
   (i) The probability of an impossible event is ...... .
   (ii) The probability of a sure event is ...... .
   (iii) For any event $E$, $P(E) + P(\text{not } E)$ = ...... .
   (iv) The probability of a possible but not a sure event lies between ...... and ...... .
   (v) The sum of probabilities of all the outcomes of an experiment is ...... .
2. A coin is tossed once. What is the probability of getting a tail?
3. Two coins are tossed simultaneously. Find the probability of getting
   (i) exactly 1 head (ii) at most 1 head (iii) at least 1 head.
4. A die is thrown once. Find the probability of getting
   (i) an even number (ii) a number less than 5
   (iii) a number greater than 2 (iv) a number between 3 and 6
   (v) a number other than 3 (vi) the number 5.

*Short-Answer Questions*

5. A letter of English alphabet is chosen at random. Determine the probability that the chosen letter is a consonant. [CBSE 2015]

6. A child has a die whose 6 faces show the letters given below:

| | | | | | |
|---|---|---|---|---|---|
| A | B | C | A | D | A |

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

7. It is known that a box of 200 electric bulbs contains 16 defective bulbs. One bulb is taken out at random from the box. What is the probability that the bulb drawn is (i) defective, (ii) nondefective?

8. If the probability of winning a game is 0.7, what is the probability of losing it?

9. There are 35 students in a class of whom 20 are boys and 15 are girls. From these students one is chosen at random. What is the probability that the chosen student is a (i) boy, (ii) girl?

10. In a lottery there are 10 prizes and 25 blanks. What is the probability of getting a prize?

11. 250 lottery tickets were sold and there are 5 prizes on these tickets. If Kunal has purchased one lottery ticket, what is the probability that he wins a prize?

12. 17 cards numbered 1, 2, 3, 4, ..., 17 are put in a box and mixed thoroughly. A card is drawn at random from the box. Find the probability that the card drawn bears (i) an odd number (ii) a number divisible by 5. [CBSE 2012]

13. 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 and these are equally likely outcomes. Find the probability that the arrow will point at any factor of 8. [CBSE 2015]

14. In a family of 3 children, find the probability of having at least one boy. [CBSE 2014]

15. A bag contains 4 white balls, 5 red balls, 2 black balls and 4 green balls. A ball is drawn at random from the bag. Find the probability that it is (i) black, (ii) not green, (iii) red or white, (iv) neither red nor green. [CBSE 2012]

16. A card is drawn at random from a well-shuffled pack of 52 cards. Find the probability of getting (i) a red king, (ii) a queen or a jack. [CBSE 2012]

17. A card is drawn at random from a well-shuffled pack of 52 cards. Find the probability that the drawn card is neither a king nor a queen. [CBSE 2013]

18. A card is drawn from a well-shuffled pack of 52 cards. Find the probability of getting (i) a red face card (ii) a black king. [CBSE 2013C]

19. Two different dice are tossed together. Find the probability that (i) the number on each die is even, (ii) the sum of the numbers appearing on the two dice is 5. [CBSE 2014]

20. Two different dice are rolled simultaneously. Find the probability that the sum of the numbers on the two dice is 10. [CBSE 2014]

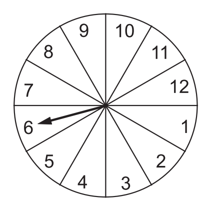
21. Two different dice are thrown together. Find the probability that
    (i) the sum of the numbers appeared is less than 7. [CBSE 2011]
    (ii) the product of the numbers appeared is less than 18. [CBSE 2017]

22. Two dice are rolled together. Find the probability of getting such numbers on two dice whose product is a perfect square. [CBSE 2011]

23. Two dice are rolled together. Find the probability of getting such numbers on the two dice whose product is 12. [CBSE 2013]

24. Cards marked with numbers 5 to 50 are placed in a box and mixed thoroughly. A card is drawn from the box at random. Find the probability that the number on the taken out card is (i) a prime number less than 10 (ii) a number which is a perfect square. [CBSE 2008]

25. A game of chance consists of spinning an arrow which is equally likely to come to rest pointing to one of the numbers 1, 2, 3, …, 12 as shown in the figure. What is the probability that it will point to




    (i) 6? (ii) an even number?
    (iii) a prime number? (iv) a number which is a multiple of 5?

26. 12 defective pens are accidently mixed with 132 good ones. It is not possible to just look at pen and tell whether or not it is defective. One pen is taken out at random from this lot. Find the probability that the pen taken out is good one.

27. A lot consists of 144 ballpoint pens of which 20 are defective and others good. Tanvy will buy a pen if it is good, but will not buy it 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?

28. 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.

29. (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 not replaced. Now, bulb is drawn at random from the rest. What is the probability that this bulb is not defective?

30. A bag contains lemon-flavoured candies only. Hema 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?

31. There are 40 students in a class of whom 25 are girls and 15 are boys. The class teacher has to select one student as a class representative. He writes the name of each student on a separate card, the cards being identical. Then she puts cards in a bag and stirs them thoroughly. She then draws one card from the bag. What is the probability that the name written on the card is the name of (i) a girl? (ii) a boy?

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

    (i) an ace (ii) a '4' of spades

    (iii) a '9' of a black suit (iv) a red king.

33. A card is drawn at random from a well-shuffled deck of 52 cards. Find the probability of getting [CBSE 2003]

    (i) a queen (ii) a diamond

    (iii) a king or an ace (iv) a red ace.

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

    (i) a king of red suit (ii) a face card

    (iii) a red face card (iv) a queen of black suit

    (v) a jack of hearts (vi) a spade.

35. A card is drawn at random from a well-shuffled deck of playing cards. Find the probability that the card drawn is [CBSE 2006]

    (i) a card of spades or an ace (ii) a red king

    (iii) either a king or a queen (iv) neither a king nor a queen.

36. Two different dice are thrown together. Find the probability that the numbers obtained have

    (i) even sum (ii) even product. [CBSE 2017]

37. Two different dice are thrown together. Find the probability that the numbers obtained

(i) have a sum less than 7 (ii) have a product less than 16

(iii) is a doublet of odd numbers. [CBSE 2017]

38. The king, the jack and the 10 of spades are lost from a pack of 52 cards and a card is drawn from the remaining cards after shuffling. Find the probability of getting a

(i) red card (ii) black jack

(iii) red king (iv) 10 of hearts. [CBSE 2017]

39. Peter throws two different dice together and finds the product of the two numbers obtained. Rina throws a die and squares the number obtained. Who has the better chance to get the number 25? [CBSE 2017]

## ***ANSWERS (EXERCISE 19A)***

**1.** (i) 0 (ii) 1 (iii) 1 (iv) 0, 1 (v) 1 **2.** $\frac{1}{2}$ **3.** (i) $\frac{1}{2}$ (ii) $\frac{3}{4}$ (iii) $\frac{3}{4}$

**4.** (i) $\frac{1}{2}$ (ii) $\frac{2}{3}$ (iii) $\frac{2}{3}$ (iv) $\frac{1}{3}$ (v) $\frac{5}{6}$ (vi) $\frac{1}{6}$ **5.** $\frac{21}{26}$ **6.** (i) $\frac{1}{2}$ (ii) $\frac{1}{6}$

**7.** (i) $\frac{2}{25}$ (ii) $\frac{23}{25}$ **8.** 0.3 **9.** (i) $\frac{4}{7}$ (ii) $\frac{3}{7}$ **10.** $\frac{2}{7}$ **11.** $\frac{1}{50}$

**12.** (i) $\frac{9}{17}$ (ii) $\frac{3}{17}$ **13.** $\frac{3}{8}$ **14.** $\frac{7}{8}$ **15.** (i) $\frac{2}{15}$ (ii) $\frac{11}{15}$ (iii) $\frac{3}{5}$ (iv) $\frac{2}{5}$

**16.** (i) $\frac{1}{26}$ (ii) $\frac{2}{13}$ **17.** $\frac{11}{13}$ **18.** (i) $\frac{3}{26}$ (ii) $\frac{1}{26}$ **19.** (i) $\frac{1}{4}$ (ii) $\frac{1}{9}$ **20.** $\frac{1}{12}$

**21.** (i) $\frac{5}{12}$ (ii) $\frac{13}{18}$ **22.** $\frac{2}{9}$ **23.** $\frac{1}{9}$ **24.** (i) $\frac{1}{23}$ (ii) $\frac{5}{46}$

**25.** (i) $\frac{1}{12}$ (ii) $\frac{1}{2}$ (iii) $\frac{5}{12}$ (iv) $\frac{1}{6}$ **26.** $\frac{11}{12}$ **27.** (i) $\frac{31}{36}$ (ii) $\frac{5}{36}$

**28.** (i) $\frac{9}{10}$ (ii) $\frac{1}{10}$ (iii) $\frac{1}{5}$ **29.** (i) $\frac{1}{5}$ (ii) $\frac{15}{19}$ **30.** (i) 0 (ii) 1

**31.** (i) $\frac{5}{8}$ (ii) $\frac{3}{8}$ **32.** (i) $\frac{1}{13}$ (ii) $\frac{1}{52}$ (iii) $\frac{1}{26}$ (iv) $\frac{1}{26}$

**33.** (i) $\frac{1}{13}$ (ii) $\frac{1}{4}$ (iii) $\frac{2}{13}$ (iv) $\frac{1}{26}$ **34.** (i) $\frac{1}{26}$ (ii) $\frac{3}{13}$ (iii) $\frac{3}{26}$ (iv) $\frac{1}{26}$ (v) $\frac{1}{52}$ (vi) $\frac{1}{4}$

**35.** (i) $\frac{4}{13}$ (ii) $\frac{1}{26}$ (iii) $\frac{2}{13}$ (iv) $\frac{11}{13}$ **36.** (i) $\frac{1}{2}$ (ii) $\frac{3}{4}$ **37.** (i) $\frac{5}{12}$ (ii) $\frac{25}{36}$ (iii) $\frac{1}{4}$

**38.** (i) $\frac{26}{49}$ (ii) $\frac{1}{49}$ (iii) $\frac{2}{49}$ (iv) $\frac{1}{49}$ **39.** Rina

## *HINTS TO SOME SELECTED QUESTIONS*

5. Out of 26 letters of English alphabet, there are 11 consonants.

$\therefore \quad P(\textit{getting a consonant}) = \frac{21}{26}\cdot$

6. There are 6 letters in all consisting of 3As, 1B, 1C and 1D.

$\therefore \quad$ (i) $P(\textit{getting } A) = \frac{3}{6} = \frac{1}{2}\cdot$ (ii) $P(\textit{getting } \text{D}) = \frac{1}{6}\cdot$

7. Total number of bulbs = 200.

Number of defective bulbs = 16.

Number of non-defective bulbs = 200 − 16 = 184.

(i) $P(\textit{getting a defective bulb}) = \frac{16}{200} = \frac{2}{25}\cdot$

(ii) $P(\textit{getting a non-defective bulb}) = \frac{184}{200} = \frac{23}{25}\cdot$

8. Let $E$ be the event of winning the game. Then, $P(E) = 0.7$.

Probability of losing the game $= 1 - P(E) = (1 - 0.7) = 0.3$.

9. (i) $P(\textit{choosing a boy}) = \frac{20}{35} = \frac{4}{7}\cdot$ (ii) $P(\textit{choosing a girl}) = \frac{15}{35} = \frac{3}{7}\cdot$

10. Total number of tickets = 10 + 25 = 35.

Number of prizes = 10.

$P(\textit{getting a prize}) = \frac{10}{35} = \frac{2}{7}\cdot$

11. $P(\textit{getting a prize}) = \frac{5}{250} = \frac{1}{50}\cdot$

12. Total number of cards = 17.

(i) Let $E_1$ be the event of choosing an odd number.

These numbers are 1, 3, 5, ... , 17.

Let their number be $n$. Then,

$T_n = 17 \Rightarrow 1 + (n-1) \times 2 = 17 \Rightarrow n = 9.$

$\therefore \quad P(E_1) = \frac{9}{17}\cdot$

(ii) Let $E_2$ be the event of choosing a number divisible by 5.

Numbers divisible by 5 are 5, 10, 15. Their number is 3.

$\therefore \quad P(E_2) = \frac{3}{17}\cdot$

13. All possible outcomes are 1, 2, 3, 4, 5, 6, 7, 8.

Number of all possible outcomes is 8.

All factors of 8 are 2, 4, 8.

Number of favourable outcomes = 3.

Probability that the arrow will point at any factor of 8 $= \frac{3}{8}\cdot$

14. All possible outcomes are *BBB, BBG, BGB, GBB, BGG, GBG, GGB, GGG.*

Number of all possible outcomes = 8.

Let $E$ be the event of having at least one boy.

Then, $E$ contains *GGB, GBG, BGG, BBG, BGB, GBB, BBB.*

Number of cases favourable to $E = 7$.

$\therefore$ required probability $= P(E) = \frac{7}{8}\cdot$

15. Total number of balls = 4 + 5 + 2 + 4 = 15.

(i) Number of black balls = 2.

$P(\textit{getting a black ball}) = \frac{2}{15}\cdot$

(ii) Number of balls which are not green = 4 + 5 + 2 = 11.

$P(\textit{getting a ball which is not green}) = \frac{11}{15}\cdot$

(iii) Number of balls which are red or white = 5 + 4 = 9.

$P(\textit{getting a ball which is red or white}) = \frac{9}{15} = \frac{3}{5}\cdot$

(iv) Number of balls which are neither red nor green = 4 + 2 = 6.

$P(\textit{getting a ball which is neither red nor green}) = \frac{6}{15} = \frac{2}{5}\cdot$

16. Total number of cards = 52.

(i) Number of red kings = 2.

$\therefore \quad P(\textit{getting a red king}) = \frac{2}{52} = \frac{1}{26}\cdot$

(ii) There are 4 queens and 4 jacks.

$\therefore \quad P(\textit{getting a queen or a jack}) = \frac{8}{52} = \frac{2}{13}\cdot$

17. Toal number of cards = 52.

Total number of kings and queens = 4 + 4 = 8.

Remaining number of cards = 52 − 8 = 44.

$\therefore \quad P(\textit{getting a card which is neither a king nor a queen}) = \frac{44}{52} = \frac{11}{13}\cdot$

18. Total number of cards = 52.

(i) 4 kings, 4 queens and 4 jacks are all face cards.

Number of red face cards = 2 + 2 + 2 = 6.

$\therefore \quad P(\textit{getting a red face card}) = \frac{6}{52} = \frac{3}{26}\cdot$

(ii) Number of black kings = 2.

$\therefore \quad P(\textit{getting a black king}) = \frac{2}{52} = \frac{1}{26}\cdot$

19. When two different dice are thrown, then total number of outcomes = 36.

(i) Let $E_1$ be the event of getting an even number on each die.

These numbers are (2, 2), (2, 4), (2, 6), (4, 2), (4, 4), (4, 6), (6, 2), (6, 4), (6, 6).

Number of favourable outcomes = 9.

$\therefore$ $P(\textit{getting an even number on both dice}) = P(E_1) = \frac{9}{36} = \frac{1}{4}\cdot$

(ii) Let $E_2$ be the event of getting the sum 5. Then these numbers are

(1, 4), (2, 3), (4, 1), (3, 2).

Number of favourable outcomes = 4.

$\therefore$ $P(E_2) = \frac{4}{36} = \frac{1}{9}\cdot$

20. Number of all possible outcomes is 36.

Let $E$ be the event of getting the sum 10 on the two dice.

Then, the favourable outcomes are (4, 6), (6, 4), (5, 5).

Number of favouable outcomes = 3.

$\therefore$ $P(E) = \frac{3}{36} = \frac{1}{12}\cdot$

21. (i) Number of all possible outcomes is 36.

Let $E$ be the event of getting the sum less than 7 on the two dice.

Then, the favourable outcomes are

(1, 1), (1, 2), (1, 3), (1, 4), (1, 5), (2, 1), (2, 2), (2, 3),

(2, 4), (3, 1), (3, 2), (3, 3), (4, 1), (4, 2), (5, 1).

Number of favourable outcomes = 15.

$\therefore$ $P(E) = \frac{15}{36} = \frac{5}{12}\cdot$

22. Number of all possible outcomes is 36.

Let $E$ be the event of getting the product of numbers on the two dice, as a perfect square.

Then, the favourable outcomes are

(1, 1), (1, 4), (4, 1), (2, 2), (3, 3), (4, 4), (5, 5), (6, 6).

Number of favourable outcomes = 8.

$\therefore$ $P(E) = \frac{8}{36} = \frac{2}{9}\cdot$

23. Number of all possible outcomes is 36.

Let $E$ be the event of getting all those two numbers whose product is 12.

Then, the favourable outcomes are (2, 6), (6, 2), (3, 4), (4, 3).

Number of favourable outcomes = 4.

$\therefore$ $P(E) = \frac{4}{36} = \frac{1}{9}\cdot$

24. Total number of cards = 50 – 4 = 46.

(i) Out of the given numbers, prime numbers less than 10 are 5 and 7.

$\therefore$ number of prime numbers less than 10 = 2.

$\therefore$ $P(\textit{getting a prime number less than } 10) = \frac{2}{46} = \frac{1}{23}\cdot$

(ii) From given numbers, the perfect square numbers are 9, 16, 25, 36, 49.

Their number is 5.

$\therefore$ $P(\textit{getting a perfect square number}) = \frac{5}{46}\cdot$

25. Number of all possible outcomes = 12.

(i) $P(\textit{getting a } 6) = \frac{1}{12}\cdot$

(ii) Out of the given numbers there are 6 even numbers.

$\therefore$ $P(\textit{getting an even number}) = \frac{6}{12} = \frac{1}{2}\cdot$

(iii) Out of the given numbers, the prime numbers are 2, 3, 5, 7, 11.

Their number is 5.

$\therefore$ $P(\textit{getting a prime number}) = \frac{5}{12}\cdot$

(iv) Out of the given numbers, the multiples of 5 are 5, 10.

Their number is 2.

$\therefore$ $P(\textit{getting a multiple of } 5) = \frac{2}{12} = \frac{1}{6}\cdot$

26. Total number of pens = 132 + 12 = 144.

Number of good pens = 132.

$\therefore$ $P(\textit{getting a good pen}) = \frac{132}{144} = \frac{11}{12}\cdot$

27. Total number of pens = 144.

Number of defective pens = 20.

Number of non-defective pens = 144 − 20 = 124.

(i) $P(\textit{buying the pen}) = P(\textit{getting a non-defective pen}) = \frac{124}{144} = \frac{31}{36}\cdot$

(ii) $P(\textit{not buying the pen}) = P(\textit{getting a defective pen}) = \frac{20}{144} = \frac{5}{36}\cdot$

28. Total number of discs = 90.

(i) Number of discs bearing 2-digit numbers

= number of numbers from 10 to 90 = (90 − 9) = 81.

$P(\textit{getting a 2-digit number}) = \frac{81}{90} = \frac{9}{10}\cdot$

(ii) Perfect square numbers are $1^2, 2^2, 3^2, \ldots, 9^2$. Their number is 9.

Number of discs bearing perfect square numbers = 9.

$\therefore$ $P(\textit{getting a perfect square number}) = \frac{9}{90} = \frac{1}{10}\cdot$

(iii) Numbers divisible by 5 are 5, 10, 15, ... , 90. They are 18 in number.

$\therefore$ $P(\textit{getting a number divisible by } 5) = \frac{18}{90} = \frac{1}{5}\cdot$

29. (i) Total number of bulbs = 20. Number of defective bulbs = 4.

Number of non-defective bulbs = 20 − 4 = 16.

$\therefore$ $P(\textit{getting a defective bulb}) = \frac{4}{20} = \frac{1}{5}\cdot$

(ii) After removing 1 non-defective bulb, we have remaining number of bulbs = 20 − 1 = 19.
Out of these, the number of non-defective bulbs = 16 − 1 = 15.

$\therefore$ $P(\textit{getting a non-defective bulb}) = \frac{15}{19}\cdot$

30. Suppose there are $x$ candies in the bag.
Then, number of orange-flavoured candies in the bag = 0.
And, the number of lemon-flavoured candies in the bag = $x$.

$\therefore$ (i) $P(\textit{getting an orange-flavoured candy}) = \frac{0}{x} = 0.$

(ii) $P(\textit{getting a lemon-flavoured candy}) = \frac{x}{x} = 1.$

31. Total number of students in the class = 40.
Number of girls = 25, number of boys = 15.

(i) $P(\textit{selecting the name of a girl}) = \frac{25}{40} = \frac{5}{8}\cdot$

(ii) $P(\textit{selecting the name of a boy}) = \frac{15}{40} = \frac{3}{8}\cdot$

32. (i) There are 4 aces in all.

$\therefore$ $P(\textit{getting an ace}) = \frac{4}{52} = \frac{1}{13}\cdot$

(ii) There is one '4' of spades.

$\therefore$ $P(\textit{getting 4 of spades}) = \frac{1}{52}\cdot$

(iii) There are two nines of black suits.

$\therefore$ $P(\textit{getting a '9' of a black suit}) = \frac{2}{52} = \frac{1}{26}\cdot$

(iv) There are two red kings.

$\therefore$ $P(\textit{getting a red king}) = \frac{2}{52} = \frac{1}{26}\cdot$

33. (i) There are 4 queens.

$\therefore$ $P(\textit{getting a queen}) = \frac{4}{52} = \frac{1}{13}\cdot$

(ii) There are 13 diamonds.

$\therefore$ $P(\textit{getting a diamond}) = \frac{13}{52} = \frac{1}{4}\cdot$

(iii) There are 4 kings and 4 aces.

$\therefore$ $P(\textit{getting a king or an ace}) = \frac{8}{52} = \frac{2}{13}\cdot$

(iv) There are 2 red aces.

$\therefore$ $P(getting\ a\ red\ ace) = \frac{2}{52} = \frac{1}{26}\cdot$

34. (i) There are 4 kings of red suits.

$\therefore$ $P(getting\ a\ king\ of\ a\ red\ shuit) = \frac{2}{52} = \frac{1}{26}\cdot$

(ii) There are 12 face cards in all.

$\therefore$ $P(getting\ a\ face\ card) = \frac{12}{52} = \frac{3}{13}\cdot$

(iii) There are 6 red face cards.

$\therefore$ $P(getting\ a\ red\ face\ card) = \frac{6}{52} = \frac{3}{26}\cdot$

(iv) There are 2 queens of black suits.

$\therefore$ $P(getting\ a\ queen\ of\ a\ black\ suit) = \frac{2}{52} = \frac{1}{26}\cdot$

(v) There is 1 jack of hearts.

$\therefore$ $P(getting\ a\ jack\ of\ hearts) = \frac{1}{52}\cdot$

(vi) There are 3 cards of spades.

$\therefore$ $P(getting\ a\ spade) = \frac{13}{52} = \frac{1}{4}\cdot$

35. (i) There are 13 cards of spades including 1 ace and 3 more aces are there.

$\therefore$ $P(getting\ a\ card\ of\ spades\ or\ an\ ace) = \frac{13+3}{52} = \frac{16}{52} = \frac{4}{13}\cdot$

(ii) There are 2 red kings.

$\therefore$ $P(getting\ a\ red\ king) = \frac{2}{52} = \frac{1}{26}\cdot$

(iii) There are 4 kings and 4 queens.

$\therefore$ $P(getting\ either\ a\ king\ or\ a\ queen) = \frac{4+4}{52} = \frac{8}{52} = \frac{2}{13}\cdot$

(iv) $P(neither\ a\ king\ nor\ a\ queen) = 1 - P(either\ a\ king\ or\ a\ queen)$

$$= \left(1 - \frac{2}{13}\right) = \frac{11}{13}\cdot$$

. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .

## EXERCISE 19B

*Long-Answer Questions*

1. A box contains 25 cards numbered from 1 to 25. A card is drawn at random from the bag. Find the probability that the number on the drawn card is (i) divisible by 2 or 3, (ii) a prime number. [CBSE 2015]

2. A box contains cards numbered 3, 5, 7, 9,... , 35, 37. A card is drawn at random from the box. Find the probability that the number on the card is a prime number. [CBSE 2013]

3. Cards numbered 1 to 30 are put in a bag. A card is drawn at random from the bag. Find the probability that the number on the drawn card is (i) not divisible by 3, (ii) a prime number greater that 7, (iii)not a perfect square number. [CBSE 2014]

4. Cards bearing numbers 1, 3, 5,... , 35 are kept in a bag. A card is drawn at random from the bag. Find the probability of getting a card bearing (i) a prime number less than 15, (ii) a number divisible by 3 and 5. [CBSE 2010]

5. A box contains cards bearing numbers 6 to 70. If one card is drawn at random from the box, find the probability that it bears (i) a one-digit number, (ii) a number divisible by 5, (iii) an odd number less than 30, (iv) a composite number between 50 and 70. [CBSE 2015]

6. Cards marked with numbers 1, 3, 5, ..., 101 are placed in a bag and mixed thoroughly. A card is drawn at random from the bag. Find the probability that the number on the drawn card is (i) less than 19, (ii) a prime number less than 20. [CBSE 2012]

7. Tickets numbered 2, 3, 4, 5, ..., 100, 101 are placed in a box and mixed thoroughly. One ticket is drawn at random from the box. Find the probability that the number on the ticket is
   (i) an even number
   (ii) a number less than 16
   (iii) a number which is a perfect square
   (iv) a prime number less than 40.

8. (i) A box contains 80 discs, which are numbered from 1 to 80. If one disc is drawn at random from the box, find the probability that it bears a perfect square number. [CBSE 2011]
   (ii) A box contains 90 discs which are numbered 1 to 90. If one disc is drawn at random from the box, find the probability that it bears (a) a two-digit number (b) a number divisible by 5 [CBSE 2017]

9. A piggy bank contains hundred 50-p coins, seventy ₹ 1 coin, fifty ₹ 2 coins and thirty ₹ 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 ₹ 1 coin? (ii) will not be a ₹ 5 coin (iii) will be 50-p or a ₹ 2 coin? [CBSE 2013C]

10. The probability of selecting a red ball at random from a jar that contains only red, blue and orange balls is $\frac{1}{4}\cdot$ The probability of selecting a blue ball at random from the same jar is $\frac{1}{3}\cdot$ If the jar contains 10 orange balls, find the total number of balls in the jar. [CBSE 2015]

11. A bag contains 18 balls out of which $x$ balls are red.
    (i) If one ball is drawn at random from the bag, what is the probability that it is not red?
    (ii) If two more red balls are put in the bag, the probability of drawing a red ball will be $\frac{9}{8}$ times the probability of drawing a red ball in the first case. Find the value of $x$. [CBSE 2015]

12. A jar contains 24 marbles. Some of these are green and others are blue. If a marble is drawn at random from the jar, the probability that it is green is $\frac{2}{3}\cdot$ Find the number of blue marbles in the jar.

13. A jar contains 54 marbles, each of which some are blue, some are green and some are white. The probability of selecting a blue marble at random is $\frac{1}{3}$ and the probability of selecting a green marble at random is $\frac{4}{9}\cdot$ How many white marbles does the jar contain?

14. A carton consists of 100 shirts of which 88 are good and 8 have minor defects. Rohit, a trader, will only accept the shirts which are good. But, Kamal, an another trader, will only reject the shirts which have major defects. One shirt is drawn at random from the carton. What is the probability that it is acceptable to (i) Rohit and (ii) Kamal?

15. A group consists of 12 persons, of which 3 are extremely patient, other 6 are extremely honest and rest are extremely kind. A person from the group is selected at random. Assuming that each person is equally likely to be selected, find the probability of selecting a person who is (i) extremely patient, (ii) extremely kind or honest. Which of the above values you prefer more? [CBSE 2013]

16. A die is rolled twice. Find the probability that [CBSE 2014]
    (i) 5 will not come up either time,
    (ii) 5 will come up exactly one time,
    (iii) 5 will come up both the times.

17. Two dice are rolled once. Find the probability of getting such numbers on two dice whose product is a perfect square. [CBSE 2011]

18. A letter is chosen at random from the letters of the word 'ASSOCIATION'. Find the probability that the chosen letter is a (i) vowel (ii) consonant (iii) an S.

19. Five cards—the ten, jack, queen, king and ace of diamonds are well shuffled with their faces downwards. One card is then picked up at random. (a) What is the probability that the drawn card is the queen? (b) If the queen is drawn and put aside and a second card is drawn, find the probability that the second card is (i) an ace, (ii) a queen. [CBSE 2014]

20. A card is drawn at random from a well shuffled pack of 52 cards. Find the probability that the card drawn is neither a red card nor a queen. [CBSE 2011]

21. What is the probability that an ordinary year has 53 Mondays?

22. All red face cards are removed from a pack of playing cards. The remaining cards are well shuffled and then a card is drawn at random from them. Find the probability that the drawn card is (i) a red card, (ii) a face card, (iii) a card of clubs. [CBSE 2015]

23. All kings, queens and aces are removed from a pack of 52 cards. The remaining cards are well-shuffled and then a card is drawn from it. Find the probability that the drawn card is (i) a black face card, (ii) a red card. [CBSE 2012]

24. A game consists of tossing a one-rupee coin three times, and noting its outcome each time. Find the probability of getting (i) three heads, (ii) at least 2 tails. [CBSE 2015]

25. Find the probability that a leap year selected at random will contain 53 Sundays.

26. The probability of selecting a rotten apple randomly from a heap of 900 apples is 0.18. What is the number of rotten apples in the heap? [CBSE 2017]

27. A bag contains 15 white and some black balls. If the probability of drawing a black ball from the bag is thrice that of drawing a white ball find the number of black balls in the bag. [CBSE 2017]

28. Find the probability of getting the sum of two numbers, less than 3 or more than 11, when a pair of distinct dice is thrown together. [CBSE 2017]

## *ANSWERS (EXERCISE 19B)*

**1.** (i) $\frac{16}{25}$ (ii) $\frac{9}{25}$ **2.** $\frac{11}{18}$ **3.** (i) $\frac{2}{3}$ (ii) $\frac{1}{5}$ (iii) $\frac{5}{6}$ **4.** (i) $\frac{5}{18}$ (ii) $\frac{1}{9}$

**5.** (i) $\frac{4}{65}$ (ii) $\frac{1}{5}$ (iii) $\frac{12}{65}$ (iv) $\frac{3}{13}$ **6.** (i) $\frac{3}{17}$ (ii) $\frac{7}{51}$

**7.** (i) $\frac{1}{2}$ (ii) $\frac{7}{50}$ (iii) $\frac{9}{100}$ (iv) $\frac{3}{25}$ **8.** (i) $\frac{1}{10}$ (ii) (a) $\frac{9}{10}$ (b) $\frac{1}{5}$

**9.** (i) $\frac{7}{25}$ (ii) $\frac{22}{25}$ (iii) $\frac{3}{5}$ **10.** 24 **11.** (i) $\frac{(18-x)}{18}$ (ii) $x = 8$

**12.** 8 **13.** 12 **14.** (i) $\frac{22}{25}$ (ii) $\frac{24}{25}$ **15.** (i) $\frac{1}{4}$ (ii) $\frac{3}{4}$

**16.** (i) $\frac{25}{36}$ (ii) $\frac{5}{18}$ (ii) $\frac{1}{36}$ **17.** $\frac{2}{9}$ **18.** (i) $\frac{6}{11}$ (ii) $\frac{5}{11}$ (iii) $\frac{2}{11}$

**19.** (a) $\frac{1}{5}$ (b) (i) $\frac{1}{4}$ (ii) 0 **20.** $\frac{6}{13}$ **21.** $\frac{1}{7}$ **22.** (i) $\frac{10}{23}$ (ii) $\frac{3}{23}$ (iii) $\frac{6}{23}$

**23.** (i) $\frac{1}{20}$ (ii) $\frac{1}{2}$ **24.** (i) $\frac{1}{8}$ (ii) $\frac{1}{2}$ **25.** $\frac{2}{7}$ **26.** 162

**27.** 45 **28.** $\frac{1}{18}$

## *HINTS TO SOME SELECTED QUESTIONS*

1. Number of all possible outcomes = 25.

   (i) Numbers divisible by 2 or 3 are 2, 4, 6, 8,10, 12, 14, 16, 18, 20, 22, 24, 3, 9, 15, 21.
   Their number is 16.

   $\therefore$ *P*(*getting a number divisible by* 2 *or* 3) $= \frac{16}{25}\cdot$

   (ii) Prime numbers from 1 to 25 are 2, 3, 5, 7, 11, 13, 17, 19, 23.
   Their number is 9.

   $\therefore$ *P*(*getting a prime number*) $= \frac{9}{25}\cdot$

2. Given numbers 3, 5, 7, 9, ..., 35, 37 form an AP with $a = 3$ and $d = 2$.
   Let $T_n = 37$. Then,

   $$3 + (n-1)\times 2 = 37 \Rightarrow (n-1)\times 2 = 34 \Rightarrow n-1 = 17 \Rightarrow n = 18.$$

   Out of these numbers, the prime numbers are 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37.
   Their number is 11.

   $\therefore$ *P*(*getting a prime number*) $= \frac{11}{18}\cdot$

3. Number of all possible outcomes = 30.

   (i) There are 10 numbers divisible by 3.
   Number of numbers not divisible by $3 = 30 - 10 = 20$.

$\therefore$ $P(\textit{getting a number not divisible by } 3) = \frac{20}{30} = \frac{2}{3}.$

(ii) Prime numbers greater than 7 are 11, 13, 17, 19, 23, 29.

Number of these prime numbers = 6.

$\therefore$ $P(\textit{getting a prime number greater than } 7) = \frac{6}{30} = \frac{1}{5}.$

(iii) Perfect square numbers are 1, 4, 9, 16, 25. These are 5 in number.

Number of those numbers which are not perfect squares = $30 - 5 = 25$.

$\therefore$ $P(\textit{getting non-perfect square numbers}) = \frac{25}{30} = \frac{5}{6}.$

4. The numbers 1, 3, 5, ..., 35 form an AP with $a = 1$ and $d = 2$.

Let $T_n = 35$. Then,

$$1 + (n-1)\times 2 = 35 \Rightarrow (n-1)\times 2 = 34 \Rightarrow n - 1 = 17 \Rightarrow n = 18.$$

$\therefore$ number of all possible outcomes = 18.

(i) Out of the given numbers, the prime numbers less than 15 are 3, 5, 7, 11, 13. Their number is 5.

$\therefore$ $P(\textit{getting a prime number}) = \frac{5}{18}.$

(ii) A number is divisible by 3 and 5 means, it must be divisible by 15.

The numbers divisible by 15 are 15 and 30.

Their number is 2.

$\therefore$ $P(\textit{getting a number divisible by both } 3 \textit{ and } 5) = \frac{2}{18} = \frac{1}{9}.$

5. Given numbers 6, 7, 8, ..., 70 form an AP with $a = 6$ and $d = 1$.

Let $T_n = 70$. Then, $6 + (n-1)\times 1 = 70 \Rightarrow n - 1 = 64 \Rightarrow n = 65$.

$\therefore$ total number of cards = 65.

(i) Out of the given numbers, the one-digit numbers are 6, 7, 8, 9.

Number of one-digit numbers = 4.

$\therefore$ $P(\textit{getting a one-digit number}) = \frac{4}{65}.$

(ii) Out of the given numbers, those divisible by 5 are 10, 15, 20, 25, ..., 70.

Let $T_n = 70$. Then,

$$10 + (n-1)\times 5 = 70 \Rightarrow (n-1)\times 5 = 60 \Rightarrow n - 1 = 12 \Rightarrow n = 13.$$

$\therefore$ $P(\textit{getting a number divisible by } 5) = \frac{13}{65} = \frac{1}{5}.$

(iii) Out of the given numbers, odd numbers less than 30 are 7, 9, 11, 13, ... , 29.

Let $T_m = 29$. Then,

$$7 + (m-1)\times 2 = 29 \Rightarrow (m-1)\times 2 = 22 \Rightarrow m - 1 = 11 \Rightarrow m = 12.$$

$\therefore$ $P(\textit{getting an odd number less than } 30) = \frac{12}{65}.$

(iv) Number of numbers between 50 and 70 = numbers from 51 to 69.

Their number = $(69 - 51) + 1 = 19$.

Prime numbers between 50 and 70 = 53, 59, 61, 67.

Number of prime numbers = 4.

Number of composite numbers = 19 − 4 = 15.

$\therefore$ $P(getting\ a\ composite\ number) = \frac{15}{65} = \frac{3}{13}\cdot$

6. Given numbers 1, 3, 5, ..., 101 form an AP with $a = 1$ and $d = 2$.

Let $T_n = 101$. Then,

$1 + (n-1)\times 2 = 101 \Rightarrow (n-1)\times 2 = 100 \Rightarrow n - 1 = 50 \Rightarrow n = 51.$

$\therefore$ total number of cards = 51.

(i) Out of the given numbers, those less than 19 are 1, 3, 5, ..., 17.

Let $t_m = 17$.

Then, $1 + (m-1)\times 2 = 17 \Rightarrow (m-1)\times 2 = 16 \Rightarrow m - 1 = 8 \Rightarrow m = 9.$

$\therefore$ $P(getting\ a\ number\ less\ than\ 19) = \frac{9}{51} = \frac{3}{17}\cdot$

(ii) Out of the given numbers, the prime numbers less than 20 are 3, 5, 7, 11, 17, 19.

Their number is 7.

$\therefore$ $P(getting\ a\ prime\ number\ less\ than\ 20) = \frac{7}{51}\cdot$

7. The tickets bear the numbers 2, 3, 4, ... , 100, 101. So, the number of tickets = 100.

(i) Out of the given numbers, the even numbers are 2, 4, 6, 8, ..., 100.

Their number is 50.

$\therefore$ $P(getting\ an\ even\ number) = \frac{50}{100} = \frac{1}{2}\cdot$

(ii) Out of the given numbers, the number of numbers less than 16 is 14.

$\therefore$ $P(getting\ number\ less\ than\ 16) = \frac{14}{100} = \frac{7}{50}\cdot$

(iii) Out of the given numbers, the perfect square numbers are $2^2, 3^2, 4^2, ..., 10^2$.

Their number is 9.

$\therefore$ $P(getting\ a\ perfect\ square\ number) = \frac{9}{100}\cdot$

(iv) Prime numbers less than 40 are 2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37.

Their number is 12.

$\therefore$ $P(getting\ a\ prime\ number\ less\ than\ 40) = \frac{12}{100} = \frac{3}{25}\cdot$

10. $P(getting\ a\ red\ ball) = \frac{1}{4}$, $P(getting\ a\ blue\ ball) = \frac{1}{3}\cdot$

Let $P(getting\ an\ orange\ ball)$ be $x$.

Since there are only thre types of balls in the jar, the sum of probabilities of drawing these balls must be 1.

$\therefore$ $\frac{1}{4} + \frac{1}{3} + x = 1 \Rightarrow \frac{7}{12} + x = 1 \Rightarrow x = \left(1 - \frac{7}{12}\right) = \frac{5}{12}\cdot$

$\therefore$ $P(getting\ an\ orange\ ball) = \frac{5}{12}\cdot$ ... (i)

Let the total number of balls in the jar be $n$.

Number of orange balls = 10.

$\therefore$ $P(\textit{getting an orange ball}) = \frac{10}{n}\cdot$

$\Rightarrow$ $\frac{10}{n} = \frac{5}{12} \Rightarrow 5n = 120 \Rightarrow n = 24$ [using (i)].

Hence, the total number of balls in the jar is 24.

11. (i) Total number of balls = 18.

Number of red balls = $x$.

Number of balls which are not red = $18 - x$.

$\therefore$ $P(\textit{getting a ball which is not red}) = \frac{18-x}{18}\cdot$

(ii) Now, total number of balls = 18 + 2 = 20.

Number of red balls now = $x + 2$.

$P(\textit{getting a red ball now}) = \frac{x+2}{20}$ and $P(\textit{getting a red ball in first case}) = \frac{x}{18}$

$\Rightarrow$ $\frac{x+2}{20} = \frac{9}{8} \times \frac{x}{18} \Rightarrow 144(x+2) = 180x$

$\Rightarrow$ $180x - 144x = 288 \Rightarrow 36x = 288 \Rightarrow x = \frac{288}{36} = 8.$

Hence, $x = 8$.

12. Total number of marbles in the jar = 24.

Let the number of blue marbles be $x$.

Then, the number of green marbles = $24 - x$.

$P(\textit{getting a green marble}) = \frac{24-x}{24}\cdot$

But, $P(\textit{getting a green marble}) = \frac{2}{3}$ (given).

$\therefore$ $\frac{24-x}{24} = \frac{2}{3} \Rightarrow 72 - 3x = 48 \Rightarrow 3x = 24 \Rightarrow x = 8.$

Hence, the number of blue marbles in the jar is 8.

13. Total number of marbles in the jar = 54.

$P(\textit{getting a blue marble}) = \frac{1}{3}$ and $P(\textit{getting a green marble}) = \frac{4}{9}\cdot$

Let $P(\textit{getting a white marble})$ be $x$.

Since there are only three given types of marbles in the jar, we have

$\frac{1}{3} + \frac{4}{9} + x = 1 \Rightarrow \frac{7}{9} + x = 1 \Rightarrow x = 1 - \frac{7}{9} = \frac{2}{9}\cdot$

$\therefore$ $P(\textit{getting a white marble}) = \frac{2}{9}\cdot$

Let the number of white marbles be $n$.

Then, $P(\textit{getting a white marble}) = \frac{n}{54}\cdot$

$\therefore$ $\frac{n}{54} = \frac{2}{9} \Rightarrow 9n = 108 \Rightarrow n = 12.$

Hence, there are 12 white marbles in the jar.

14. Total number of shirts = 100.

Number of good shirts = 88.

Number of shirts having minor defects = 8.

Number of shirts having major defects = 100 − (88 + 8) = 4.

∴ (i) $P(\textit{that the drawn shirt is acceptable to Rohit}) = \frac{88}{100} = \frac{22}{25}\cdot$

(ii) $P(\textit{that the drawn shirt is acceptable to Kamal}) = \frac{88+8}{100} = \frac{96}{100} = \frac{24}{25}\cdot$

15. Total number of persons in the group = 12.

(i) Number of persons who are extremely patient = 3.

$P(\textit{selecting a person who is extremely patient}) = \frac{3}{12} = \frac{1}{4}\cdot$

(ii) Number of persons who are extremely honest = 6.

Number of persons who are extremely kind = 12 − (3 + 6) = 3.

∴ $P(\textit{selecting a person who is extremely kind or extremely honest}) = \frac{3+6}{12} = \frac{9}{12} = \frac{3}{4}\cdot$

From the given three values, we prefer honesty. Honesty can get rid of rampant corruption which is a burning issue of the present society.

16. Number of all possible outcomes = 36.

(i) All those cases where 5 comes up on at least one face are

(1, 5), (2, 5), (3, 5), (4, 5), (5, 5), (6, 5), (5, 1), (5, 2), (5, 3), (5, 4), (5, 6).

Number of such cases = 11.

Number of those cases where 5 will not come up any time = 36 − 11 = 25.

∴ $P(\textit{that 5 will not come up either time}) = \frac{25}{36}\cdot$

(ii) All those case where 5 comes up exactly one time are

(1, 5), (2, 5), (3, 5), (4, 5), (6, 5), (5, 1), (5, 2), (5, 3), (5, 4), (5, 6).

Number of such cases = 10.

∴ $P(\textit{that 5 will come up exactly one time}) = \frac{10}{36} = \frac{5}{18}\cdot$

(iii) There is only one case, namely (5, 5) when 5 comes up both the times.

∴ $P(\textit{that 5 will come up both the times}) = \frac{1}{36}\cdot$

17. Number of all possible outcomes = 36.

Let $E$ be the event of getting 2 numbers on the two dice whose product is a perfect square.

Then, the favourable outcomes are (1, 1), (1, 4), (4, 1), (2, 2), (3, 3), (4, 4) (5, 5), (6, 6).

Their number is 8. So, $P(E) = \frac{8}{36} = \frac{2}{9}\cdot$

18. Total number of letters in the the given word = 11.

(i) Number of vowels in the given word = 6.

∴ $P(\textit{selecting a vowel}) = \frac{6}{11}\cdot$

(ii) Number of consonants in the given word = 5.

$P(\textit{selecting a consonant}) = \frac{5}{11}\cdot$

(iii) Number of S in the given word = 2.

$\therefore \quad P(\textit{getting an } \mathrm{S}) = \frac{2}{11}\cdot$

19. Total number of cards = 5.

(a) $P(\textit{getting a queen}) = \frac{1}{5}\cdot$

(b) When the queen is set aside, remaining number of cards = 4.

(i) $P(\textit{getting an ace now}) = \frac{1}{4}\cdot$

(ii) $P(\textit{getting a queen now}) = \frac{0}{4} = 0.$

20. There are 26 red cards containing 2 queens and 2 more queens are there.

$P(\textit{getting a red card or a queen}) = \frac{28}{52} = \frac{7}{13}\cdot$

$\therefore \quad P(\textit{getting neither a red card nor a queen}) = 1 - \frac{7}{13} = \frac{6}{13}\cdot$

21. An ordinary year has 365 days consisting of 52 weeks 1 day.
This day can be any day of the week.

$P(\textit{of this day to be Monday}) = \frac{1}{7}\cdot$

22. There are 6 red face cards. These are removed.

Remaining number of cards = 52 – 6 = 46.

(i) Number of red cards now = 26 – 6 = 20.

$\therefore \quad P(\textit{getting a red card}) = \frac{20}{46} = \frac{10}{23}\cdot$

(ii) Remaining number of face cards = 12 – 6 = 6.

$\therefore \quad P(\textit{getting a face card}) = \frac{6}{46} = \frac{3}{23}\cdot$

(iii) There are 12 cards of clubs.

$\therefore \quad P(\textit{getting a card of clubs}) = \frac{12}{46} = \frac{6}{23}\cdot$

23. 4 kings, 4 queens and 4 aces have been removed.
Remaining number of cards = 52 – 12 = 40.

(i) There are 2 black face cards in the remaining cards.
These are 2 black jacks.

$\therefore \quad P(\textit{getting } 2 \textit{ black face cards}) = \frac{2}{40} = \frac{1}{20}\cdot$

(ii) Remaining number of red cards = 26 – (2 + 2 + 2) = 20.

$\therefore \quad P(\textit{getting a red card}) = \frac{20}{40} = \frac{1}{2}\cdot$

24. When a coin is tossed 3 times, all possible outcomes are

*HHH, HHT, HTH, THH, HTT, THT, TTH, TTT.*

Number of all possible outcomes = 8.

(i) $P(getting\ 3\ heads) = \frac{1}{8}\cdot$

(ii) At least 2 tails means 2 or 3 tails.

All such cases are *HTT*, *THT*, *TTH*, *TTT*. Their number is 4.

$\therefore\ P(getting\ at\ least\ 2\ tails) = \frac{4}{8} = \frac{1}{2}\cdot$

25. A leap year has 366 days = 52 weeks and 2 days.

Now, 52 weeks contain 52 Sundays.
The remaining 2 days can be:

(i) Sunday and Monday
(ii) Monday and Tuesday
(iii) Tuesday and Wednesday
(iv) Wednesday and Thursday
(v) Thursday and Friday
(vi) Friday and Saturday
(vii) Saturday and Sunday

Out of these 7 cases, their are 2 cases favouring it to be Sunday.

$\therefore\ P(a\ leap\ year\ having\ 53\ Sundays) = \frac{2}{7}\cdot$

## MULTIPLE-CHOICE QUESTIONS (MCQ)

*Choose the correct answer in each of the following questions:*

1. If $P(E)$ denotes the probability of an event $E$ then [CBSE 2013C]

(a) $P(E) < 0$ (b) $P(E) > 1$ (c) $0 \le P(E) \le 1$ (d) $-1 \le P(E) \le 1$

2. If the probability of occurrence of an event is $p$ then the probability of non-happening of this event is [CBSE 2013C]

(a) $(p - 1)$ (b) $(1 - p)$ (c) $p$ (d) $\left(1 - \frac{1}{p}\right)$

3. What is the probability of an impossible event?

(a) $\frac{1}{2}$ (b) 0 (c) 1 (d) More than 1

4. What is the probability of a sure event?

(a) 0 (b) $\frac{1}{2}$ (c) 1 (d) Less than 1

5. Which of the following cannot be the probability of an event? [CBSE 2011]

(a) 1.5 (b) $\frac{3}{5}$ (c) 25% (d) 0.3

6. A number is selected at random from the numbers 1 to 30. What is the probability that the selected number is a prime number? [CBSE 2014]

(a) $\frac{2}{3}$ (b) $\frac{1}{6}$ (c) $\frac{1}{3}$ (d) $\frac{11}{30}$

7. The probability that a number selected at random from the numbers 1, 2, 3, ..., 15 is a multiple of 4, is [CBSE 2014]

(a) $\frac{4}{15}$ (b) $\frac{2}{15}$ (c) $\frac{1}{5}$ (d) $\frac{1}{3}$

8. A box contains cards numbered 6 to 50. A card is drawn at random from the box. The probability that the drawn card has a number which is a perfect square is [CBSE 2013]

(a) $\frac{1}{45}$ (b) $\frac{2}{15}$ (c) $\frac{4}{45}$ (d) $\frac{1}{9}$

9. A box contains 90 discs, numbered from 1 to 90. If one disc is drawn at random from the box, the probability that it bears prime number less than 23 is [CBSE 2013]

(a) $\frac{7}{90}$ (b) $\frac{1}{9}$ (c) $\frac{4}{45}$ (d) $\frac{8}{89}$

10. Cards bearing numbers 2, 3, 4, ..., 11 are kept in a bag. A card is drawn at random from the bag. The probability of getting a card with a prime number is [CBSE 2012]

(a) $\frac{1}{2}$ (b) $\frac{2}{5}$ (c) $\frac{3}{10}$ (d) $\frac{5}{9}$

11. One ticket is drawn at random from a bag containing tickets numbered 1 to 40. The probability that the selected ticket has a number, which is a multiple of 7, is [CBSE 2013C]

(a) $\frac{1}{7}$ (b) $\frac{1}{8}$ (c) $\frac{1}{5}$ (d) $\frac{7}{40}$

12. Which of the following cannot be the probability of an event?

(a) $\frac{1}{3}$ (b) 0.3 (c) 33% (d) $\frac{7}{6}$

13. If the probability of winning a game is 0.4 then the probability of losing it, is

(a) 0.96 (b) $\frac{1}{0.4}$ (c) 0.6 (d) none of these

14. If an event cannot occur then its probability is

(a) 1 (b) $\frac{1}{2}$ (c) $\frac{3}{4}$ (d) 0

15. There are 20 tickets numbered as 1, 2, 3, ..., 20 respectively. One ticket is drawn at random. What is the probability that the number on the ticket drawn is a multiple of 5?

(a) $\frac{1}{4}$ (b) $\frac{1}{5}$ (c) $\frac{2}{5}$ (d) $\frac{3}{10}$

16. There are 25 tickets numbered as 1, 2, 3, 4, ..., 25 respectively. One ticket is drawn at random. What is the probability that the number on the ticket is a multiple of 3 or 5?

(a) $\frac{2}{5}$ (b) $\frac{11}{25}$ (c) $\frac{12}{25}$ (d) $\frac{13}{25}$

17. Cards, each marked with one of the numbers 6, 7, 8, ..., 15, are placed in a box and mixed thoroughly. One card is drawn at random from the box. What is the probability of getting a card with number less than 10? [CBSE 2009C]

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

18. A die is thrown once. The probability of getting an even number is [CBSE 2013]

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

19. The probability of throwing a number greater than 2 with a fair die is [CBSE 2011]

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

20. A die is thrown once. The probability of getting an odd number greater than 3 is [CBSE 2013C]

(a) $\frac{1}{3}$ (b) $\frac{1}{6}$ (c) $\frac{1}{2}$ (d) 0

21. A die is thrown once. The probability of getting a prime number is [CBSE 2013]

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

22. Two dice are thrown together. The probability of getting the same number on both dice is [CBSE 2012]

(a) $\frac{1}{2}$ (b) $\frac{1}{3}$ (c) $\frac{1}{6}$ (d) $\frac{1}{12}$

23. The probability of getting 2 heads, when two coins are tossed, is [CBSE 2012]

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

24. Two dice are thrown together. The probability of getting a doublet is [CBSE 2013]

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

25. Two coins are tossed simultaneously. What is the probability of getting at most one head?

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

26. Three coins are tossed simultaneously. What is the probability of getting exactly two heads?

(a) $\frac{1}{2}$ (b) $\frac{1}{4}$ (c) $\frac{3}{8}$ (d) $\frac{3}{4}$

27. In a lottery, there are 8 prizes and 16 blanks. What is the probability of getting a prize?

(a) $\frac{1}{2}$ (b) $\frac{1}{3}$ (c) $\frac{2}{3}$ (d) None of these

28. In a lottery, there are 6 prizes and 24 blanks. What is the probability of not getting a prize?

(a) $\frac{3}{4}$ (b) $\frac{3}{5}$ (c) $\frac{4}{5}$ (d) None of these

29. A box contains 3 blue, 2 white and 4 red marbles. If a marble is drawn at random from the box, what is the probability that it will not be a white marble? [CBSE 2009C]

(a) $\frac{1}{3}$ (b) $\frac{4}{9}$ (c) $\frac{7}{9}$ (d) $\frac{2}{9}$

30. A bag contains 4 red and 6 black balls. A ball is taken out of the bag at random. What is the probability of getting a black ball? [CBSE 2008]

(a) $\frac{2}{5}$ (b) $\frac{3}{5}$ (c) $\frac{1}{10}$ (d) None of these

31. A bag contains 8 red, 2 black and 5 white balls. One ball is drawn at random. What is the probability that the ball drawn is not black?

(a) $\frac{8}{15}$ (b) $\frac{2}{15}$ (c) $\frac{13}{15}$ (d) $\frac{1}{3}$

32. A bag contains 3 white, 4 red and 5 black balls. One ball is drawn at random. What is the probability that the ball drawn is neither black nor white?

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

33. A card is drawn at random from a well-shuffled deck of 52 cards. What is the probability of getting a black king? [CBSE 2009C]

(a) $\frac{1}{13}$ (b) $\frac{1}{26}$ (c) $\frac{2}{39}$ (d) None of these

34. From a well-shuffled deck of 52 cards, one card is drawn at random. What is the probability of getting a queen?

(a) $\frac{1}{13}$ (b) $\frac{1}{26}$ (c) $\frac{4}{39}$ (d) None of these

35. One card is drawn at random from a well-shuffled deck of 52 cards. What is the probability of getting a face card?

(a) $\frac{1}{26}$ (b) $\frac{3}{26}$ (c) $\frac{3}{13}$ (d) $\frac{4}{13}$

36. One card is drawn at random from a well-shuffled deck of 52 cards. What is the probability of getting a black face card?

(a) $\frac{1}{26}$ (b) $\frac{3}{26}$ (c) $\frac{3}{13}$ (d) $\frac{3}{14}$

37. One card is drawn at random from a well-shuffled deck of 52 cards. What is the probability of getting a 6?

(a) $\frac{3}{26}$ (b) $\frac{1}{52}$ (c) $\frac{1}{13}$ (d) None of these

## ANSWERS (MCQ)

**1.** (c) **2.** (b) **3.** (b) **4.** (c) **5.** (a) **6.** (c) **7.** (c) **8.** (d) **9.** (c) **10.** (a)
**11.** (b) **12.** (d) **13.** (c) **14.** (d) **15.** (b) **16.** (c) **17.** (d) **18.** (a) **19.** (d) **20.** (b)
**21.** (c) **22.** (c) **23.** (d) **24.** (b) **25.** (d) **26.** (c) **27.** (b) **28.** (c) **29.** (c) **30.** (b)
**31.** (c) **32.** (c) **33.** (b) **34.** (a) **35.** (c) **36.** (b) **37.** (c)

## HINTS TO SOME SELECTED QUESTIONS

2. $P(\textit{occurrent of an event}) = p$

$\Rightarrow$ $P(\textit{non-occurence of this event}) = (1 - p)$.

5. The probability of an event cannot be greater than 1.

6. Prime numbers from 1 to 30 are 2, 3, 5, 7, 11, 13, 17, 19, 23, 29.

Their number is 10.

$\therefore$ $P(\textit{getting a prime number}) = \frac{10}{30} = \frac{1}{3}$.

7. Total number of given numbers = 15.

From given numbers, the multiples of 4 are 4, 8, 12.

They are 3 in number.

$\therefore$ $P(\textit{getting a multiple of } 4) = \frac{3}{15} = \frac{1}{5}$.

8. Given numbers are 6, 7, 8, 9, ..., 50.

Number of these numbers = 50 – 5 = 45.

Perfect square numbers from these are $3^2, 4^2, 5^2, 6^2, 7^2$.

Their number is 5.

$\therefore \quad P(\textit{getting a perfect square number}) = \frac{5}{45} = \frac{1}{9}\cdot$

9. Total number of discs = 90.

Prime number less than 23 are 2, 3, 5, 7, 11, 13, 17, 19.

Their number is 8.

$P(\textit{getting a prime number less than } 23) = \frac{8}{90} = \frac{4}{45}\cdot$

10. Total number of cards = 10.

Prime numbers from given numbers are 2, 3, 5, 7, 11.

Their number is 5.

$\therefore \quad P(\textit{getting a prime number}) = \frac{5}{10} = \frac{1}{2}\cdot$

11. Total number of tickets = 40.

Tickets bearing the numbers as multiple of 7 bear the numbers 7, 14, 21, 28, 35.

Their number is 5.

$\therefore \quad P(\textit{getting a multiple of } 7) = \frac{5}{40} = \frac{1}{8}\cdot$

13. $P(\textit{losing the game}) = 1 - P(\textit{winning the game}) = (1 - 0.4) = 0.6$.

14. If an event cannot occur then its probability is 0.

15. Total number of tickets = 20.

Multiples of 5 are 5, 10, 15, 20.

Their number is 4.

$\therefore \quad P(\textit{getting a multiple of } 5) = \frac{4}{20} = \frac{1}{5}\cdot$

16. Total number of tickets = 25.

Multiples of 3 or 5 are 3, 6, 9, 12, 15, 18, 21, 24, 5, 10, 20, 25.

Number of these numbers = 12.

$\therefore \quad P(\textit{getting a multiple of } 3 \textit{ or } 5) = \frac{12}{25}\cdot$

17. Total number of cards = 15 – 5 = 10.

Number of cards with number less than 10 = 4.

$\therefore \quad P(\textit{getting a card with number less than } 10) = \frac{4}{10} = \frac{2}{5}\cdot$

18. Number of all possible outcomes = 6.

Even numbers are 2, 4, 6. Their number is 3.

$\therefore \quad P(\textit{getting an even number}) = \frac{3}{6} = \frac{1}{2}\cdot$

19. Number of all possible outcomes = 6.

Numbers greater than 2 are 3, 4, 5, 6. Their numbr is 4.

$\therefore \quad P(\textit{getting a number greater than } 2) = \frac{4}{6} = \frac{2}{3}\cdot$

20. Number of all possible outcomes = 6.

Odd number greater than 3 is 5 only. Its number is 1.

$\therefore \quad P(\textit{getting an odd number greater than } 3) = \frac{1}{6}.$

21. Number of all possible outcomes = 6.

Prime numbers are 2, 3, 5. Their number is 3.

$\therefore \quad P(\textit{getting a prime number}) = \frac{3}{6} = \frac{1}{2}.$

22. Total number of all possible outcomes = 36.

Getting same number on both dice means getting

(1, 1), (2, 2), (3, 3), (4, 4), (5, 5), (6, 6).

Their number is 6.

$\therefore \quad P(\textit{getting the same number on both dice}) = \frac{6}{36} = \frac{1}{6}.$

23. All possible outcomes are *HH*, *HT*, *TH*, *TT*. Their number is 4.

Getting 2 heads, means getting *HH*. Its number is 1.

$\therefore \quad P(\textit{getting } 2 \textit{ heads}) = \frac{1}{4}.$

24. Number of all possible outcomes = 36.

The doublets are (1, 1), (2, 2), (3, 3), (4, 4), (5, 5), (6, 6).

Their number is 6.

$\therefore \quad P(\textit{getting a doublet}) = \frac{6}{36} = \frac{1}{6}.$

25. When two coins are tossed simultaneously, all possible outcomes are *HH*, *HT*, *TH*, *TT*. Their number is 4.

All favourable outcomes are *TT*, *TH*, *HT*. Their number is 3.

$\therefore \quad P(\textit{getting at most } 1 \textit{ head}) = \frac{3}{4}.$

26. When 3 coins are tossed, all possible outcomes are *HHH*, *HHT*, *HTH*, *THH*, *HTT*, *THT*, *TTH*, *TTT*.

Their number is 8.

Favourable outcomes are *HHT*, *HTH*, *THH*. Their number is 3.

$\therefore \quad P(\textit{getting exactly } 2 \textit{ heads}) = \frac{3}{8}.$

27. Total number of lottery tickets = 8 + 16 = 24.

Number of prizes = 8.

$\therefore \quad P(\textit{getting a prize}) = \frac{8}{24} = \frac{1}{3}.$

28. Total number of tickets = 6 + 24 = 30.

Number of blanks = 24.

$\therefore \quad P(\textit{not getting a prize}) = \frac{24}{30} = \frac{4}{5}.$

29. Total number of marbles = 3 + 2 + 4 = 9.
Number of non-white marbles = 3 + 4 = 7.
$\therefore \quad P(\textit{getting a non-white marble}) = \frac{7}{9}\cdot$

30. Total number of balls in the bag = 4 + 6 = 10.
Number of black balls = 6.
$\therefore \quad P(\textit{getting a black ball}) = \frac{6}{10} = \frac{3}{5}\cdot$

31. Total number of balls in the bag = 8 + 2 + 5 = 15.
Number of non-black balls = 8 + 5 = 13.
$P(\textit{getting a non-black ball}) = \frac{13}{15}\cdot$

32. Total number of balls in the bag = 3 + 4 + 5 = 12.
Number of non-black and non-white balls = 4.
$\therefore \quad P(\textit{getting a ball which is neither black nor white}) = \frac{4}{12} = \frac{1}{3}\cdot$

33. Number of all possible outcomes = 52.
Number of black kings = 2.
$\therefore \quad P(\textit{getting a black king}) = \frac{2}{52} = \frac{1}{26}\cdot$

34. Number of all possible outcomes = 52.
Number of queens = 4.
$\therefore \quad P(\textit{getting a queen}) = \frac{4}{52} = \frac{1}{13}\cdot$

35. Total number of cards = 52.
Number of face cards = 12
(4 kings + 4 queens + 4 jacks).
$\therefore \quad P(\textit{getting a face card}) = \frac{12}{52} = \frac{3}{13}\cdot$

36. Total number of cards = 52.
Number of black face cards = 6
(2 kings +2 queens + 2 jacks).
$\therefore \quad P(\textit{getting a face card}) = \frac{6}{52} = \frac{3}{26}\cdot$

37. Total number of cards = 52.
Number of 6 $s$ = 4.
$\therefore \quad P(\textit{getting a } 6) = \frac{4}{52} = \frac{1}{13}\cdot$

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