CHAPTER 14

Probability

In this chapter, we shall first recall the study of probability done in earlier classes and then continue it to study theoretical (classical) definition of probability and problems based on it.

Meaning of Probability

Probability is the study of the chances (or likelihood) of events happening. By means of probability, the chance (or likelihood) of events is measured by a number lying between 0 and 1.

Experiment

An operation which produces some well-defined outcomes, is called an experiment.

e.g. Tossing a coin, throwing a die, etc.

There are two types of experiment

(i) Random experiment

(ii) Deterministic experiment

Random Experiment

If an experiment, when repeated under identical conditions, do not produce the same outcome every time but the outcome produced in each trial is one of the several possible outcomes, then it is known as a random or probabilistic experiment.

Tossing a fair coin is a random experiment because if we toss a coin, then either a head or a tail will come up. But if we toss a coin again and again, then each time outcome will not be the same but it will be sure either head or tail.

Note it An experiment whose outcome is known, is not a random experiment.

e.g. Throwing a stone upward is not a random experiment because when a stone is thrown upward, it is sure that the stone will fall downward.

Deterministic Experiment

An experiment which when repeated under identical conditions produce the same result or outcome, is known as deterministic experiment.

e.g. Tossing of an unfair coin (having either tail or head on both sides) is a deterministic experiment, as it gives same result while tossing the coin any number of times.

Event

An event for an experiment is the collection of some outcomes of the experiment. We generally denote it by capital letter E.

e.g. Getting an even number in a single throw of a die is an event. This event would consist of three outcomes, namely 2, 4 and 6.

Elementary Event

An event having only one outcome of the random experiment is called an elementary event.

e.g. In tossing of a coin, the possible outcomes are head (H) and tail (T). Getting H or T are known as elementary events.

Occurrence of an Event

An event E associated to a random experiment is said to be occur (or happen) in a trial, if the outcome of trial is one of the outcomes that favours E.

e.g. If a die is rolled and the outcome of a trial is 4, then we say that event getting an even number has happened (or occurred).

Probability of an Event (or Probability of occurrence of an Event)

If E is an event associated with a random experiment, then probability of E, denoted by $P(E)$, represents the chance of occurrence of event E.

e.g. If E denotes the event of getting an even number in a single throw of a die, then $P(E)$ represents the chance of occurrence of event E i.e. the chance of getting 2, 4 or 6.

Probability-An Experimental Approach

The empirical (or experimental) probability of an event E is given by

$$P(E) = \frac{\text{Number of trials in which the event happened}}{\text{Total number of trials}}$$

e.g. If a coin is tossed 1000 times with the following frequencies as Head : 455 times, Tail : 545 times and if E_1 is the event of getting a head and E_2 is the event of getting a tail, then $P(E_1)$ = Probability of occurrence of head

$$= \frac{455}{1000} = 0.455$$

and $P(E_2)$ = Probability of occurrence of tail

$$= \frac{545}{1000} = 0.545$$

Probability-A Theoretical Approach

A theoretical approach of probability has some limitations, like repetition of experiment is not possible in every situation as it may be very expensive or unfeasible.

e.g. Repeating the experiment of launching a satellite in order to compute the empirical probability of its failure during launching, will be very expensive.

Note it The basic difference between these two approaches of probability is that in the experimental approach, the probability of an event is based on what has been actually happened while in theoretical approach, we try to predict what will happen without actually performing the experiment.

Compound Event

A collection of two or more elementary events associated with an experiment is called a compound event.

e.g. In the random experiment of tossing of two coins simultaneously, if we define the event of getting exactly one head, then it is a collection of elementary events (or outcomes) HT and TH. So, it is a compound event.

Equally Likely Outcomes

The outcomes of a random experiment are said to be equally likely, when each outcome is as likely to occur as the other i.e. when we have no reason to believe that one is more likely to occur than the other.

e.g. When a die is thrown, all the six outcomes i.e. 1, 2, 3, 4, 5 and 6 are equally likely to appear. So, the outcomes 1, 2, 3, 4, 5 and 6 are equally likely outcomes.

Favourable Outcomes

The outcomes which ensure the occurrence of an event are called favourable outcomes to the event.
e.g. The favourable outcomes to the event of getting an even number when a die is thrown are 2, 4 and 6.

Complement of an Event/ Negation of an Event

Let E be an event associated with a random experiment. Then, we can define the complement of event E or negation of event E, denoted by $\bar{E}$, as an event which occurs if and only if E does not occur.

e.g. Let E be the event of getting an even number in a single throw of a die. Then, its complement can be define as event $\bar{E}$ of getting an odd number, as E is consisting 2, 4 and 6. Therefore, $\bar{E}$ would consist 1, 3 and 5.

Note it E and $\bar{E}$ are called complementary events.

Theoretical Definition (Classical definition) of Probability

Let us assume all the outcomes of an experiment are equally likely and E is an event associated with the experiment, then the theoretical probability (or classical probability) of the event E is given by

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

Example 1. If a die is thrown, then find the probability of getting 4.

Sol. When a die is thrown, there are six possible outcomes i.e. 1, 2, 3, 4, 5, 6.
So, total number of outcomes is 6.
Let E be the event of getting 4.
$\therefore$ Number of outcome favourable to E = 1 (i.e. 4)

$$\text{Hence, } P(E) = \frac{\text{Number of outcomes favourable to } E}{\text{Total number of outcomes}} = \frac{1}{6}$$

Important Results Related to Probability

1. The experimental probability of an event approaches to its theoretical probability, if the number of trials of an experiment is very large.
2. The probability of happening of an event always lies between 0 to 1 (0 and 1 inclusive) i.e. $0 \le P(E) \le 1$. Also, probability can be expressed as a percentage by multiplying it by 100. Thus, probability (in percentage) lies between 0% to 100% (0 and 100 inclusive).

3. Probability of an event can never be negative.
4. The sum of the probabilities of complementary events of an experiment is 1

i.e. if E and $\bar{E}$ are complementry events.

Then, $P(E)+P(\bar{E})=1$ or $P(\bar{E})=1-P(E)$

or $P(E)=1-P(\bar{E})$

where, $P(E)$ represents the probability of occurrence of an event E and $P(\bar{E})$ represents the probability of non-occurrence of an event E.

Justification If m outcomes are favourable to an event E out of n possible outcomes, then the number of outcomes which ensure the non-occurrence of event E is $n-m$.

Thus, we have

$$P(\bar{E})=\frac{n-m}{n}=1-\frac{m}{n}=1-P(E)\Rightarrow P(\bar{E})+P(E)=1$$

Note it

- The ratio $P(E):P(\bar{E})$ i.e. $m:n-m$ known as odd in favour of occurrence of event E.
- The ratio $P(\bar{E}):P(E)$ i.e. $n-m:m$ known as odd in against of the occurrence of event E.

Some Special Events

Impossible Event

An event which is impossible to occur, is called an impossible event and probability of impossible event is always zero.

e.g. In throwing a die, there are only six possible outcomes 1, 2, 3, 4, 5 and 6. Let we are interested in getting a number 7 on throwing a die. Since, no face of the die is marked with 7. So, 7 cannot come in any throw. Hence, getting 7 is an impossible event.

Then, $P(\text{getting a number 7})=\frac{0}{6}=0$

Sure Event or Certain Event

An event which is sure to occur, is called a sure event or certain event and probability of sure event is always 1.

e.g. Suppose we want to find the probability of getting a number less than 7 in a single throw of a die having numbers 1 to 6 on its six faces.

We are sure that, we shall always get a number less than 7, whenever we throw a die. So, getting a number less than 7 is a sure event.

Then, $P(\text{getting a number less than 7})=\frac{6}{6}=1$

Different Types of Problems Related to Probability of an Event

Let us discuss the procedure of finding probability for the problems of following types

Type I Problems Based on Tossing a Coin

A coin has two sides, head (H) and tail (T). If we toss one or more coins, then their possible outcomes are as follows :

(i) In case of one coin, possible outcomes are H and T.

(ii) In case of two coins, possible outcomes are HH, HT, TH, TT.

(iii) In case of three coins, possible outcomes are $HHH, HHT, HTH, HTT, THH, THT, TTH, TTT$.

Note it

- When we talk about a coin, we assume that it to be 'fair', i.e. symmetrical so that there is no reason for it to come down more often on one side than the other. This property of the coin is said to be 'unbiased'.
- **Random toss of a coin** It is a phrase which means that the coin is allowed to fall freely without any bias or interference.

Example 2. Two coins are tossed simultaneously. Find the probability of getting

(i) exactly two head. (ii) atleast one head.

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Sol. When two coins are tossed simultaneously, then possible outcomes are (H, H), (H, T), (T, H) and (T, T).

$\therefore$ Total number of outcomes $=4$

We know that for an event E

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

(i) Let E_1 be the event of getting exactly two head. Then, the outcomes favourable to E_1 is (H, H)

i.e. Number of outcomes favourable to $E_1=1$

$\therefore \quad P(E_1)=\frac{1}{4}$

(ii) Let E_2 be the event of getting atleast one head i.e. one head or two head. Then, outcomes favourable to E_2 are (H,T), (T,H) and (H, H)

i.e. Number of outcomes favourable to $E_2=3$

$\therefore \quad P(E_2)=\frac{3}{4}$

Type II Problems Based on Throwing a Die

A die has six faces marked as 1, 2, 3, 4, 5 and 6. If we have more than one die, then all dice are considered as distinct, if not otherwise stated.

If we throw one (or two) die (or dice), then their possible outcomes are as follows :

(i) In case of a die, possible outcomes are 1, 2, 3, 4, 5 and 6.

(ii) In case of two dice, 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) and (6, 6).

Example 3. **Suppose we throw a die once.**

(i) What is the probability of getting a number greater than 4?

(ii) What is the probability of getting a number less than or equal to 4? NCERT Exemplar

Sol. Possible outcomes of the experiment are 1, 2, 3, 4, 5 and 6.

$\therefore$ Total number of outcomes = 6

(i) Let E be the event of getting a number greater than 4. Then, outcomes favourable to E are 5 and 6, as 5 and 6 are greater than 4.

Therefore, the number of outcomes favourable to $E = 2$

$\therefore P(E) = P(\text{number greater than 4}) \quad \frac{2}{6} = \frac{1}{3}$

(ii) Let F be the event of getting a number less than or equal to 4.

Outcomes favourable to the event F are 1, 2, 3 and 4.

So, the number of outcomes favourable to $F = 4$

$\therefore P(F) = P(\text{number less than or equal to 4}) = \frac{4}{6} = \frac{2}{3}$

Example 4. **Two dice are thrown simultaneously.**

(i) Find the probability of getting a multiple of 2 on one die and a multiple of 3 on the other die.

(ii) Find the probability that the sum of the two numbers appearing on the top of the dice is 9.

Sol. Here, two dice are thrown, so 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) and (6, 6)

$\therefore$ Total number of outcomes = 36

(i) Let E be the event of getting a multiple of 2 on one die and a multiple of 3 on the other die.

Here, multiples of 2 are 2, 4 and 6, and multiples of 3 are 3 and 6. So, favourable outcomes for event E are (2, 3), (4, 3), (6, 3), (2, 6), (4, 6), (6, 6), (3, 2), (3, 4), (3, 6), (6, 2) and (6, 4).

$\therefore$ Number of outcomes favourable to $E = 11$

$\therefore$ Required probability $= P(E)$

$$= \frac{\text{Number of outcomes favourable to } E}{\text{Total number of outcomes}} = \frac{11}{36}$$

(ii) The outcomes favourable to the event, 'the sum of two numbers is 9' denoted by F, are (3, 6), (4, 5), (5, 4), (6, 3).

$\therefore$ Number of outcomes favourable to $F = 4$

Hence, required probability $= P(F) = \frac{4}{36} = \frac{1}{9}$

Note It According to the question, a multiple of 2 occurs on one die and a multiple of 3 occurs on other. So, here we take two cases. In first case, we will take (2, 4, 6) on first die and (3, 6) on second and in second case, we will take (3, 6) on first die and (2, 4, 6) on other. Thus, we get 11 favourable outcomes.

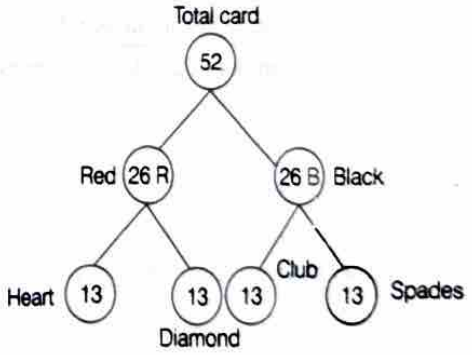
Type III Problems Based on Playing Cards

A deck of playing cards consists of 52 cards out of which 26 are black cards and other 26 are red cards, where red cards consist of 13 cards of heart (♥), 13 cards of diamond (♦) and black cards consist of 13 cards of spades (♠) and 13 cards of club (♣).

Thus, 52 playing cards are divided into four parts (called suits) of 13 cards each, namely heart, diamond, spades and club.

Also, 13 cards in each suit are ace, king, queen, jack, 10, 9, 8, 7, 6, 5, 4, 3 and 2.

Tree diagram of playing cards



Face Cards King, Queen and Jack are called face cards.

So, total face cards = 12

Example 5. **One card is drawn at random from a well shuffled deck of 52 cards. Find the probability that the card drawn**

(I) is queen of hearts.

(II) is not a jack. CBSE 2024 (Standard)

Sol. Total number of cards in one deck of card is 52.

$\therefore$ Total number of outcomes = 52

(i) Let E_1 = Event of getting a queen of heart

$\therefore$ Number of outcomes favourable to $E_1 = 1$

Hence, probability of getting a queen of heart,

$$P(E_1) = \frac{1}{52}$$

(ii) Let E_2 = Event of getting is not a jack

$\therefore$ Number of outcomes favourable to $E_2 = 48$

Hence, probability of getting a card is not a jack,

$$P(E_2) = \frac{48}{52} = \frac{12}{13}$$

Type IV Problems Based on Selection of an Object from a Bag/Box

In this type of problems, we have to find the probability of selecting an item/object of particular colour/type from a bag/box containing items/objects (like 5 balls, 4 marbles, 8 oranges, 7 bulbs etc.) in more than one colour/type.

Example 6. A box contains 20 discs which are numbered from 1 to 20. If one disc is drawn at random from the box, then find the probability that the number on the drawn disc is a CBSE 2023 (Basic)

(i) 2-digit number.

(ii) number less than 10.

Sol. (i) Let E be the event of getting a 2-digit number.

Outcomes favourable to E are

10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20

Number of favourable outcomes to $E = 11$

Total number of possible outcomes = 20

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

$$= \frac{11}{20}$$

(ii) Favourable outcomes = 1, 2, 3, 4, 5, 6, 7, 8, 9

Number of favourable outcomes = 9

Total number of possible outcomes = 20

$$\therefore \text{Probability} = \frac{9}{20}$$

Example 7. Three bags containing 10 orange, 10 green and 10 red balls, respectively are mixed together in one large bag. If one of the balls is taken out at random without looking into the bag, then what is the probability that it is

(i) orange? **(ii) not orange?**

Sol. Given, number of orange balls = 10,

number of green balls = 10

and number of red balls = 10

Since, all balls are mixed in one large bag.

So, total number of balls in large bag

$$= 10 + 10 + 10 = 30$$

$\therefore$ Total number of outcomes = 30

(i) Let E be the event of selecting an orange ball.

Then, number of outcomes favourable to $E = 10$

[$\because$ there are 10 orange balls]

$\therefore$ Required probability of getting an orange ball,

$$P(E) = \frac{10}{30} = \frac{1}{3}$$

(ii) Let F be the event of selecting a ball which is not orange.

Since, there are 10 green and 10 red balls.

$\therefore$ Number of outcomes favourable to $F = 20$

$\therefore$ Required probability of getting a ball not orange,

$$P(F) = \frac{20}{30} = \frac{2}{3}$$

Alternate Method

$P(F) = 1 - P(\text{getting an orange ball}) = 1 - P(E)$

[$\because E$ and F are complementary events]

$$= 1 - \frac{1}{3} = \frac{2}{3}$$

Example 8. Cards numbered 1, 2, 3, 4, 5, ..., 17 are put in a box and mixed thoroughly. One person draws a card from the box. Find the probability that the number on the card is

(i) an odd number.

(ii) a prime number.

(iii) divisible by 2 and 3 both.

(iv) a multiple of 3 or 5.

Sol. There are 17 cards numbered 1, 2, 3, 4, 5,...,17 in a box.

Out of 17 cards, one card can be drawn in 17 ways.

$\therefore$ Total number of outcomes = 17

(i) There are 9 odd numbered cards, namely

1, 3, 5, 7, 9, 11, 13, 15 and 17.

$\therefore$ Number of favourable outcomes = 9

Hence, P (getting an odd number)

$$= \frac{\text{Number of favourable outcomes}}{\text{Total number of outcomes}}$$

$$= \frac{9}{17}$$

(ii) There are 7 prime numbered cards, namely 2, 3, 5, 7, 11, 13 and 17.

$\therefore$ Number of favourable outcomes = 7

Hence, P (getting a prime number)

$$= \frac{\text{Number of favourable outcomes}}{\text{Total number of outcomes}} = \frac{7}{17}$$

(iii) If a number is divisible by 2 and 3 both, then it must be a multiple of 6. In cards bearing number 1, 2, 3, 4, ..., 17, there are only 2 cards which bear a number divisible by 2 and 3 both i.e. by 6. These cards bearing numbers 6 and 12.

$\therefore$ Number of favourable outcomes = 2

Hence, P (getting a card bearing number divisible by 2 and 3 both)

$$= \frac{\text{Number of favourable outcomes}}{\text{Total number of outcomes}} = \frac{2}{17}$$

(iv) There are 7 numbered cards, which are multiple of 3 or 5 namely, 3, 6, 9, 12, 15, 5 and 10.

$\therefore$ Number of favourable outcomes = 7

Hence,

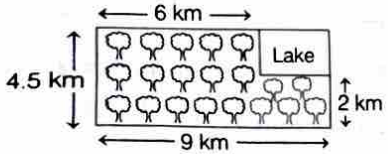
P (getting a card bearing a number multiple of 3 or 5)

$$= \frac{\text{Number of favourable outcomes}}{\text{Total number of outcomes}} = \frac{7}{17}$$

Type V Problems Based on Geometry

In this type of problems, a geometrical figure is given to us and we have to find the probability that, a given element lies inside the small part of the geometrical figure. For this, we first find the area/volume of both geometrical figures (small and big) separately and then find the required probability by taking area/volume of small part as number of favourable outcomes and area/volume of whole part as total number of outcomes.

Example 9. A missing helicopter is reported to have crashed somewhere in the rectangular region shown in figure. What is the probability that it crashed inside the lake shown in the figure?



Sol. Here, the helicopter is equally likely to crash anywhere in the region. The given geometrical figure is a rectangle and its small part i.e. lake is also a rectangle.

For rectangular region, length = 9 km

and breadth = 4.5 km

$\therefore$ Area of entire rectangular region, where the helicopter can crash $= 4.5 \times 9 = 40.5 \text{ km}^2$

For rectangular lake,

Length = 9 − 6 = 3 km

Breadth = 4.5 − 2 = 2.5 km

$\therefore$ Area of the lake $= 2.5 \times 3 = 7.5 \text{ km}^2$

Hence, probability that helicopter crashed inside the lake

$$= \frac{\text{Area of favourable region}}{\text{Total area of region}}$$

$$= \frac{7.5}{40.5} = \frac{75}{405} = \frac{5}{27}$$

Type VI Miscellaneous Problems

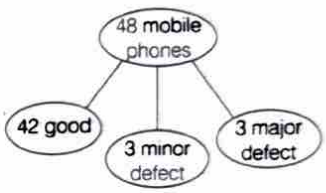
Sometimes the given problem is not of the type I to V which are discussed before.

Example 10. A lot consists of 48 mobile phones of which 42 are good, 3 have only minor defect and 3 have major defect. Varnika will buy a phone, if it is good but the trader will only buy a mobile, if it has no major defect. One phone is selected at random from the lot. What is the probability that it is

(i) acceptable to Varnika?

(ii) acceptable to the trader? NCERT Exemplar

Sol. Given, total number of mobile phones is 48. So, number of possible outcomes = 48



(i) Let E_1 be the event that phone is acceptable to Varnika i.e. E_1 be the event of getting a good phone.

$\therefore$ Number of outcomes favourable to $E_1 = 42$

Hence, probability that phone is acceptable to Varnika,

$$P(E_1) = \frac{42}{48} = \frac{7}{8}$$

(ii) Let E_2 be the event that phone is acceptable to the trader i.e. E_2 be the event of getting a good phone or a phone with minor defect.

$\therefore$ Number of outcomes favourable to E_2

= Number of good phones + Number of phone with minor defect

= 42 + 3 = 45

Hence, probability that phone is acceptable to the trader,

$$P(E_2) = \frac{45}{48} = \frac{15}{16}$$

Example 11. **Savita and Hamida are friends. What is the probability that both will have**

(i) the same birthday?

(ii) different birthdays? (ignoring a leap year)

Sol. There are 365 days in a year, so Savita's birthday can be at any day of 365 days in the year.

Similarly, Hamida's birthday can be at any day of 365 days in the year. So, total number of outcomes = 365×365

(i) If both have same birthday, then the number of favourable outcomes for their birthday = 365

$\therefore$ P (Savita and Hamida have same birthday)

$$= \frac{365}{365 \times 365}$$

$$= \frac{1}{365}$$

(ii) P (Savita and Hamida have different birthdays)

$= 1 - P$ (Savita and Hamida have same birthday)

$[\because P(E) + P(\bar{E}) = 1]$

$$= 1 - \frac{1}{365} = \frac{364}{365}$$

Example 12. **In a musical chair game, the person playing the music has been advised to stop playing the music at any time within 2 min after she starts playing. What is the probability that the music will stop within the first half-minute after starting?**

Sol. Here, the music is stopped at any time within 2 min. So, the possible outcomes are all real numbers (representing minute) between 0 and 2 which are represented on the number line.

Let E be the event that the music is stopped within the first half-minute. Then, outcomes favourable to E are points on the number line from 0 to $\frac{1}{2}$.

Here, all the outcomes are equally likely.

So, total number of outcomes

= Total distance from 0 to 2 = 2

and number of outcomes favourable to event E

$$= \text{Distance from 0 to } \frac{1}{2} = \frac{1}{2}$$

Hence, required probability = $P(E)$

$$= \frac{1/2}{2} = \frac{1}{4}$$

Example 13. **Two players Neha and Shivani play a tennis match. It is known that the probability of Neha winning the match is 0.62. What is the probability of Shivani winning the match?**

Sol. Let E and F denote the events that Neha and Shivani win the match, respectively.

It is clear that, if Neha wins the match, then Shivani losses the match and if Shivani wins the match, then Neha losses the match.

Thus, E and F are complementary events.

$\therefore$ $P(E) + P(F) = 1$

Since, probability of Neha's winning the match

i.e. $P(E) = 0.62$

$\therefore$ Probability of Shivani's winning the match,

$P(F) = P$ (Neha losses the match)

$= 1 - P(E)$ $[\because P(E) + P(F) = 1]$

$= 1 - 0.62$

$= 0.38$

Example 14. **Find the probability that a number selected at random from the numbers 3, 4, 4, 4, 5, 5, 6, 6, 6, 7 will be their mean.** CBSE 2019

Sol. Given, numbers are 3, 4, 4, 4, 5, 5, 6, 6, 6, 7.

Here, $n = 10$

$\because$ Number of all possible outcomes = 10

Now, mean of given numbers,

$$\bar{x} = \frac{3+4+4+4+5+5+6+6+6+7}{10}$$

$$= \frac{50}{10} = 5$$

Let E be the event of getting a mean from given numbers.

Here, we see that mean 5 is repeated in the given numbers are two times.

So, number of favourable outcomes = 2

$\therefore$ Required probability $P(E) = \frac{2}{10} = \frac{1}{5}$

Exercise 14.1

Q1. Complete the following statements:

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

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

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

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

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

Sol. (i) 1, because the sum of probabilities of complementary events is equal to one.

(ii) 0, impossible event.

(e.g. Suppose a die is thrown and we have to determine the probability of getting 8. This type of event is called an impossible event and probability of this event is 0.)

(iii) 1, sure event.

(e.g. The event of getting a number less than 7 in a single throw of a die is a sure event and its probability is 1.)

(iv) 1, (e.g. Suppose a die is thrown, then $P(\text{getting 1}) + P(\text{getting 2}) + P(\text{getting 3}) + P(\text{getting 4}) + P(\text{getting 5}) + P(\text{getting 6}) = 1$)

(v) 0, 1

Since, the probability of each event lies between 0 and 1.

Q2. Which of the following experiments have equally likely outcomes? Explain.

(i) A driver attempts to start a car. The car starts or does not start.

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

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

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

Sol. (i) The car starts normally but when there is some defect, then car does not start. So, the outcomes are not equally likely.

(ii) The outcomes in this situation are not equally likely because the outcomes depends on many factors such as training of the player, quality of basketball, etc.

(iii) The outcomes in trial of true-false question is either true or false. Hence, the two outcomes are equally likely.

(iv) A new baby can be either a boy or a girl, so both the outcomes are equally likely.

Q3. Why is tossing a coin considered to be a fair way of deciding which team should get the ball at the beginning of a football game?

Sol. When we toss a coin, we get either head or tail which are equally likely outcomes. Hence, the result of the toss of a coin is completely unpredictable or unbiased. So, tossing a coin is a fair way of deciding.

Q4. Which of the following cannot be the probability of an event?

(i) $\frac{2}{3}$ (ii) -1.5 (iii) 15% (iv) 0.7

Sol. (ii) The probability of an event is always lies from 0 to 1. So, the probability of an event cannot be negative in any case.

Q5. If $P(E) = 0.05$, what is the probability of 'not E'?

Sol. Given, $P(E) = 0.05$

We know that, $P(E) + P(\bar{E}) = 1$

$\therefore \quad P(\bar{E}) = 1 - P(E) \Rightarrow P(\bar{E}) = 1 - 0.05 = 0.95.$

Q6. A bag contains lemon flavoured candies only. Malini takes out one candy without looking into the bag. What is the probability that she takes out

(i) an orange flavoured candy?

(ii) a lemon flavoured candy?

Sol. (i) Let E be an event of getting an orange flavoured candy. All possible outcomes are against the event E because in a bag, all candies are lemon flavoured.

So, $P(E) = 0$

(ii) Let F be an event of getting a lemon flavoured candy. All possible outcomes are favourable to event F because all the candies in the bag are lemon flavoured.

So, $P(F) = 1$

Q7. It is given that in a group of 3 students, the probability of 2 students not having the same birthday is 0.992. What is the probability that the 2 students have the same birthday?

Sol. Do same as Example 13. **Ans.** 0.008

Q8. **A bag contains 3 red balls and 5 black balls. A ball is drawn at random from the bag. What is the probability that the ball drawn is**

(i) red? (ii) not red?

Sol. Do same as Example 7. **Ans.** (i) $\frac{3}{8}$ (ii) $\frac{5}{8}$

Q9. **A box contains 5 red marbles, 8 white marbles and 4 green marbles. One marble is taken out of the box at random. What is the probability that the marble taken out will be**

(i) red? (ii) white? (iii) not green?

Sol. (i) Do same as Example 7. **Ans.** $\frac{5}{17}$

(ii) Do same as Example 7. **Ans.** $\frac{8}{17}$

(iii) Let E_3 be the event of drawing a marble which is not green

i.e. event of drawing either red or white marble.

$\therefore$ Number of outcomes favourable to $E_3 = 5+8=13$

So, probability of taken out not a green marble,

$P(E_3) = \frac{13}{17}$

Q10. **A piggy bank contains hundred 50 paise coins, fifty ₹ 1 coins, twenty ₹ 2 coins and ten ₹ 5 coins. If it is equally likely that one of the coins will fall out when the bank is turned upside down, then what is the probability that the coin**

(i) will be a 50 paise coin?

(ii) will not be a ₹ 5 coin?

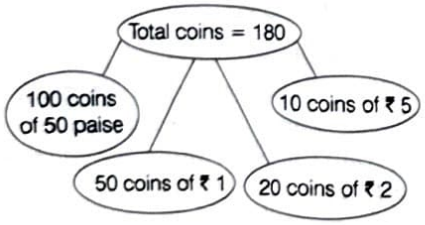
Sol. Given, number of 50 paise coins = 100,

number of ₹ 1 coins = 50,

number of ₹ 2 coins = 20

and number of ₹ 5 coins = 10

$\therefore$ Total number of coins = 100 + 50 + 20 + 10 = 180



(i) $P(\text{50 paise coin}) = \frac{\text{Number of 50 paise coins}}{\text{Total number of coins}}$

$= \frac{100}{180} = \frac{5}{9}$

(ii) Number of coins which are not of ₹ 5

= Total number of coins − Number of ₹ 5 coins

= 180 − 10 = 170

$\therefore$ $P(\text{that the coin will not be a ₹ 5 coin}) = \frac{170}{180} = \frac{17}{18}$

Q11. **Gopi buys a fish from a shop for her aquarium. The shopkeeper takes out one fish at random from a tank containing 5 male fishes and 8 female fishes (see figure). What is the probability that the fish taken out is a male fish?**

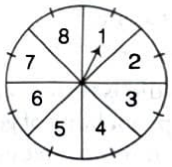
Sol. Total number of fishes in the tank

= 5 male fishes + 8 female fishes = 13 fishes

$\therefore$ Probability of taken out a male fish

$= \frac{\text{Number of male fishes}}{\text{Total number of fishes}} = \frac{5}{13}$

Q12. **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 and 8 (see figure) and these are equally likely outcomes.**



What is the probability that it will point at

(i) 8?

(ii) an odd number?

(iii) a number greater than 2?

(iv) a number less than 9?

Sol. Total number of points on the circle = 8

(i) Let E_1 be the event of getting arrow at number 8.

$\therefore$ Number of outcomes favourable to $E_1 = 1$

Probability that arrow comes at number 8,

$P(E_1) = \frac{1}{8}$

(ii) Let E_2 be the event of getting arrow at an odd number.

Here, odd numbers are 1, 3, 5 and 7.

$\therefore$ Number of outcomes favourable to $E_2 = 4$

Probability that arrow comes at an odd number,

$P(E_2) = \frac{4}{8} = \frac{1}{2}$

(iii) Let E_3 be the event of getting arrow at a number greater than 2 i.e. at 3, 4, 5, 6, 7 or 8.

$\therefore$ Number of outcomes favourable to $E_3 = 6$

Probability that arrow comes at a number greater than 2, $P(E_3) = \frac{6}{8} = \frac{3}{4}$

(iv) Do same as part (iii). **Ans.** 1

Q13. A die is thrown once. Find the probability of getting

(i) a prime number. CBSE 2020 (Standard)

(ii) a number lying between 2 and 6. CBSE 2019

(iii) an odd number.

Sol. On a die, there are six numbers 1, 2, 3, 4, 5 and 6.

$\therefore$ Total number of possible outcomes = 6

(i) Let E_1 be the event of getting a prime number.

Then, E_1 would consist of three outcomes namely 2, 3 and 5.

$\therefore$ Number of outcomes favourable to $E_1 = 3$

Probability of getting a prime number,

$$P(E_1) = \frac{3}{6} = \frac{1}{2}$$

(ii) Let E_2 be the event of getting a number lying between 2 and 6.

Then, E_2 would consist of three outcomes, namely 3, 4 and 5.

$\therefore$ Number of outcomes favourable to $E_2 = 3$

Probability of getting a number lying between 2 and 6,

$$P(E_2) = \frac{3}{6} = \frac{1}{2}$$

(iii) Do same as Q. 12 (ii). **Ans.** $\frac{1}{2}$

Q14. One card is drawn from a well-shuffled deck of 52 cards. Find the probability of getting

(i) a king of red colour.

(ii) a face card.

(iii) a red face card.

(iv) the jack of hearts.

(v) a spade.

(vi) the queen of diamonds.

Sol. Total number of cards in one deck of cards is 52.

$\therefore$ Total number of outcomes = 52

(i) Let E_1 be the event of getting a king of red colour.

$\therefore$ Number of outcomes favourable to $E_1 = 2$

[$\because$ there are four kings in a deck of playing cards out of which two are red and two are black]

Hence, probability of getting a king of red colour,

$$P(E_1) = \frac{2}{52} = \frac{1}{26}$$

(ii) Let E_2 be the event of getting a face card.

$\therefore$ Number of outcomes favourable to $E_2 = 12$

[$\because$ in a deck of cards, there are 12 face cards, namely 4 kings, 4 jacks, 4 queens]

Hence, probability of getting a face card,

$$P(E_2) = \frac{12}{52} = \frac{3}{13}$$

(iii) Do same as Part (ii). **Ans.** $\frac{3}{26}$

(iv) Let E_4 be the event of getting a jack of heart.

$\therefore$ Number of outcomes favourable to $E_4 = 1$

[$\because$ there are four jack cards in a deck, namely 1 of heart, 1 of club, 1 of spade and 1 of diamond]

Hence, probability of getting a jack of heart,

$$P(E_4) = \frac{1}{52}$$

(v) Let E_5 be the event of getting a spade

$\therefore$ Number of outcomes favourable to $E_5 = 13$

[$\because$ in a deck of cards, there are 13 spades, 13 clubs, 13 hearts and 13 diamonds]

Hence, probability of getting a spade,

$$P(E_5) = \frac{13}{52} = \frac{1}{4}$$

(vi) Do same as Part (iv). **Ans.** $\frac{1}{52}$

Q15. Five cards — the ten, jack, queen, king and ace of diamonds are well-shuffled with their face downwards. One card is then picked up at random.

(i) What is the probability that the card is the queen?

(ii) If the queen is drawn and put a side, then what is the probability that the second card picked up is

(a) an ace? (b) a queen?

Sol. (i) Total number of cards = 5

$\therefore$ Number of all possible outcomes = 5

P(picking a queen card) $= \frac{1}{5}$

[$\because$ as there is only one queen]

(ii) Suppose a queen is drawn and put a side. Then, four cards are left namely, ten, jack, king and ace of diamonds.

Now, number of all possible outcomes = 4

(a) P(the second card picked up is an ace) $= \frac{1}{4}$

(b) P(the second card picked up is a queen) $= \frac{0}{4} = 0$

[$\because$ queen is drawn before]

Q16. 12 defective pens are accidentally mixed with 132 good ones. It is not possible to just look at a pen and tell whether or not it is defective. One pen is taken out at random from this lot. Determine the probability that the pen taken out is a good one.

Sol. Total number of pens = 12 defective + 132 good

= 144 pens

Let E be the event of selecting a good pen.

Then, number of outcomes favourable to $E = 132$

$\therefore$ Probability of selecting a good pen, $P(E) = \frac{132}{144} = \frac{11}{12}$

Q17. (i) A lot of 20 bulbs contain 4 defective ones. One bulb is drawn at random from the lot. What is the probability that this bulb is defective?

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

Sol. (i) Total number of bulbs is 20.

$\therefore$ Number of all possible outcomes = 20

Let E be the event of getting a defective bulb.

Then, the number of outcomes favourable to $E = 4$

$\therefore$ Probability of selecting a defective bulb,

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

(ii) Suppose one good bulb is drawn and put outside.

Then, 15 good bulbs and 4 defective bulbs are remain in a lot.

Now, total number of bulbs = 19

$\therefore$ Number of all possible outcomes = 19

Let E_1 be the event of selecting a good bulb.

Then, the number of outcomes favourable to $E_1 = 15$

$\therefore$ Required probability $= P(E_1) = \frac{15}{19}$

Q18. **A box contains 90 discs, which are numbered from 1 to 90. If one disc is drawn at random from the box, find the probability that it bears**

(i) a two-digit number.

(ii) a perfect square number.

(iii) a number divisible by 5.

Sol. (i) Total number of discs in a box = 90

$\therefore$ Number of all possible outcomes = 90

Let E_1 be the event of getting a disc bearing a two-digit number.

Here, two-digit numbers are 10, 11, ..., 90

$\therefore$ Number of outcomes favourable to $E_1 = 81$

Hence, probability of getting a disc bearing a two-digit number, $P(E_1) = \frac{81}{90} = \frac{9}{10}$

(ii) Let E_2 be the event of getting a disc bearing a perfect square number.

Here, perfect square numbers are 1, 4, 9, 16, 25, 36, 49, 64 and 81.

$\therefore$ Number of outcomes favourable to $E_2 = 9$

Hence, probability of getting a disc bearing a perfect square number, $P(E_2) = \frac{9}{90} = \frac{1}{10}$

(iii) Let E_3 be the event of getting a disc bearing a number divisible by 5.

Here, the numbers divisible by 5 are 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85 and 90.

$\therefore$ Number of outcomes favourable to $E_3 = 18$

Hence, required probability $= P(E_3) = \frac{18}{90} = \frac{1}{5}$

Q19. **A child has a die whose six faces show the letters as given below**

A	B	C	D	E	A

The die is thrown once. What is the probability of getting

(i) A? (ii) D? CBSE 2020 (Standard)

Sol. Total number of outcomes in a single throw of a six faces die = 6

(i) Let E_1 be the event of getting a letter A.

Then, number of outcomes favourable to $E_1 = 2$

Hence, probability of getting a letter A,

$$P(E_1) = \frac{2}{6} = \frac{1}{3}$$

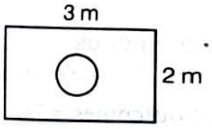
(ii) Let E_2 be the event of getting a letter D.

Then, number of outcomes favourable to $E_2 = 1$

Hence, probability of getting a letter D,

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

Q20. **Suppose, you drop a die at random on the rectangular region shown in figure. What is the probability that it will land inside the circle of diameter 1 m?**



Sol. Area of rectangle $= 3 \times 2 = 6\ m^2$

and area of circle of radius $\frac{1}{2}$ m $= \pi\left(\frac{1}{2}\right)^2 = \frac{\pi}{4}\ m^2$

$$\left[\because \text{diameter} = 1\,m \Rightarrow \text{radius} = \frac{1}{2}\,m\right]$$

Now, probability that the die land inside the circle

$$= \frac{\text{Area of circle}}{\text{Area of rectangle}} = \frac{\pi/4}{6} = \frac{\pi}{24}$$

Q21. **A lot consists of 144 ball pens of which 20 are defective and the others are good. Nuri will buy a pen if it is good, but will not buy if it is defective. The shopkeeper draws one pen at random and gives it to her. What is the probability that**

(i) she will buy it?

(ii) she will not buy it?

Sol. Total number of ball pens = 144

$\therefore$ Number of all possible outcomes = 144

(i) Let E be the event of getting a good ball pen.

Then, number of outcomes favourable to E

= Total number of ball pens – Defective ball pens

= 144 – 20 = 124

She will buy a pen, if it is a good pen.

$\therefore$ Required probability $= P(E) = \frac{124}{144} = \frac{31}{36}$

(ii) She will not buy a pen, if it is not a good pen.

$\therefore$ Required probability

= 1 – Probability of getting a good pen

$[\because P(E) + P(\bar{E}) = 1]$

$= 1 - P(E) = 1 - \frac{31}{36} = \frac{5}{36}$

Q22. Two dice, one blue and one grey, are thrown at the same time. Then

(i) Complete the following table:

Event : Sum on 2 dice	2	3	4	5	6	7	8	9	10	11	12
Probability	$\frac{1}{36}$						$\frac{5}{36}$				$\frac{1}{36}$

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

Sol. (i) Total possible outcomes on throwing two dice 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) and (6,6)

$\therefore$ Number of all possible outcomes = 36

(a) Let E_1 be the sum of two dice is 3.

Then, E_1 would consist of two outcomes, namely (1, 2) and (2,1).

$\therefore$ Number of outcomes favourable to $E_1 = 2$

Hence, $P(E_1) = \frac{2}{36} = \frac{1}{18}$

(b) Let E_2 be the sum of two dice is 4.

Then, E_2 would consist of three outcomes, namely (1, 3), (2, 2) and (3,1).

$\therefore$ Number of outcomes favourable to $E_2 = 3$

Hence, $P(E_2) = \frac{3}{36} = \frac{1}{12}$

(c) Let E_3 be the sum of two dice is 5.

Then, E_3 would consist of four outcomes, namely (1, 4), (2, 3), (3, 2) and (4, 1).

$\therefore$ Number of outcomes favourable to $E_3 = 4$

Hence, $P(E_3) = \frac{4}{36} = \frac{1}{9}$

(d) Let E_4 be the sum of two dice is 6.

Then, E_4 would consist of five outcomes, namely (1, 5), (2, 4), (3, 3), (4, 2) and (5, 1).

$\therefore$ Number of outcomes favourable to $E_4 = 5$

Hence, $P(E_4) = \frac{5}{36}$

(e) Let E_5 be the sum of two dice is 7.

Then, E_5 would consist of six outcomes, namely (1, 6), (2, 5), (3, 4), (4, 3), (5, 2) and (6, 1).

$\therefore$ Number of outcomes favourable to $E_5 = 6$

Hence, $P(E_5) = \frac{6}{36} = \frac{1}{6}$

(f) Let E_6 be the sum of two dice is 9.

Then, E_6 would consist of four outcomes, namely (3, 6), (4, 5), (5, 4) and (6, 3).

$\therefore$ Number of outcomes favourable to $E_6 = 4$

Hence, $P(E_6) = \frac{4}{36} = \frac{1}{9}$

(g) Let E_7 be the sum of two dice is 10.

Then, E_7 would consist of three outcomes, namely (4, 6), (5, 5) and (6, 4).

$\therefore$ Number of outcomes favourable to $E_7 = 3$

Hence, $P(E_7) = \frac{3}{36} = \frac{1}{12}$

(h) Let E_8 be the sum of two dice is 11.

Then, E_8 would consist of two outcomes, namely (6, 5) and (5, 6).

$\therefore$ Number of outcomes favourable to $E_8 = 2$

Hence, $P(E_8) = \frac{2}{36} = \frac{1}{18}$

(ii) No, we do not agree with the given argument because the events of eleven sums are not equally likely.

Q23. A game consists of tossing a one rupee coin 3 times and noting its outcome each time. Hanif wins if all the tosses give the same result; i.e. three heads or three tails, and loses otherwise. Calculate the probability that Hanif will lose the game.

CBSE 2019

Sol. The total possible outcomes on tossing a coin three times are $(HHH), (HHT), (HTH), (THH), (HTT), (THT), (TTH)$ and (TTT).

$\therefore$ Number of all possible outcomes $= 8$

Let E be the event that Hanif will lose the game.

Hanif will lose the game, if all tosses do not have same result

i.e. if outcomes are

$(HHT), (HTH), (THH), (HTT), (THT)$ or (TTH).

$\therefore$ Number of outcomes favourable to $E = 6$

Hence, required probability $= P(E) = \frac{6}{8}$

$$= \frac{3}{4}$$

Q24. A die is thrown twice. What is the probability that

(i) 5 will not come up either time?

(ii) 5 will come up atleast once?

Hint Throwing a die twice and throwing two dice simultaneously are treated as the same experiment.

Sol. Total number of outcomes = 36

(i) Let E be the event that 5 will not come up either time.

Then, E would consist of 25 outcomes, namely

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

$\therefore$ Number of outcomes favourable to $E = 25$

Hence, probability that 5 will not come up either time,

$$P(E) = \frac{25}{36}$$

(ii) Probability that 5 will come up at least once,

$$P(\bar{E}) = 1 - P(E)$$

$$= 1 - \frac{25}{36} = \frac{11}{36}$$

Q25. Which of the following arguments are correct and which are not correct? Give reasons for your answer.

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

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

Sol. (i) **Incorrect.** We can classify the outcomes like this but they are not 'equally likely'. Reason is that 'one of each' can result in two ways– from a head on first coin and tail on the second coin or from a tail on the first coin and head on the second coin. This makes it twice as likely as two heads (or two tails).

(ii) **Correct.** Since, the two outcomes considered in the question, are equally likely, therefore we can classify the outcomes as given in the question.

So, we have, P (getting an odd number)

$= P$ (getting an even number) ... (i)

[$\because$ outcomes are equally likely]

Also, we know that sum of probabilities of all elementary events of an experiment is 1.

Since, we have, P (getting an odd number)

$+ P$ (getting an even number) $= 1$

$\Rightarrow 2P$ (getting an odd number) $= 1$ [using Eq. (i)]

$\Rightarrow P$ (getting an odd number) $= \frac{1}{2}$

REVIEW EXERCISE

Including Competency Based Questions

Part I

Multiple Choice Questions

1. Let k be the probability that a player wins a medium prize in his first attempt. If a player wins a small and a large prize in his first two attempts, then the probability that he wins a medium prize in his third attempt is **Competency Based Question**

(a) equal to k (b) less than k
(c) more than k
(d) cannot be determined using the given information

2. Which of the following cannot be the probability of an event? **CBSE 2022 (Basic)**

(a) 0.01 (b) 3% (c) $\frac{16}{17}$ (d) $\frac{17}{16}$

3. Which of the following numbers cannot be the probability of happening of an event? **CBSE 2023 (Standard)**

(a) 0 (b) $\frac{7}{0.01}$ (c) 0.07 (d) $\frac{0.07}{3}$

4. The probability of guessing the correct answer to a certain test question is $\frac{x}{6}$. If the probability of not guessing the correct answer to this question is $\frac{2}{3}$, then the value of x is **CBSE 2024 (Standard)**

(a) 2 (b) 3 (c) 4 (d) 6

5. If $P(E) = 0.65$, then the value of P(not E) is **CBSE 2022 (Basic)**

(a) 1.65 (b) 0.25 (c) 0.65 (d) 0.35

6. For an event E, $P(E) + P(\bar{E}) = x$, then the value of $x^3 - 3$, is **CBSE 2021 Term I (Standard)**

(a) -2 (b) 2 (c) 1 (d) -1

7. Two coins are tossed simultaneously. The probability of getting at most one tail is **CBSE 2024 (Standard)**

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

8. Two coins are tossed together. The probability of getting atleast one tail is **CBSE 2023 (Standard)**

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

9. When a dice is thrown once, the probability of getting an even number less than 4 is **Competency Based Question**

(a) $\frac{1}{4}$ (b) 0 (c) $\frac{1}{2}$ (d) $\frac{1}{6}$

10. A dice is rolled twice. The probability that 5 will not come up either time is **CBSE 2022 (Basic)**

(a) $\frac{11}{36}$ (b) $\frac{1}{3}$ (c) $\frac{13}{36}$ (d) $\frac{25}{36}$

11. One card is drawn at random from a well-shuffled deck of 52 playing cards. The probability that it is a red king is **CBSE 2023 (Basic)**

(a) $\frac{1}{52}$ (b) $\frac{1}{26}$ (c) $\frac{2}{26}$ (d) $\frac{2}{13}$

12. 2 cards of heart and 4 cards of spade are missing from a pack of 52 cards. What is the probability of getting a black card from the remaining pack? **CBSE Sample Paper 2023 (Basic)**

(a) $\frac{22}{52}$ (b) $\frac{22}{46}$ (c) $\frac{24}{52}$ (d) $\frac{24}{46}$

13. One card is drawn at random from a well-shuffled deck of 52 playing cards. What is the probability of getting a black king? **CBSE 2023 (Basic)**

(a) $\frac{1}{26}$ (b) $\frac{1}{13}$ (c) $\frac{1}{52}$ (d) $\frac{1}{2}$

14. A card is drawn at random from a well-shuffled deck of 52 playing cards. The probability of getting a face card is

(a) $\frac{1}{2}$ (b) $\frac{3}{13}$ (c) $\frac{4}{13}$ (d) $\frac{1}{13}$

15. One card is drawn at random from a well-shuffled pack of 52 playing cards. The probability that the drawn card is a queen, is **CBSE 2023 (Standard)**

(a) $\frac{4}{13}$ (b) $\frac{1}{13}$ (c) $\frac{2}{13}$ (d) $\frac{1}{26}$

16. A bag contains 5 pink, 8 blue and 7 yellow balls. One ball is drawn at random from the bag. What is the probability of getting neither a blue nor a pink ball?

(a) $\frac{1}{4}$ (b) $\frac{2}{5}$ (c) $\frac{7}{20}$ (d) $\frac{13}{20}$

17. A bag contains 8 red balls and some blue balls. If the probability of drawing a blue ball is three times of a red ball, then the number of blue balls in the bag **Competency Based Question**

(a) 12 (b) 18 (c) 24 (d) 36

18. 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 like 4, 9 .... is **Competency Based Question**

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

19. 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 a prime number less than 23 is **CBSE 2023 (Standard)**

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

20. Two fair coins are tossed together. The probability of getting 2 heads is **CBSE 2024 (Basic)**

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

21. There is a green square board of side $2a$ unit circumscribing a red circle. Jayadev is asked to keep a dot on the above said board. Find the probability that he keeps the dot on the green region. **CBSE Sample Paper 2023 (Basic)**

(a) $\frac{\pi}{4}$ (b) $\frac{4-\pi}{4}$ (c) $\frac{\pi-4}{4}$ (d) $\frac{4}{\pi}$

Assertion-Reason Type Questions

22. **Assertion** In a cricket match, a batsman hits a boundary 9 times out of 45 balls he plays. The probability that in a given ball, he does not hit the boundary is $\frac{4}{5}$. **CBSE 2024 (Standard)**

Reason $P(E)+P(\text{not } E)=1$

(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

(b) Both Assertion and Reason are correct but Reason is not the correct explanation of Assertion.

(c) Assertion is correct but Reason is incorrect.

(d) Assertion is incorrect but Reason is correct.

23. **Assertion** When two coins are tossed together, the probability of getting no tail is $\frac{1}{4}$.

Reason The probability $P(E)$ of an event E satisfies $0 \le P(E) \le 1$. **CBSE 2023 (Basic)**

(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

(b) Both Assertion and Reason are correct but Reason is not the correct explanation of Assertion.

(c) Assertion is correct but Reason is incorrect.

(d) Assertion is incorrect but Reason is correct.

24. **Assertion** The probability of selecting a number from the numbers 1 to 20 is $\frac{1}{20}$.

Reason For any event E, if $P(E) = 1$, then E is called an impossible event.

(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

(b) Both Assertion and Reason are correct but Reason is not the correct explanation of Assertion.

(c) Assertion is correct but Reason is incorrect.

(d) Assertion is incorrect but Reason is correct.

25. **Assertion** In a lottery, there are 5 prizes and 20 blanks, the probability of not getting a prize is $\frac{4}{5}$.

Reason A die is tossed once, then the probability of getting a number less than 5 is $\frac{2}{3}$.

(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

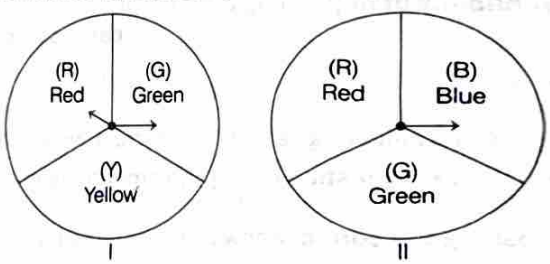
(b) Both Assertion and Reason are correct but Reason is not the correct explanation of Assertion.

(c) Assertion is correct but Reason is incorrect.

(d) Assertion is incorrect but Reason is correct.

Case Study Based Questions

26. A middle school decided to run the following spinner game as a fund-raiser on Christmas Carnival.



Making Purple : Spin each spinner once, blue and red make purple. So, if one spinner shows Red (R) and another Blue (B), then you 'win'. One such outcome is written as 'RB'. **CBSE 2023 (Standard)**

Based on the above, answer the following questions

(i) List all possible outcomes of the game.

(ii) Find the probability of 'Making Purple'.

(iii) For each win, a participant gets ₹ 10, but if he/she loses, he/she has to pay ₹5 to the school.

If 99 participants played, calculate how much fund could the school have collected.

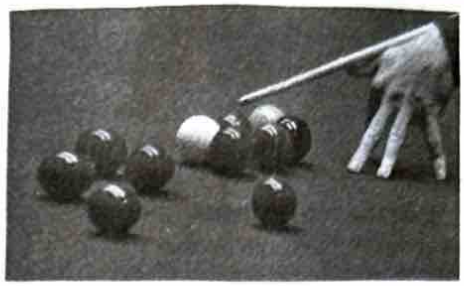
Or

If the same amount of ₹ 5 has been decided for winnings or losing the game, then how much fund had been collected by school?

(Number of participants = 99)

27. "Eight Ball" is a game played on a pool table with 15 balls numbered from 1 to 15 and a "cue ball" that is solid and white. Out of the 15 balls, eight are solid (non-white) coloured and numbered from 1 to 8 and seven are striped balls numbered from 9 to 15.

CBSE 2023 (Standard)



The 15 numbered pool balls (no cue ball) are placed in a large bowl and mixed, then one ball is drawn out at random.

Based on the above information, answer the following questions :

(i) What is the probability that the drawn ball bears number 8?

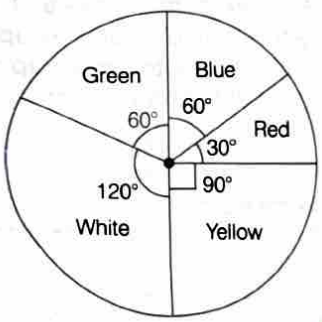
(ii) What is the probability that the drawn ball is a solid coloured and bears an even number?

(iii) What is the probability that the drawn ball bears an even number?

Or

What is the probability that the drawn ball bears a number, which is a multiple of 3?

28. Some students were asked to list their favourite colour. The measure of each colour is shown by the central angle of a pie-chart given below :



CBSE 2023 (Basic)

Study the pie-chart and answer the following questions :

(i) If a student is chosen at random, then find the probability of his/her favourite colour being white?

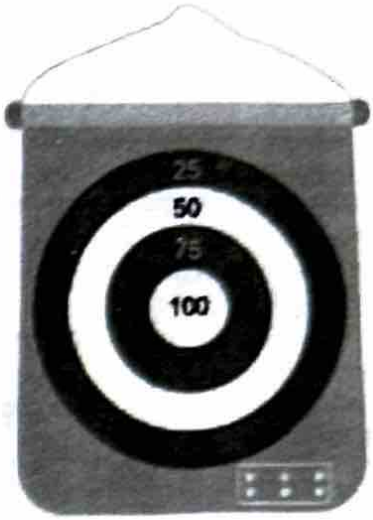
(ii) What is the probability of his/her favourite colour being blue or green?

(iii) If 15 students liked the colour yellow, how many students participated in the survey?

Or

What is the probability of the favourite colour being red or blue?

29. Nishant and Kapil are playing a game of dart. They use this dart board.



Here, are the rules of the game.

When your dart is placed in any circular region, you get the points mentioned in that region.

If your dart strikes outside the circles you get zero point.

During the game, all the darts of both Nishant and Kapil fall in the circular region.

The radius of the innermost circle is 7 cm and the width of all other circular regions is 7 cm.

Based on the above information, answer the following questions.

(i) Nishant throws the first dart. What is the probability of Nishant getting a score of 100 in the first throw?

(ii) Kapil threw a dart which hits the board. What is the probability of the dart hitting the outermost circular region on the board?

(a) $\frac{1}{4}$ (b) $\frac{4}{5}$ (c) $\frac{7}{16}$ (d) $\frac{9}{16}$

(iii) In the first three throw Nishant gets 75 points in two throw and 100 points in the third throw. What is the probability of Nishant getting a 75 in the next throw?

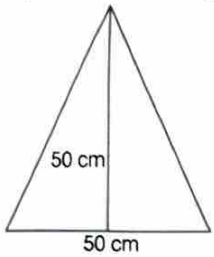
(a) $\frac{1}{2}$ (b) $\frac{2}{3}$ (c) $\frac{3}{4}$ (d) $\frac{3}{16}$

(iv) Kapil gets 25 points each, in the first and second throw. How many possibilities are there for the total points Kapil can have after four throw?

(a) 2 (b) 4

(c) 10 (d) 16

30. In a classroom, a rectangular board is fitted on a wall. The length of the board is 2m and the width of the board is 1m. Anuj draws this triangle on the board.



Based on the above information, answer the following questions.

(i) Anuj throws a bunch of chalks randomly at the board with all the chalks striking the board. What proportion of the chalks are expected to fall in the triangular region?

(ii) What is the probability of a chunk of chalk not hitting the board?

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

31. Ross observed the food a few puppies preferred to eat. The table given below shows the number of puppies and their preferred food during day time.

Food	Number of puppies
Egg	10
Meat	20
Milk	7
Pet food	13

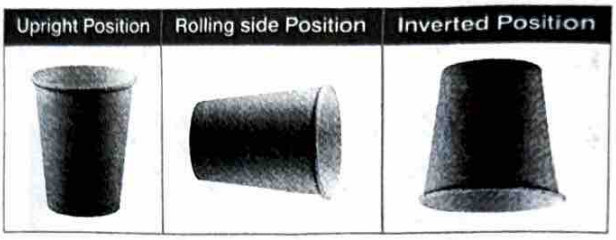
Based on the above information, answer the following questions.

(i) A puppy was chosen at random from the group that Ross observed. What is the probability that the chosen puppy prefers to have pet food during the day?

(ii) Sixty percent of the time, puppies prefers to have the same food at night, which they had eaten during the day. A puppy ate eggs during the day. What is the probability that the puppy will not eat eggs at night as well?

32. This is a paper cup.

Jaya tossed this cup. When the cup lands on the table, it can land in three possible positions, as shown below.



To calculate the probability of falling in each position, Jaya tosses the cup 60 times. She records her observations in the table below.

Position of cup after toss	Frequency
Inverted	20
Upright	5
Rolling side	35

Based on the above information, answer the following questions.

(i) Jaya tosses the cup one more time. What would be the probability of the cup falling in the upright position?

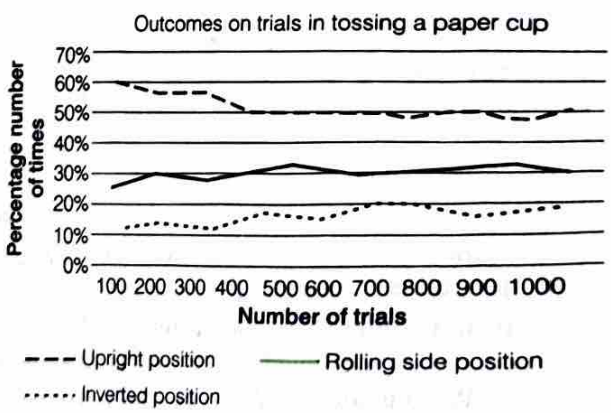
(a) $\frac{1}{3}$

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

(c) $\frac{1}{12}$

(d) $\frac{1}{60}$

(ii) Vani does an experiment to see, if Jaya is correct in declaring the probability of the cup falling in the upright position. She tosses a cup many times and plots a graph of her observations as shown below.



Based on the graph and Vani's observations, what should be the probability of the cup falling in the upright position if Jaya were to toss the cup again?

Part II

Very Short Answer Type Questions

1. What is the probability of non-occurrence of an event that is certain to happen?

2. The probability that it will rain today is 0.07. What is the probability that it will not rain today?

Or If the probability of winning a game is 0.07, then what is the probability of losing it? **CBSE 2020 (Standard)**

3. Shivesh was tossing a fair coin. Shown below are the outcomes of his first 5 tosses.

Tail Tail Tail Tail Tail

Is the probability of Shivesh getting a head in his sixth toss higher than the probability of getting a tail? Give a valid reason. **Competency Based Question**

4. If I toss a coin 3 times and get head each time, then I should expect a tail to have a higher chance in the 4th toss. Is it true?

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

A B C A A B

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

6. A die is thrown once. What is the probability of getting a number less than 3? **CBSE 2020 (Standard)**

7. If a die is thrown, then what is the probability of getting a number less than 3 and greater than 2?

8. A die is thrown once. Find the probability of getting a number which is not a factor of 36.

9. In a throw of a pair of dice, what is the probability of getting a doublet or same numbers?

10. Cards marked with numbers 5 to 75 are placed in a box and mixed thoroughly. One card is drawn from the box. Find the probability that the number on the card is odd. **Competency Based Question**

11. A single letter is selected at random from the word 'PROBABILITY'. Find the probability that it is a vowel.

12. A letter of English alphabet is chosen at random. Determine the probability that the letter is a consonant. **NCERT Exemplar**

13. A letter is chosen at random from the English alphabet. What is the probability that it is a letter of the word 'RAMANUJAN'?

14. A school has five houses *A*, *B*, *C*, *D* and *E*. A class has 23 students, 4 from house *A*, 8 from house *B*, 5 from house *C*, 2 from house *D* and rest from house *E*. A single student is selected at random to be the class monitor. Find the probability that the selected students is not from *A*, *B* and *C*. **Competency Based Question**

15. A number is chosen from 1 to 100. Find the probability that it is a prime number. **NCERT Exemplar**

16. The probability of getting a bad egg in a lot of 400 eggs is 0.045. The number of good eggs in the lot is **CBSE 2024 (Standard)**

(a) 18 (b) 180 (c) 382 (d) 220

17. Find the probability that a non-leap year selected at random will contain 53 Sundays. **CBSE 2016; NCERT Exemplar**

18. The probability of guessing the correct answer to certain question is $p/12$. If the probability of not guessing the correct answer to same question is $3/4$, then find the value of p.

19. A girl calculates that the probability of her winning the first prize in a lottery is 0.08. If 6000 tickets are sold, then how many tickets has she bought? **NCERT Exemplar**

20. A student says that, if you throw a die, it will show up 1 or not 1. Therefore, the probability of getting 1 or not 1 is equal to $\frac{1}{2}$. Is this correct? Give reasons.

21. Find the probability that a number selected at random from the numbers 1, 2, 3, ..., 15 is a multiple of 4.

22. In a family having three children, there may be no girl, one girl, two girls or three girls. So, the probability of each is $\frac{1}{4}$. Is it true? **NCERT Exemplar**

23. In a family of 3 children, find the probability of having atleast one boy.

24. In a cricket match a batsman hits the boundary 8 times out of 40 balls he plays. Find the probability that he did not hit the boundary.

25. A number x is chosen at random from the numbers $-4, -3, -2, -1, 0, 1, 2, 3, 4$. What is the probability that $|x| < 2$? **Competency Based Question**

Short Answer Type Questions

26. Which of the following experiments have equally likely outcomes? Explain.

(i) A coin is tossed. It is head or tail.

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

(iii) A bag contains red, blue and green color lemon flavoured candies. The man picked red or blue color lemon candy.

27. Anu, Priya and Jyoti were fighting to get first chance in a game. Anu says, "Let us toss two coins. If both heads appear, Priya will take first chance, if both tails appear Jyoti will get it and if one head and one tail appears, I will get the chance".

(i) What is the probability of Anu, Priya and Jyoti getting the first chance?

(ii) Is her decision fair? **Competency Based Question**

28. Three different coins are tossed together. Find the probability of getting

(i) exactly two heads.

(ii) atleast two heads.

(iii) atleast two tails.

29. In a game, the entry fee is ₹ 5. The game consists of tossing a coin 3 times. If one or two heads show, then Sweta gets her entry fee back. If she tosses 3 heads, then she receives double the entry fee. Otherwise, she will loss. For tossing a coin three times, find the probability that she

(i) losses the entry fee.

(ii) gets double entry fee.

(iii) just gets her entry fee. **NCERT Exemplar**

30. Two different dice are tossed together. Find the probability **CBSE 2020 (Standard), 18**

(i) of getting a doublet.

(ii) of getting a sum 10 of the numbers on the two dice.

31. Two dice, one red and one black are thrown simultaneously. A student of Class X makes the following table.

Event: Sum on 2 dice	1	6	12	15
Probability	0	$\frac{5}{36}$	$\frac{1}{36}$	0

Ritu observes the above table and remarks that it is correct. Is she right? Explain. **Competency Based Question**

32. Aproov throws two dice once and computes the product of the numbers appearing on the dice. Peehu throws one die and squares the number that appears on it. Who has the better chance of getting the number 36? Why? **NCERT Exemplar**

33. Two different dice are tossed together. Find the probability

(i) that the number on each die is even.

(ii) that the sum of numbers appearing on the two dice is 5.

34. A die has its six faces marked 0, 1, 1, 1, 6, 6. Two such dice are thrown together and the total score is recorded.

(i) How many different scores are possible?

(ii) What is the probability of getting a total of 7? **NCERT Exemplar**

35. Two dice are thrown at the same time and the product of numbers appearing on them is noted. Find the probability that the product is less than 9. **NCERT Exemplar**

36. Two dice are thrown together. Find the probability that the product of the numbers on the top of the dice is

(i) 6

(ii) 12

(iii) 7 **CBSE 2011; NCERT Exemplar**

37. A pair of dice is thrown once. Find the probability of getting

(i) doublet of prime numbers.

(ii) a doublet of odd numbers.

38. Two dice are thrown at the same time. Determine the probability that the difference of the numbers on the two dice is 2. **NCERT Exemplar**

39. A 4-sided fair die is numbered 1-4. Nikhil and Pratik are playing with such a die each. They roll their dice once at the same time. A player wins only if they get a number larger than the other player.

What is the probability of Pratik winning the game? Show your work. **Competency Based Question**

40. Cards marked with numbers 5, 6, 7, ..., 74 are placed in a bag and mixed thoroughly. One card is drawn at random from the bag. Find the probability that the number on the card is a perfect cube.

41. The king, queen and jack of clubs are removed from a deck of 52 playing cards and then well-shuffled. Now, one card is drawn at random from the remaining cards. Find the probability of getting a card of

(i) a heart. (ii) a king. **NCERT Exemplar**

42. There are 80 cards numbered from 1 to 80. One card is drawn at random from them. Find the probability that the number on the selected card is not divisible by 8. **CBSE 2024 (Basic)**

43. A ticket is drawn at random from a bag containing tickets numbered from 1 to 40. Find the probability that the selected ticket has a number,

(i) which is a multiple of 7.

(ii) which is a multiple of 5. **CBSE 2011; NCERT Exemplar**

44. A carton of 24 bulbs contains 6 defective bulbs. One bulb is drawn at random. What is the probability that the bulb is not defective? If the bulb selected is defective and it is not replaced and a second bulb is selected at random from the rest, then what is the probability that the second bulb is defective? **NCERT Exemplar**

45. Box *A* contains 25 slips of which 19 are marked ₹ 1 and other are marked ₹ 5. Box *B* contains 50 slips of which 45 are marked ₹ 1 and others are marked ₹ 13. Slips of both boxes are put into a third box and reshuffled. A slip is drawn at random. What is the probability that it is marked other than ₹ 1? **NCERT Exemplar**

46. A number is selected at random from first 50 natural numbers. Find the probability that it is a multiple of 3 and 4.

47. Rohan has a bag of multiple balls either pink, green or yellow in colour. He randomly picks up one ball. His friend, Farid predicted, "The probability of Rohan picking a pink ball is definitely $\frac{1}{3}$ as there are 3 colours". Is Farid's statement true or false. Give a valid reason or a counter example.

Competency Based Question

48. A bag contains 7 green balls and some red balls. If the probability of drawing a red ball from the bag is thrice that of a green ball, then the number of red balls in the bag are 21 and drawing a red ball is not an equally likely outcomes. Atul at once said that "It is wrong". Do you agree with Atul? Justify.

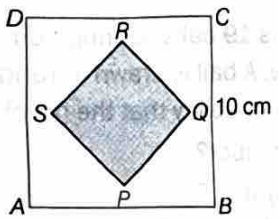
49. A carton consists of 100 shirts of which 88 are good, 8 have minor defect and 4 have major defect. Jimmy, a trader, will only accept the shirts which are good but Sujata, another trader, will only reject the shirts which have major defect. One shirt is drawn at random from the carton. What is the probability that it is acceptable to

(i) Jimmy?

(ii) Sujata?

Competency Based Question

50. A square of side 5 cm is drawn in the interior of another square of side 10 cm and shaded as shown in the following figure.



A point is selected at random from the interior of square *ABCD*. What is the probability that the point will be chosen from the shaded part?

Competency Based Question

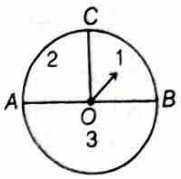
51. A bag contains 18 balls out of which x balls are red.

(i) If one ball is drawn at random from the bag, what is the probability that it is red ball?

(ii) If 2 more red balls are put in the bag, the probability of drawing a red ball will be 9/8 times that of probability of red ball coming in part (i). Find the value of x.

Competency Based Question

52. A game of chance consists of an arrow which comes to rest pointing at one of the regions 1, 2 or 3. O is the centre of the circle, $OC \perp AB$.



Find the probability that

(i) arrow is resting on 3.

(ii) arrow is resting on 1.

(iii) arrow is not resting on 2.

53. Videocon Electronics has launched two new mobile hands sets: Set I and Set II. Set I is cheaper as compared to Set II. But Set II has built-in device to recharge the battery with an auto-cut power supply when it is fully charged. In a lot, there are 250 pieces of Set I and 100 pieces of Set II. If a mobile is picked at random, then

(i) find the probability of getting Set I.

(ii) find the probability of getting Set II.

Competency Based Question

54. A traffic signal displays green light for 3 min to allow passage of traffic on a particular road. If the signal is currently displaying green light, then find the probability that it will turn red within the next half a minute.

55. Anita, Sita, Gita and Rita are four friends having same birthday. What is the probability that (in a non-leap year)

(i) their birthday fall in the month of October?

(ii) their birthdays falls on 10th day of the month?

(iii) their birthday fall in January or February?

Competency Based Question

56. An integer is chosen at random between 1 and 100. Find the probability that it is

(i) divisible by 8. (ii) not divisible by 8. CBSE 2018

57. Two friends were born in the year 2000. What is the probability that they have the same birthday?

58. A box contains 80 discs numbered from 1 to 80. If one disc is drawn at random from the box, find the probability that it bears

(i) a perfect square number.

(ii) a number divisible by 2 and 3.

Competency Based Question

59. A number is selected from the numbers 2, 3, 3, 5, 5, 5, 7, 7, 7, 7, 9, 9, 9, 9, 9 at random. Find the probability that the number selected is

(i) their median.

(ii) their mode.

Long Answer Type Questions

60. A die is numbered in such a way that its faces show the 1, 2, 4, 4, 6, 6. Reema thrown the die two times, total score in two throws noted as the following table given below:

+	Number in first throw					
Number in second throw	1	2	4	4	6	6
1	2	3	5	5	7	7
2	3	4	6	6	8	8
4	5	6	8	8	10	10
4	5	6	8	8	10	10
6	7	8	10	10	12	12
6	7	8	10	10	12	12

and she get probability that the total score is

(i) odd

(ii) 6

(iii) atleast 8,

are respectively, $\frac{5}{18}, \frac{1}{9}$ and $\frac{5}{9}$. Is she right? Verify.

Competency Based Question

61. A child's game has 8 triangles of which 3 are blue and rest are red and 10 squares of which 6 are blue and rest are red. One piece is lost at random. Find the probability that it is a

(i) triangle.

(ii) square.

(iii) square of blue colour.

(iv) triangle of red colour. **NCERT Exemplar**

62. A bag contains 6 red, 4 black and some white balls.

(i) Find the number of white balls in the bag, if the probability of drawing a white ball is 1/3.

(ii) How many red balls should be removed from the bag for the probability of drawing a white ball to be $\frac{1}{2}$?

CBSE Sample Paper 2023 (Basic)

63. A bag contains white, black and red balls only. A ball is drawn at random from the bag. The probability of getting a white ball is $\frac{3}{10}$ and that of a black ball is $\frac{2}{5}$. 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. **Competency Based Question**

64. A box contains cards bearing numbers from 6 to 70. If one card is drawn at random from the box, find the probability that it bears

(i) a one-digit number.

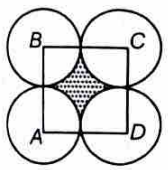
(ii) a number divisible by 5.

(iii) an odd number less than 30.

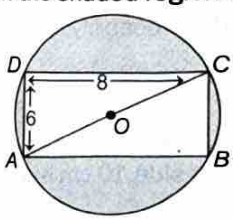
(iv) a composite number between 50 and 70.

Competency Based Question

65. In the given figure, points A, B, C and D are the centres of four circles that each have a radius of length one unit. If a point is selected at random from the interior of square $ABCD$. What is the probability that the point will be chosen from the shaded region?



66. In the given figure, a dart is thrown and lands in the interior of the circle. What is the probability that the dart will land in the shaded region?



67. A box contains 19 balls bearing numbers 1, 2, 3, ..., 19. A ball is drawn at random from the box. What is the probability that the number on the ball is

(i) a prime number?

(ii) divisible by 3 or 5?

(iii) neither divisible by 5 nor by 10?

(iv) an even number? **Competency Based Question**

68. There are 1000 sealed envelopes in a box, 10 of them contain a cash prize of ₹ 100 each, 100 of them contain a cash prize of ₹ 50 each and 250 of them contain a cash prize of ₹ 10 each and rest do not contain any cash prize. If they are well-shuffled and an envelope is picked up out, what is the probability that it contains no cash prize? **NCERT Exemplar**

69. A number x is selected at random from the numbers 1, 2, 3 and 4. Another number y is selected at random from the numbers 1, 4, 9 and 16. Find the probability that product of x and y is less than 16.

HINTS & SOLUTIONS

Part I

1. (a) Let k be the probability that the player wins a medium prize in his first attempt.
$\because$ The outcomes of one event does not affect the outcome of another, the outcome of the third attempt is independent of the outcomes of the first two attempts.
$\therefore$ The probability of winning a medium prize in the third attempt is k.

2. (d) Since, probability lies between 0 and 1.
$\therefore$ The probability of an event cannot be possible is $\frac{17}{16}$.

3. (b) We know that the probability of an event E is a number $P(E)$ such that $0 \le P(E) \le 1$

$$\frac{7}{0.01} = 7 \times 100 = 700, \text{ not possible}$$

4. (a) $P(A) = P$ (guessing correct answer to a certain test question)

$$= \frac{x}{6}$$

$P(\overline{A}) = P$ (not guessing correct answer to this question)

$$= \frac{2}{3}$$

We know that

$$P(A) = 1 - P(\overline{A})$$

$$\Rightarrow \quad \frac{x}{6} = 1 - \frac{2}{3}$$

$$\Rightarrow \quad \frac{x}{6} = \frac{1}{3} \Rightarrow x = \frac{6}{3} = 2$$

$$\therefore \quad x = 2$$

5. (d) $P(E) = 0.65$

$$P(\overline{E}) = 1 - P(E)$$
$$= 1 - 0.65$$
$$= 0.35$$

6. (a) Given, $P(E) + P(\overline{E}) = x$ ...(i)

$\because$ $P(E) + P(\overline{E}) = 1$ ...(ii)

From Eqs. (i) and (ii), we get

$$x = 1$$

$$\therefore \quad x^3 - 3 = (1)^3 - 3 = 1 - 3 = -2$$

7. (c) When two coins are tossed, the possible outcomes are HH, HT, TH, TT.
$\therefore$ Number of possible outcomes = 4
Let E be an event of getting atmost one tail.
Favourable outcomes are HT, TH, HH.
$\therefore$ Number of favourable outcome = 3

$$P(E) = \frac{\text{Number of favourable outcomes}}{\text{Number of possible outcomes}} = \frac{3}{4}$$

8. (c) $S = \{HH, HT, TH, TT\}$
Favourable outcomes = 1 tail and 2 tails = $\{HT, TH, TT\}$

$$\text{Probability} = \frac{\text{Number of favourable outcomes}}{\text{Total number of outcomes}} = \frac{3}{4}$$

9. (d) Let E be the event of getting an even number less than 4.
Outcomes favourable to E: $\{2\}$
Possible outcomes = $\{1,2,3,4,5,6\}$

$$\because P(E) = \frac{\text{Number of outcomes favourable to } E}{\text{Total number of possible outcomes}} = \frac{1}{6}$$

10. (d) Do same as Question 24 (i) of NCERT Folder Exercise 14.1

11. (b) Total number of outcomes = 52
Number of red king cards = 2

$$\therefore \text{ Probability} = \frac{2}{52} = \frac{1}{26}$$

12. (b) Total cards left in the pack = 52 − 6 = 46
Black cards left in the pack = 26 − 4 = 22
[$\because$ total black cards in a complete pack = 26]

$$\therefore P(\text{getting a black card from the remaining pack}) = \frac{22}{46}$$

13. (a) There are 2 black kings in a deck of 52 playing cards.

$$\therefore \text{ Probability of getting a black king} = \frac{2}{52} = \frac{1}{26}$$

14. (b) Let E be the event of getting a face card.
Total number of face cards in a deck = 12 (4 Queen, 4 King, 4 Jack)

$$\therefore P(E) = \frac{\text{Number of outcomes favourable to the event } E}{\text{Number of possible outcomes}}$$
$$= \frac{12}{52} = \frac{3}{13}$$

15. (b) Total number of outcomes = 52
Number of favourable outcomes = 4

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

16. (c) Let E be the event of getting neither blue nor pink ball (i.e. getting yellow ball)

$$\therefore P(E) = \frac{\text{Number of outcomes favourable to the event } E}{\text{Number of possible outcomes}}$$
$$= \frac{7}{5+8+7} = \frac{7}{20}$$

17. (c) Let there be x blue balls in the bag.
$\therefore$ Total number of balls in the beg = $(8 + x)$
Now, P_1 = Probability of drawing a blue ball = $\frac{x}{8+x}$

and P_2 = Probability of drawing a red ball $= \frac{8}{8+x}$

It is given that, $P_1 = 3P_2$

$\Rightarrow \quad \frac{x}{8+x} = 3 \times \frac{8}{(8+x)}$

$\Rightarrow \quad \frac{x}{8+x} = \frac{24}{8+x} \Rightarrow x = 24$

Hence, there are 24 blue balls in the bag.

18. (d) Total number of cards $= 50 - 6 + 1 = 45$

Perfect square numbers (6 to 50) are 9, 16, 25, 36, 49.

$\therefore$ Number of perfect square numbers $= 5$

$\therefore$ The required probability $= \frac{5}{45} = \frac{1}{9}$

19. (c) Prime numbers less than 23 are 2, 3, 5, 7, 11, 13, 17, 19.

$\therefore$ Number of favourable outcomes $= 8$

and total number of possible outcomes $= 90$

$\therefore \quad P = \frac{8}{90} = \frac{4}{45}$

20. (c) When two fair coins are tossed together, the possibility are as follows

$\{HH, HT, TH, TT\}$

$\therefore$ Total number of possible outcomes $= 4$

The possibility of getting 2 heads is 1 i.e. $\{HH\}$

$\therefore$ Number of favourable outcomes $= 1$

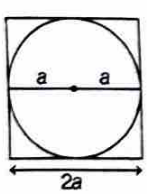
Thus, the probability of getting 2 heads

$$= \frac{\text{Number of favourable outcomes}}{\text{Total number of possible outcomes}}$$

$$= \frac{1}{4}$$

Hence, required probability is $\frac{1}{4}$.

21. (b)



Radius of the circle $= \frac{2a}{2} = a$ units

$\therefore$ Area of the square board $= (2a)^2 = 4a^2$ sq units

$\therefore$ Area of red region = area of circle

$= \pi a^2$ sq units

$\therefore$ Area of green region = Area of the square board $-$ Area of red region

$= (4a^2 - \pi a^2)$ sq units

$\therefore$ Probability (keeping the dot on the green region)

$$= \frac{\text{Area of the green region}}{\text{Area of the square board}}$$

$$= \frac{4a^2 - \pi a^2}{4a^2}$$

$$= \frac{4 - \pi}{4}$$

22. (a) A bastman hits a boundary 9 times out of 45 balls he plays.

$P(A) = P(\text{hits a target}) = \frac{9}{45} = \frac{1}{5}$

Since, $\quad P(A) + P(\bar{A}) = 1$

$\Rightarrow \quad P(\bar{A}) = 1 - P(A)$

$= 1 - \frac{1}{5} = \frac{4}{5}$

$\therefore$ Probability of not hitting the boundary is $\frac{4}{5}$.

$\therefore$ Both Assertion (A) and reason (R) are correct.

23. (b) $S = \{HH, HT, TH, TT\}$

Favourable outcomes $= \{HH\}$

Total number of outcomes $= 4$

$\therefore$ Probability $= \frac{\text{Number of favourable outcomes}}{\text{Total number of outcomes}} = \frac{1}{4}$

Reason is true but not correct explanation of Assertion.

24. (c) Total possible outcomes are 20 as there as 20 numbers from the numbers 1 to 20 and favourable outcome is 1.

$\therefore$ Required probability $= \frac{1}{20}$

25. (b) Number of prizes $= 5$

Number of blanks in lottery $= 20$

$\therefore$ Number of tickets in lottery $= 5 + 20 = 25$

$\therefore$ The probability of getting a prize $= \frac{5}{25} = \frac{1}{5}$

and the probability of not getting a prize $= 1 - \frac{1}{5} = \frac{4}{5}$

26. (i) Possible outcomes

$= \{RR, RB, RG, GR, GB, GG, YR, YB, YG\}$

(ii) Total outcomes $= 9$

Favourable outcomes $= \{RB\}$

$\therefore$ Probability $= \frac{1}{9}$

(iii) Since, probability of wining the game $= \frac{1}{9}$

and probability of lossing the game $= \frac{8}{9}$

Given, number of participants $= 99$

$\therefore$ Number of winner students $= 99 \times \frac{1}{9} = 11$

and number of students that losses the game

$= \frac{99 \times 8}{9} = 88$

$\therefore$ Fund collected by school $= 88 \times 5 - 11 \times 10$

$= 440 - 110 = ₹\ 330$

Or

If the same amount of ₹ 5 has been decided for winning or loosing the game.

$\therefore$ Fund collected by school $= 88 \times 5 - 11 \times 5$

$= 77 \times 5 = ₹\ 385$

27. (i) Number of possible outcomes = 15

Number of favourable outcomes = 1

$\therefore$ P (drawn balls bears number 8) $= \frac{1}{15}$

(ii) Favourable outcomes are when balls numbered as 2, 4, 6 and 8.

$\therefore$ P (drawn ball is a solid coloured and bears an even number) $= \frac{4}{15}$

(iii) Favourable outcomes are when balls numbered as 2, 4, 6, 8, 10, 12, 14.

$\therefore$ P (drawn ball bears even number) $= \frac{7}{15}$

Or

Favourable outcomes are when balls numbered as 3, 6, 9, 12 and 15.

$\therefore$ P (drawn ball bears a number which is multiple of 3) $= \frac{5}{15} = \frac{1}{3}$

28. (i) Total angle $= 360°$

Angle of white $= 120°$

$\therefore$ Probability $= \frac{120°}{360°} = \frac{1}{3}$

(ii) Total angle $= 360°$

Angle of blue $= 60°$

Angle of green $= 60°$

$\therefore$ Probability $= \frac{60° + 60°}{360°}$

$= \frac{120°}{360°} = \frac{1}{3}$

(iii) Let n students participated in the survey.

$\Rightarrow \frac{90°}{360°} \times n = 15 \Rightarrow n = 15 \times 4 = 60$

$\therefore$ 60 students participated in the survey.

Or

Total angle $= 360°$

Angle of red $= 30°$

Angle of blue $= 60°$

$\therefore$ Probability $= \frac{60° + 30°}{360°} = \frac{90°}{360°} = \frac{1}{4}$

29. (i) Consider, radius of each circle is r, r_1, r_2 and r_3 respectively from innermost circle and to find radius for each ring and thickness of each ring into radius of innermost circle.

Now, radius of innermost circle = 7 cm

$\therefore$ Area of innermost circle $= \pi(r^2) = \pi(7)^2$

$= 49\pi$

and total area of the dart $= \pi(r_3)^2$

$= \pi(28)^2$

$\therefore$ Probability of Nishant getting a score of 100

$= \frac{\text{Area of required region}}{\text{Total area of dart}}$

$= \frac{49\pi}{(28)^2\pi}$

$= \frac{7 \times 7}{28 \times 28}$

$= \frac{1}{16}$

(ii) (c) Area of the outermost circular region

= Total area of the dart

− Area of the circular region upto ring 3

$= \pi(r_3)^2 - \pi(r_2)^2$

$= \pi(28)^2 - \pi(21)^2$

$= \pi[784 - 441]$

$= 343\pi$

Total area of dart $= (28)^2\pi$

$\therefore$ Probability of dart hitting the outermost circular region on the board

$= \frac{\text{Area of required region}}{\text{Total area of the region}}$

$= \frac{343\pi}{784\pi} = \frac{49 \times 7}{28 \times 28} = \frac{7}{16}$

(iii) (d) Area of required region i.e. ring of 75 points

$= \pi(14)^2 - \pi(7)^2$

Probability of getting 75 points

$= \frac{\text{Area of required region}}{\text{Total area of the region}}$

$= \frac{\pi(14)^2 - \pi(7)^2}{\pi(28)^2} = \frac{(14+7)(14-7)}{28 \times 28}$

$= \frac{21 \times 7}{28 \times 28} = \frac{3}{16}$

(iv) (d) Kapil gets 25 points each in the first and second throw.

Total number of throw kapil had = 4

Now, two throw are remaining.

Therefore, only two places are left to calculate the probability,

$$\underset{\text{1st throw}}{\frac{25}{}}, \quad \underset{\text{2nd throw}}{\frac{25}{}}, \quad \underset{\text{3rd throw}}{\frac{}{}}, \quad \underset{\text{4th throw}}{\frac{}{}}$$

Now, we make probabilities for 3rd and 4th throw, which are

(25, 25), (25, 50), (25, 75), (25, 100), (50, 25), (75, 25), (100, 25), (50, 75), (75, 50), (50, 100), (100, 50), (75, 100), (100, 75), (50, 50), (75, 75), (100, 100).

Therefore, he can score total points by 3rd and 4th throw in there many ways which are 16.

30. (i) Length of rectangular board = 2 m = 200 cm

Breadth of board = 1 m = 100 cm

$\therefore$ Area of board = Length × Breadth

$$= 200 \times 100 = 20000 \text{ cm}^2$$

and area of triangle drawn on board

$$= \frac{1}{2} \times \text{Base} \times \text{Height}$$

$$= \frac{1}{2} \times 50 \times 50 = \frac{2500}{2} = 1250 \text{ cm}^2$$

Now, probability of chalk expected to fall in the triangular region $= \dfrac{\text{Area of required region}}{\text{Total area of the region}}$

$$= \frac{1250}{20000} \text{ cm}^2 = \frac{1}{16}$$

(ii) (a) Probability of chalk not hitting the board

$$= 1 - P(E) = 0$$

31. (i) Total number of puppies $= 10 + 20 + 7 + 13$

$$= 50$$

Number of puppies prefer pet food = 13

$\therefore$ Probability that chosen puppies prefer pet food

$$= \frac{\text{Favourable outcomes}}{\text{Total number of outcomes}}$$

$$= \frac{13}{50}$$

(ii) Sixty percent of time, puppies prefer same food at night.

Therefore, $P(E) = 0.6$

Now, probability that puppy will not eat egg at night $= 1 - P(E)$

$$= 1 - 0.6$$

$$= 0.4$$

32. (i) (c) Frequency of cup falling in upright position = 5

Total outcomes = 20 + 5 + 35 = 60

Now, probability of cup falling in upright position

$$= \frac{\text{Favourable outcomes}}{\text{Total outcomes}}$$

$$= \frac{5}{60}$$

$$= \frac{1}{12}$$

(ii) From the graph, we see the probability of the cup falling in the upright position is 0.2, if Jaya were to toss the cup again.

Part II

1. 0, an event which is certain to happen has a probability of non-occurrence is zero.

2. Given, $P(E) = 0.07$

$\therefore$ $P(\text{not } E) = P(\bar{E}) = 1 - P(E)$ $\quad [\because P(E) + P(\bar{E}) = 1]$

$= 1 - 0.07 = 0.93$

3. No. e.g. When tossing a fair coin, the probability of getting a head is equal to the probability of getting a tail.

4. False

5. Do same as Q. 19 from NCERT Folder

Ans. (i) $\frac{1}{2}$ (ii) $\frac{1}{3}$

6. Do same as Example 3 (ii) **Ans.** $\frac{1}{3}$

7. **Hint** There is no such number on a die which is less than 3 and greater than 2.

$\therefore$ Probability will be zero.

8. **Hint** The factors of 36 are 1, 2, 3, 4, 6, 9, 12, 18, 36.

Here, we see that 5 is not a factor of 36.

$\therefore$ Number of outcomes favourable to $E = 1$ **Ans.** $\frac{1}{6}$

9. **Hint** Total number of outcomes $= 6 \times 6 = 36$

If E is the event of getting a doublet i.e. event of getting (1,1), (2, 2), (3, 3) (4,4) (5, 5) (6, 6).

$\therefore$ Number of outcomes favourable to $E = 6$

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

10. **Hint** Given, cards marked with the numbers 5 to 75.

$\therefore$ Total number of cards = 71

Let E be the event of getting an odd number from 5 to 75

i.e. event of getting = 5, 7, 9, 11, ..., 75

So, the number of outcomes favourable to $E = 36$

$\therefore$ P (drawn card is of odd number) $= \frac{36}{71}$

11. **Hint** Total number of outcomes = 11

There are 4 vowels namely O, A, I, I.

So, number of favourable outcomes = 4

Ans. $\frac{4}{11}$

12. Hint We know that in English alphabet, there are 26 letters (5 vowels + 21 consonants).
So, total number of outcomes = 26
Let E be the event of choosing a consonant.
$\therefore$ Number of outcomes favourable to $E = 21$
Hence, required probability $= P(E) = \frac{21}{26}$

13. Hint Number of all possible outcomes = 26
Letters in the word 'RAMANUJAN' are R, A, M, N, U, J.
$\therefore$ Number of favourable outcomes = 6
Hence, required probability $= \frac{6}{26} = \frac{3}{13}$

14. Hint Number of all possible outcomes = 23
Number of students in houses A, B and $C = 4 + 8 + 5 = 17$
$\therefore$ Remaining students $= 23 - 17 = 6$
Thus, number of favourable outcomes = 6
So, probability that the selected student is not from A, B and $C = \frac{6}{23}$

15. Hint Total number of outcomes = 100
Let E be the event of getting a prime number
i.e. event of getting 2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89 and 97.
$\therefore$ Number of outcomes favourable to $E = 25$
Hence, P (getting a prime number) $= \frac{25}{100} = \frac{1}{4}$

16. Hint Given, total number of eggs = 400
The probability of getting a bad egg = 0.045
Let the number of bad eggs = x
We know that probability of getting a bad egg

$$= \frac{\text{Number of bad eggs}}{\text{Total number of eggs}}$$

$$\Rightarrow \quad 0.045 = \frac{x}{400}$$

$$\Rightarrow \quad \frac{45}{1000} \times 400 = x$$

$$\Rightarrow \quad x = 18$$

Number of bad eggs = 18
Number of good eggs = Total number of eggs − Number of bad eggs
$= 400 - 18 = 382$
Therefore, the number of good eggs in the lot is 382.

17. Hint In a non-leap year, total number of days is 365.
Out of them, there are 52 weeks and 1 day extra.
Thus, a non-leap year always has 52 Sundays. The remaining 1 day can be Sunday, Monday, Tuesday, Wednesday, Thursday, Friday or Saturday.
Out of these 7 cases, we have Sunday in one case.
$\therefore$ Total number of outcomes = 7
Number of favourable outcomes = 1
Hence, required probability $= \frac{1}{7}$

18. Hint Let E be the event of guessing the correct answer to a certain question.
$\therefore$ Probability (guessing the correct answer),

$$P(E) = \frac{p}{12} \qquad \text{[given]}$$

Now, probability (not guessing the correct answer),

$$P(\bar{E}) = \frac{3}{4} \qquad \text{[given]}$$

We know that $1 - P(E) = P(\bar{E})$

$$\Rightarrow \quad 1 - \frac{p}{12} = \frac{3}{4} \quad \textbf{Ans. } p = 3$$

19. Hint Given, total number of sold tickets = 6000
Let she bought x tickets.
Then, probability of her winning the first prize

$$\frac{x}{6000} = 0.08 \qquad \text{[given]}$$

$$\Rightarrow \quad x = 0.08 \times 6000 \Rightarrow x = 480$$

20. Hint No, because the outcomes '1' and 'not 1' are not equally likely.

21. Hint Total number of outcomes = 15
If E is the event of getting a multiple of 4
i.e. event of getting 4, 8, 12
$\therefore$ Number of outcomes favourable to $E = 3$ **Ans.** $\frac{1}{5}$

22. False

23. Hint Let B and G denote boy and girl respectively. So, possible outcomes are $BBB, BBG, BGG, GGG, BGB, GBB, GBG, GGB$.
$\therefore$ Total possible outcomes = 8
If E is the event of having atleast one boy
i.e. $BBB, BBG, BGG, BGB, GBB, GBG, GGB$.
$\therefore$ Number of outcomes favourable to $E = 7$.
Ans. $\frac{7}{8}$

24. Hint If E is the event of hitting the boundary, then

$$P(E) = \frac{8}{40} = \frac{1}{5} \Rightarrow P(\bar{E}) = 1 - P(E)$$

where, $\bar{E}$ denotes the event of not hitting a boundary.
Ans. $\frac{4}{5}$

25. Hint Number of all possible outcomes = 9
Numbers favourable to $|x| < 2$ are $-1, 0$ and 1.
$\therefore$ Number of favourable outcomes = 3
So, required probability $= \frac{3}{9} = \frac{1}{3}$

26. (i) A coin is tossed, then outcome can be head or tail, so both the outcomes are equally likely.

(ii) The outcomes in this situation are not equally likely because the outcomes depends on many factors such as quality of gun, training of player etc.

(iii) Man can picked either red, blue or green colour lemon candies. Thus, the possibility of red or blue colour lemon candies are not equally likely.

27. The possible outcomes of the experiment of tossing two coins are *HH*, *HT*, *TH* and *TT*.

(i) Outcomes favourable to Anu are *HT* and *TH*.

P(Anu getting first chance) $= \frac{2}{4} = \frac{1}{2}$

Outcome favourable to Priya is *HH*.

$\therefore$ P(Priya getting first chance) $= \frac{1}{4}$

Outcome favourable to Jyoti is *TT*.

$\therefore$ P(Jyoti getting first chance) $= \frac{1}{4}$

(ii) No, the number of cases favourable to each one of them are not equal.

28. **Hint** When three coins are tossed together, all possible outcomes are *HHH*, *HHT*, *HTH*, *HTT*, *THH*, *THT*, *TTH* and *TTT*.

Total number of possible outcomes = 8

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

Then, favourable outcomes are *HHT*, *HTH* and *THH*.

Number of outcomes favourable to $E_1 = 3$

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

(ii) Let E_2 be the event of getting atleast two heads

i.e. event of getting *HHT*, *HTH*, *THH* or *HHH*.

$\therefore$ Number of outcomes favourable to $E_2 = 4$

Hence, required probability $= P(E_2) = \frac{4}{8} = \frac{1}{2}$

(iii) **Hint** Do same as part (ii). **Ans.** $\frac{1}{2}$

29. **Hint** Possible outcomes on tossing a coin 3 times, are *HHH*, *HHT*, *HTH*, *THH*, *HTT*, *THT*, *TTH*, *TTT*

$\therefore$ Total number of outcomes = 8

(i) Let E_1 be the event that Sweta losses the entry fee

i.e. she tosses tail three times i.e. *TTT*.

$\therefore$ Number of outcomes favourable to $E_1 = 1$

Hence, required probability $= P(E_1) = \frac{1}{8}$

(ii) Let E_2 be the event that Sweta gets double entry fee

i.e. she tosses heads three times

i.e. *HHH*

$\therefore$ Number of outcomes favourable to $E_2 = 1$

Hence, required probability $= P(E_2) = \frac{1}{8}$

(iii) Let E_3 be the event that Sweta gets her entry fee back

i.e. Sweta gets heads one or two times

i.e. event of getting

HTT, *THT*, *TTH*, *HHT*, *HTH* or *THH*

$\therefore$ Number of outcomes favourable to $E_3 = 6$

Hence, required probability $= P(E_3) = \frac{6}{8} = \frac{3}{4}$

30. **Hint** The total number of outcomes of tossing two dice $= 6 \times 6 = 36$

(i) Number of favourable outcome

= Number of getting doublet in two dice

= 6 [$\because$ (1, 1), (2, 2), (3, 3), (4, 4), (5, 5), (6, 6)]

$\therefore$ P (getting a doublet)

$= \frac{\text{Number of favourable outcomes}}{\text{Total number of outcomes}} = \frac{6}{36} = \frac{1}{6}$

(ii) Number of favourable outcomes

= Number of pair of dice, having sum 10 = 3

[$\because$ (4, 6), (6, 4), (5, 5)]

$\therefore$ P (getting a sum 10)

$= \frac{\text{Number of favourable outcomes}}{\text{Total number of outcomes}} = \frac{3}{36} = \frac{1}{12}$

31. Yes; since, sum of the two dice as 1 and 15 are impossible events.

32. **Hint** Total number of outcomes for Aproov = 36

Number of outcomes for getting product 36 = 1

[$\because$ only (6, 6) gives product 36]

$\therefore$ Probability for Aproov $= \frac{1}{36}$

Total number of outcomes for Peehu = 6

Number of outcomes for getting 36, which is square of number 6 = 1 [$\because$ only square of 6 gives 36]

So, probability for Peehu $= \frac{1}{6} = \frac{6}{36}$

$\because$ Probability for Aproov < Probability for Peehu

$\therefore$ Peehu has better chance of getting the number 36.

33. **Hint** (i) Favourable outcomes are (2,2) (2,4) (2,6) (4,2) (4,4), (4,6) (6,2), (6,4) and (6,6). **Ans.** $\frac{1}{4}$

(ii) Favourable outcomes are (1,4) (4,1) (2, 3) (3, 2). **Ans.** $\frac{1}{9}$

34. **Hint** Two such dice are thrown together, therefore number of all possible outcomes = 36

(i) The different scores which are possible = 6 scores, namely 0, 1, 2, 6, 7 and 12.

(ii) Let E be the event of getting a sum 7

i.e. {(1, 6), (1, 6), (1, 6), (1, 6), (1, 6), (1, 6), (6, 1), (6, 1), (6, 1), (6, 1), (6, 1), (6, 1)}

$\therefore$ Number of outcomes favourable to $E = 12$

Hence, $P(E) = \frac{12}{36} = \frac{1}{3}$

35. Hint When two dice are thrown simultaneously, then number of possible outcomes = 36

$\because$ Product of numbers is less than 9

i.e. 1, 2, 3, 4, 5, 6, 7, 8 therefore favourable outcomes are (1, 1), (1, 2), (1, 3), (1, 4), (1, 5), (1, 6), (2, 1), (2, 2), (2, 3), (2, 4), (3, 1), (3, 2), (4, 1), (4, 2), (5, 1) and (6, 1) i.e. 16 outcomes.

Hence, P (product < 9) $= \frac{16}{36} = \frac{4}{9}$

36. Hint Number of all possible outcomes = 36

(i) Favourable outcomes are (1, 6), (2, 3), (3, 2) and (6, 1). **Ans.** $\frac{1}{9}$

(ii) Favourable outcomes are (2, 6), (3, 4), (4, 3) (6, 2). **Ans.** $\frac{1}{9}$

(iii) Product of the numbers on the top of the dice cannot be 7.

So, its probability is zero.

37. Hint Total number of outcomes $= 6 \times 6 = 36$

(i) Doublets of prime numbers are (2, 2), (3, 3) and (5, 5).

So, number of favourable outcomes = 3.

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

(ii) Doublets of odd numbers are (1, 1), (3, 3) and (5, 5).

So, number of favourable outcomes = 3.

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

38. Hint Favourable outcomes are (1, 3) (2,4) (3,5) (4,6) (3,1) (4, 2) (5, 3) (6, 4). **Ans.** $\frac{2}{9}$

39. The total number of outcomes are 16 i.e. {(1, 1), (1, 2), (1, 3), (1, 4), (2, 1), (2, 2), (2, 3), (2, 4), (3, 1), (3, 2), (3, 3), (3, 4), (4, 1), (4, 2), (4, 3), (4, 4)} and the probable outcomes to win the game as 6.

The probability of Pratik winning the game $\frac{6}{16}$ or $\frac{3}{8}$.

40. Hint If E is the event of getting a perfect cube

i.e. event of getting $2^3, 3^3, 4^3$.

$\therefore$ Number of outcomes favourable to $E = 3$ **Ans.** $\frac{3}{70}$

41. Hint Do same as Example 5. **Ans.** (i) 13/49 (ii) 3/49

42. Total number of possible outcomes = 80

Numbers divisible by 8 are

8, 16, 24, 32, 40, 48, 56, 64, 72, 80.

There are total 10 numbers which are divisible by 8.

Number of numbers (not divisible by 8)

$= 80 - 10 = 70$

Number of favourable outcomes = 70

Required probability is

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

$$= \frac{70}{80} = \frac{7}{8}$$

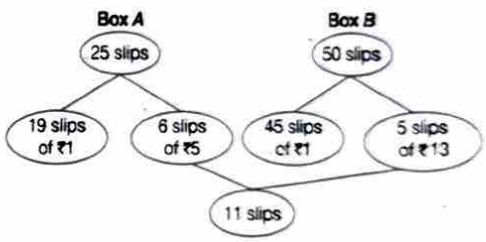
Therefore, the probability that the number on the selected card is not divisible by 8 is $\frac{7}{8}$.

43. Hint Do same as Example 8 (iv) **Ans.** (i) $\frac{1}{8}$ (ii) $\frac{1}{5}$

44. Hint Solve as Question 17 of NCERT Folder 14.1.

Ans. $\frac{3}{4}$ and $\frac{5}{23}$

45. Hint Total number of slips in third box = 25 + 50 = 75



The number of outcomes favourable to event = 11

$\therefore$ Required probability

$$= \frac{\text{Number of favourable outcomes}}{\text{Total number of outcomes}} = \frac{11}{75}$$

46. Hint Number of all possible outcomes = 50

Number of numbers which are multiple of 3 and 4

$= 4$ [$\because$ multiples of 3 and 4 are 12, 24, 36 and 48]

Probability that the selected number is multiple of 3 and $4 = \frac{4}{50} = \frac{2}{25}$

47. Hint Farid's statement is false. e.g. If a bag has 1 pink ball, 2 green balls and 2 yellow balls, the probability of randomly picking a pink ball is $\frac{1}{5}$.

48. Hint The probability of an event to be occured is the division of the number of favourable outcomes by the total number of outcomes.

Therefore, it is an equally likely outcome.

Therefore, Atul is wrong.

49. **Hint** Do same as Example 10. **Ans.** (i) 0.88 (ii) 0.96

50. **Hint** Area of the square $ABCD = (BC)^2$

$= 10^2 = 100\,cm^2$

Now, area of the square $PQRS = (side)^2 = (5)^2$

[$\because$ side = 5 cm, given]

$= 25cm^2$

$\therefore$ P (the point will be chosen from the shaded part)

$$= \frac{\text{Area of the square } PQRS}{\text{Area of the square } ABCD} = \frac{25}{100} = 0.25$$

51. **Hint** (i) Total number of balls in the bag = 18

Total number of red balls in the bag = x

$\therefore$ Probability (red ball) = $\frac{x}{18}$

(ii) Now, 2 red balls are added to the bag.

$\therefore$ Total balls in the bag = 18 + 2 = 20

Total number of red balls in the bag = $x + 2$

$\therefore$ Probability of drawing red ball = $\frac{x+2}{20}$

$$\frac{x+2}{20} = \frac{9}{8}\left(\frac{x}{18}\right)$$

Ans. 8

52. **Hint** Total angle made by the circle at O is 360°.

Angle subtended by region 1 at $O = 90°$

Angle subtended by region 2 at $O = 90°$

Angle subtended by region 3 at $O = 180°$

(i) P (arrow is resting on 3) = $\frac{180°}{360°} = \frac{1}{2}$

(ii) P (arrow resting on 1) = $\frac{90°}{360°} = \frac{1}{4}$

(iii) P (arrow is resting on 2) = $\frac{90°}{360°} = \frac{1}{4}$

$\therefore$ P (arrow is not resting on 2)

$= 1 - P$ (arrow is resting on 2)

$= 1 - \frac{1}{4} = \frac{3}{4}$

53. Given, total number of handsets = 350

(i) $P(A) = \frac{250}{350} = \frac{5}{7}$ (ii) $P(A) = \frac{100}{350} = \frac{2}{7}$

54. **Hint** The probability that it will turn red with in the next half a minute = $\frac{\frac{1}{2}}{3} = \frac{1}{6}$

55. **Hint** Do same as Example 11.

Ans. (i) $\frac{31}{365}$ (ii) $\frac{12}{365}$ (iii) $\frac{59}{365}$

56. **Hint** The total number of outcomes of choosing an integer from 1 to 100 = 100

(i) Number of favourable outcomes

= Number of integers divisible by 8 = 12

[$\because$ numbers divisible by 8 are 8, 16, 24, 32, 40, 48, 56, 64, 72, 80, 88, 96]

$\therefore$ P(getting an integer divisible by 8)

$$= \frac{\text{Number of favourable outcomes}}{\text{Total number of outcomes}}$$

$$= \frac{12}{100} = \frac{3}{25}$$

(ii) We know that

P (getting an integer divisible by 8)

$+ P$(getting an integer not divisible by 8) = 1

$\Rightarrow$ P (getting an integer not divisible by 8)

$$= 1 - \left(\frac{3}{25}\right) = \frac{25-3}{25} = \frac{22}{25}$$

57. **Hint** Do same as Example 11 (i) **Ans.** $\frac{1}{366}$

58. **Hint** (i) Favourable outcomes are $1^2, 2^2, 3^2, 4^2, 5^2, 6^2, 7^2, 8^2$ i.e. there are 8 favourable outcomes. **Ans.** $\frac{1}{10}$

(ii) Do same as Example 8 (iii). **Ans.** $\frac{13}{80}$

59. **Hint** (i) Median of the numbers is 7.

So, P(Median) = $\frac{4}{15}$

[$\because$ there are four 7's and total numbers are 15]

(ii) Mode = 9

$\therefore$ P(Mode) = $\frac{5}{15} = \frac{1}{3}$ [$\because$ there are five 9's]

60. Total number of possible outcomes = $6 \times 6 = 36$

(i) Number of possible outcomes when the sum is odd = 10

$\therefore$ Required probability = $\frac{10}{36} = \frac{5}{18}$

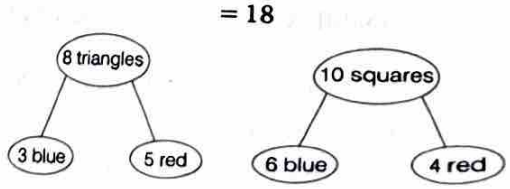
(ii) Number of possible outcomes when the sum is 6 = 4

$\therefore$ Required probability = $\frac{4}{36} = \frac{1}{9}$

(iii) Number of possible outcomes when the sum atleast 8 (greater than 7) = 20

$\therefore$ Probability of getting the sum at least 8 = $\frac{20}{36} = \frac{5}{9}$

61. **Hint** Total number of figures = 8 triangles + 10 squares = 18



(i) P (lost piece is a triangle) $= \frac{8}{18} = \frac{4}{9}$

(ii) P (lost piece is a square) $= \frac{10}{18} = \frac{5}{9}$

(iii) P (lost piece is square of blue colour) $= \frac{6}{18} = \frac{1}{3}$

(iv) P (lost piece is triangle of red colour) $= \frac{5}{18}$

62. (i) Let number of white balls be n.

Total number of balls $= 6+4+n = 10+n$

Let E be the event of drawing a white ball.

Given, $P(E) = \frac{1}{3}$

$$\Rightarrow \frac{\text{Number of outcomes favourable to } E}{\text{Total number of outcomes}} = \frac{1}{3}$$

$$\Rightarrow \frac{n}{10+n} = \frac{1}{3} \Rightarrow n = 5$$

(ii) Now, total number of balls $= 10+n = 10+5 = 15$

Let x red balls are removed from the bag.

$\therefore$ Total number of balls in the bag $= 15-x$

Now, $P(E) = \frac{1}{2}$

$$\Rightarrow \frac{5}{15-x} = \frac{1}{2}$$

$$\Rightarrow x = 5$$

63. **Hint** Clearly, probability of getting a red ball

$$= 1 - [P(\text{white ball}) + P(\text{black ball})]$$

$$= 1 - \frac{3}{10} - \frac{2}{5} = \frac{10-3-4}{10} = \frac{3}{10}$$

Now, let the number of balls in the bag be x.

Since, it is given that the number of black balls in the bag is 20.

$\therefore$ Probability of getting a black ball $= \frac{20}{x}$

$$\Rightarrow \frac{2}{5} = \frac{20}{x}$$

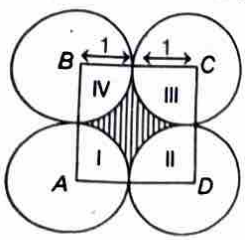
$$\Rightarrow x = 50$$

64. **Hint** Do same as Example 8.

Ans. (i) $\frac{4}{65}$ (ii) $\frac{1}{5}$ (iii) $\frac{12}{65}$ (iv) $\frac{3}{13}$

65. **Hint** Since, radius of each of the given circles is 1 unit.

$\therefore$ Side of square $ABCD = 1+1 = 2$ units



Now, area of square $= 2^2 = 4$ sq units

Clearly, area of shaded region

= Area of square - Area of quadrant (I)

- Area of quadrant (II) - Area of quadrant (III)

- Area of quadrant (IV)

$= 4 - 4 \times$ Area of a quadrant

[$\because$ each quadrant is of equal area]

$$= 4 - 4 \times \frac{\pi(1)^2}{4}$$

$$\left[\because \text{ area of a quadrant of circle with radius } r = \frac{\pi r^2}{4}\right]$$

$$= 4 - \pi$$

Hence, P (that the point chosen from the shaded region)

$$= \frac{\text{Area of shaded region}}{\text{Area of square}} = \frac{4-\pi}{4}$$

66. **Hint** Since, ΔADC is right angled at D.

$$AC^2 = AD^2 + DC^2$$

$$= 6^2 + 8^2 \quad \text{[by Pythagoras theorem]}$$

$$\Rightarrow AC = 10 \quad \text{[taking positive sqaure root]}$$

Now, radius of circle $= OC = \frac{1}{2}AC = 5$

P (dart will land in the shaded region)

$$= \frac{\text{Area of shaded region}}{\text{Area of the circle}}$$

$$= \frac{\text{Area of the circle} - \text{Area of the rectangle}}{\text{Area of the circle}}$$

Ans. $\frac{25\pi - 48}{25\pi}$

67. **Hint** Do same as Example 8.

Ans. (i) $\frac{8}{19}$ (ii) $\frac{8}{19}$ (iii) $\frac{16}{19}$ (iv) $\frac{9}{19}$

68. **Hint** Total number of envelopes in the box $= 1000$

Number of envelopes containing cash prize

$$= 10 + 100 + 250 = 360$$

Number of envelopes containing no cash prize

$$= 1000 - 360 = 640$$

$\therefore$ Required probability $= \frac{640}{1000} = 0.64$

69. **Hint** Two number x and y can be chosen in 16 ways

i.e. (1,1) (1,4) (1,9) (1,16)(2,1)(2,4)(2,9),(2,16)

(3,1) (3,4) (3,9), (3,16) (4,1) (4,4) (4,9), (4,16)

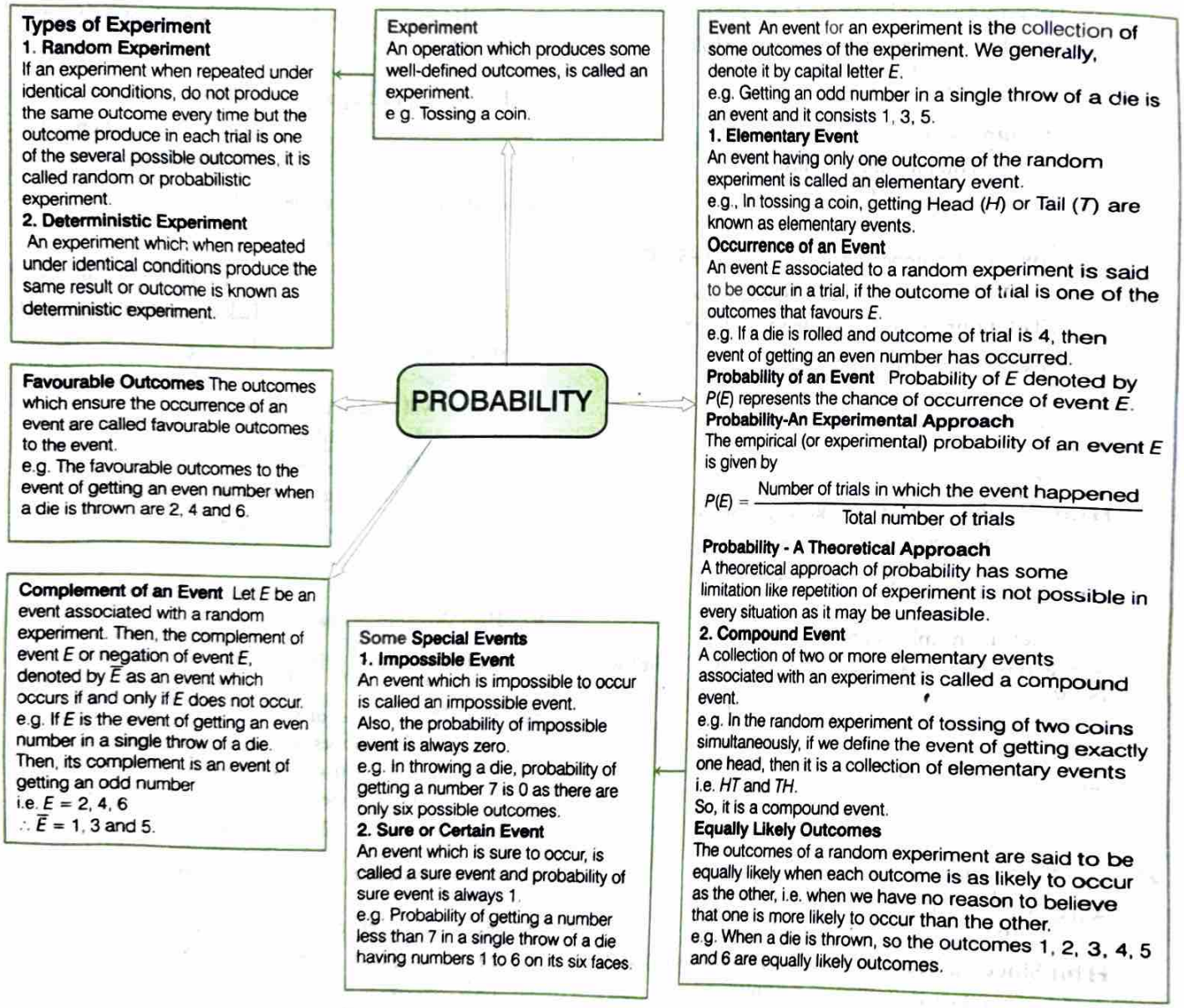
$\therefore$ Total number of possible outcomes $= 16$

Given, product of numbers is less than 16, so favourable outcomes are

(1,1) (1,4) (1,9) (2,1) (2,4), (3,1) (3,4), (4,1)

i.e. 8 outcomes **Ans.** $\frac{1}{2}$

Mind Map


PROBABILITY
Types of Experiment
1. Random Experiment
If an experiment when repeated under identical conditions, do not produce the same outcome every time but the outcome produce in each trial is one of the several possible outcomes, it is called random or probabilistic experiment.
2. Deterministic Experiment
An experiment which when repeated under identical conditions produce the same result or outcome is known as deterministic experiment.
Experiment
An operation which produces some well-defined outcomes, is called an experiment.
e g. Tossing a coin.
Event An event for an experiment is the collection of some outcomes of the experiment. We generally, denote it by capital letter E.
e.g. Getting an odd number in a single throw of a die is an event and it consists 1, 3, 5.
1. Elementary Event
An event having only one outcome of the random experiment is called an elementary event.
e.g., In tossing a coin, getting Head (H) or Tail (T) are known as elementary events.
Occurrence of an Event
An event E associated to a random experiment is said to be occur in a trial, if the outcome of trial is one of the outcomes that favours E.
e.g. If a die is rolled and outcome of trial is 4, then event of getting an even number has occurred.
Probability of an Event Probability of E denoted by P(E) represents the chance of occurrence of event E.
Probability-An Experimental Approach
The empirical (or experimental) probability of an event E is given by
P(E) = Number of trials in which the event happened / Total number of trials
Probability - A Theoretical Approach
A theoretical approach of probability has some limitation like repetition of experiment is not possible in every situation as it may be unfeasible.
2. Compound Event
A collection of two or more elementary events associated with an experiment is called a compound event.
e.g. In the random experiment of tossing of two coins simultaneously, if we define the event of getting exactly one head, then it is a collection of elementary events i.e. HT and TH.
So, it is a compound event.
Equally Likely Outcomes
The outcomes of a random experiment are said to be equally likely when each outcome is as likely to occur as the other, i.e. when we have no reason to believe that one is more likely to occur than the other.
e.g. When a die is thrown, so the outcomes 1, 2, 3, 4, 5 and 6 are equally likely outcomes.
Favourable Outcomes The outcomes which ensure the occurrence of an event are called favourable outcomes to the event.
e.g. The favourable outcomes to the event of getting an even number when a die is thrown are 2, 4 and 6.
Complement of an Event Let E be an event associated with a random experiment. Then, the complement of event E or negation of event E, denoted by $\bar{E}$ as an event which occurs if and only if E does not occur.
e.g. If E is the event of getting an even number in a single throw of a die. Then, its complement is an event of getting an odd number
i.e. E = 2, 4, 6
∴ $\bar{E}$ = 1, 3 and 5.
Some Special Events
1. Impossible Event
An event which is impossible to occur is called an impossible event.
Also, the probability of impossible event is always zero.
e.g. In throwing a die, probability of getting a number 7 is 0 as there are only six possible outcomes.
2. Sure or Certain Event
An event which is sure to occur, is called a sure event and probability of sure event is always 1.
e.g. Probability of getting a number less than 7 in a single throw of a die having numbers 1 to 6 on its six faces.

Let's Investigate

ACTIVITY 1

To identify arithmetic progressions in some given lists of numbers (patterns).

Prior Knowledge

Concept of Arithmetic Progression (AP).

Materials Required

1. Cardboard
2. White paper
3. Pen/Pencil
4. Scissors
5. Squared paper
6. Adhesive

Theory

1. An arithmetic progression is a list of numbers, in which each term is obtained by adding a fixed number to the preceding term except the first term. This fixed number is called the **common difference** *(d)* of the AP and it can be positive, negative or zero.
2. For example, if in the list of numbers $a_1, a_2, a_3, a_4, \ldots$ if the differences $a_2 - a_1$, $a_3 - a_2$, $a_4 - a_3$, ... gives the same value, i.e. if $a_{k+1} - a_k$ is same for different values of k, then the given list of numbers are said to make an **arithmetic progression.**
3. The general form of an AP is $a, a + d, a + 2d, a + 3d, \ldots$.
   where, a is the **first term** and d is the **common difference**.
   nth term of an AP is
   $$T_n = a + (n - 1)\, d$$

Procedure

1. Take a cardboard of suitable size and paste a white paper on it.
2. Take two squared papers (graph paper) of suitable size and paste them on the cardboard.
3. Let the lists of numbers be
   (i) 1, 2, 5, 9, ...
   (ii) 2, 5, 8, 11, ...
4. Make strips of length 1, 2, 5, 9 units and strips of length 2, 5, 8, 11 and breadth of each strip one unit.
5. Paste the strips of lengths 1, 2, 5, 9 units as shown in Fig. 1.1 and paste the strips of lengths 2, 5, 8,11 units as shown in Fig. 1.2.

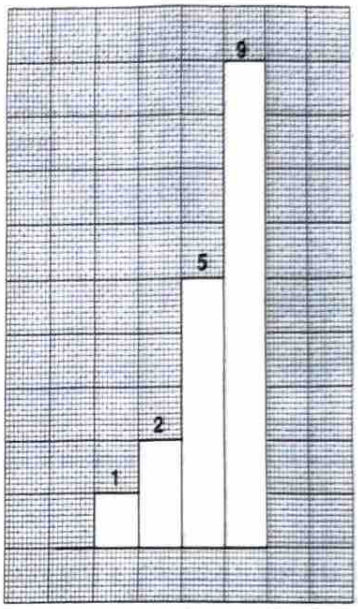


Figure 1.1

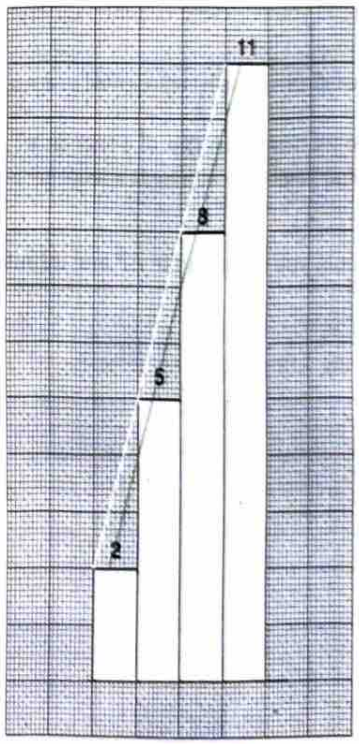


Figure 1.2