15

Chapter

Probability

In the Chapter

In this chapter, you will be studying the following points:

- The difference between experimental probability and theoretical probability.
- The theoret ical (classical) probability of an event E, written as P(E), is defined as

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

  where we assume that the outcomes of the experiment are equally likely.
- The probability of a sure event (or certain event) is 1.
- The probabi lity of an impossible event is 0.
- The probability of an event E is a number P(E) such that

$$0 < P(E) < 1$$

- An event having only one outcome is called an elementary event. The sum of the probabilities of all the elementary events of an experiment is 1.
- For any event E, $P(E) + P(\overline{E}) = 1$, where $\overline{E}$ stands for 'not E'. E and $\overline{E}$ are called complementary events.

NCERT TEXT BOOK QUESTION (SOLVED)

EXERCISE 15.1

Q.1. 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 i s greater than or equal to ..... and less than or equal to ..... .

Ans. (i) 1, (ii) 0, impossible event, (iii) 1, sure or certain event, (iv) 1, (v) 0, 1.

Q.2. Which of the following experiments have equally likely outcomes? Explain.

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

(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.

Ans. (i) In the experiment, "A driver attempts to start a car. The car starts or does not", we are not justified to assume that each outcome is as likely to occur as the other. Thus, the experiment has no equally likely outcome.

(ii) In the experiment, "a player attempts to shoot a basket ball. She/he shoots or misses the shot," We are not justified to assume that each outcome is as likely to occur as the other., This the experiment has

no equally likely outcome.

(iii) In the experiment, "A trial is made to answer a true false question. The answer is right or wrong." We know, that in advance, that the result can lead in one of the two possible ways – either right or wrong. We can reasonally assume that each outcome right or wrong, is likely to occur as the other.

Thus, the outcomes right or wrong, are equally like to occur.

(iv) In the experiment, "A body is born. It is a boy or a girl". We know, in advance, that the outcomes – either a boy or a girl. We are justified to assume that each outcome, boy or girl, is likely to occur. Thus, the outcomes boy or girl are likely to occur.

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

Ans. When we toss a coin, the outcomes are equally likely. So, the result of an individual coin toss is completely unpredictable.

Q.4. Which of the following cannot be the probability of an event?

(A) 2/3 (B) –1.5 (C) 15% (D) 0.7

Ans. –1.5 cannot be the probability of an event because $0 < P(E) < 1$.

Hence (B) is correct.

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

Ans. It is given that :

$P(E) = 0.05$, then

Probability of 'not E' = $1 - P(E)$

$\Rightarrow$ $P(E) = 1 - 0.05 = 0.95$.

Q.6. A bag cont ains lemon flavoured candles only. Mali ni 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?

Ans. (i) 0, because the bag contains the lemon flavoured candies only.

(ii) 1, because the bag contains lemon flavoured candies only.

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

Ans. Probability that the 2 students have the same birthday.

= 1 – probability that the 2 students have not the same birthday

= 1 – 0.992

= 0.008.

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

Ans. Total number of balls, $n(S) = 3 + 5 = 8$

Let E = Event of drawing 1 red ball

$\therefore$ $n(E) = 3$

(i) Probability of drawing a red ball = $\frac{n(E)}{n(S)} = \frac{3}{8}$

(ii) Probability of not drawing a red ball

= 1 – P (Drawing a red ball)

$= 1 - \frac{3}{8} = \frac{5}{8}$

Q.9. A box contains 5 red marbles, 8 white marbles and 4 green marbles. One marble is taken out of the box at random. What is the probability that the marble taken out will be (i) red ? (ii) white ? (iii) not green?

Ans. The number of marbles in a box.

$n(S) = 5 + 8 + 4 = 17$

(i) Probability of taking out a red marble = $\frac{5}{17}$

(ii) Probability of taking out a white marble= $\frac{8}{17}$

(iii) Probability of taking out not a green marble

$= \frac{\textit{Either red or white marble}}{\textit{Total number of marbles}} = \frac{5+8}{17} = \frac{13}{17}$

Q.10. A piggy bank contains hundred 50p coins, fifty Re 1 coins, twenty Rs 2 coins and ten Rs 5 coins. If it is equally likely that one of the coins will fall out when the bank is turned upside down, what is the probability that the coin (i) will be a 50 p coin ? (ii) will not be a Rs 5 coin?

Ans. Given : 50 paise coins = 100

Rs. 1 coins = 50

Rs. 2 coins = 20

Rs. 5 coins = 10

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

(i) P (50 paise coin) = $\frac{100}{180} = \frac{5}{9}$

(ii) P (will not be a Rs. 5 coin) = $\frac{180-10}{180}$

$$= \frac{170}{180} = \frac{17}{18}$$

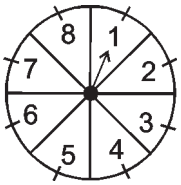
Q.11. Gopi buys a fish from a shop for his aquarium. The shopkeeper takes out one fish at random from a tank containi ng 5 male fish and 8 female fish. What is the probability that the fish taken out is a male fish?

Ans. Total number of fish in an aquarium = 5 male fish + 8 female fish = 13 fish.

∴ Probability of taken out a male fish

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

Q.12. A game of chance consists of spinning an arrow which comes to rest pointing at one of the numbers 1, 2, 3, 4, 5, 6, 7, 8 (see Fig.), 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?

Ans. (i) total number of points in a circle,

$n(S) = 8$

Let E_1 = The arrow comes at number 8

∴ $n(E_1) = 1$

Probability that arrow comes at number 8

$$= \frac{n(E_1)}{n(S)} = \frac{1}{8}$$

(ii) Let E_2 = The arrow comes at an odd numbers

$= (1, 3, 5, 7)$

∴ $n(E_2) = 4$

∴ Probability that arrow comes at an odd number

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

(iii) Let E_3 = The arrow comes at a number greater than 2

$$= \frac{n(E_3)}{n(S)} = \frac{6}{8} = \frac{3}{4}$$

(iv) Let E_4 = The arrow comes at a number less and 9

$= (1, 2, 3, 4, 5, 6, 7, 8)$

∴ $n(E_4) = 8$

Probability that arrow comes at a number less than 9

$$= \frac{n(E_4)}{n(S)} = \frac{8}{8} = 1$$

Q.13. A die is thrown once. Find the probability of getting (i) a prime number; (ii) a number lying between 2 and 6; (iii) an odd number.

Ans. If we throw a die once, then possible outcomes (S) are

$S = \{1, 2, 3, 4, 5, 6\}$

$\Rightarrow$ $n(S) = 6$

(i) Let E be the favourable outcome of getting a prime number then

$E = \{2, 3, 5\}$

$\Rightarrow$ $n(E) = 3$

Therefore, $P(E) = \frac{n(E)}{n(S)} = \frac{3}{6} = \frac{1}{2}$

(ii) Let F be the favourable outcome of getting a number lying between 2 and 6, then

$F = \{3, 4, 5\}$

$\Rightarrow$ $n(F) = 3$

Therefore $P(F) = \frac{n(F)}{n(S)} = \frac{3}{6} = \frac{1}{2}$

(iii) Let G is the favourable outcome of getting an odd number, then

$G = \{1, 3, 5\}$

$\Rightarrow$ $n(G) = 3$

Therefore $P(G) = \frac{n(G)}{n(S)} = \frac{3}{6} = \frac{1}{2}$

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

(i) a king of red colour

(ii) a face card

(iii) a red face card

(iv) the jack of hearts

(v) a spade

(vi) the queen of diamonds

Ans. Total number of all possible outcomes = 52

i.e., $n(S) = 52$

(i) Let E be the favourable outcomes of getting a king of red colour, then

$n(E) = 2$

Therefore,

$$P(E) = \frac{n(E)}{n(S)} = \frac{2}{52} = \frac{1}{26}$$

(ii) Let F be the favourable outcome of getting a face card, then

$n(F) = 12$

Therefore,

$$P(F) = \frac{n(F)}{n(S)} = \frac{12}{52} = \frac{3}{13}$$

(iii) Let G be the favourable outcome of a red face card, then

$n(G) = 6$

Therefore,

$$P(G) = \frac{n(G)}{n(S)} = \frac{6}{52} = \frac{3}{26}$$

(iv) Let H be the favourable outcome of getting the jacks from the hearts, then

$n(F) = 1$

Therefore,

$$P(H) = \frac{n(H)}{n(S)} = \frac{1}{52}$$

(v) Let I be the favourable outcome of getting a spade, then

$n(I) = 13$

Therefore :

$$P(I) = \frac{n(I)}{n(S)} = \frac{13}{52} = \frac{1}{4}$$

(vi) Let J be the favourable outcome of getting the queen of diamonds, then

$n(J) = 1$

Therefore,

$$P(J) = \frac{n(J)}{n(S)} = \frac{1}{52}$$

Q.15. Five cards—the ten, jack, queen, king and ace of diamonds, are well-shuffled with their face downwards. One card is then picked up at random.

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

(ii) If the queen is drawn and put aside, what is the probability that the s econd card picked up is (a) an ace? (b) a queen?

Ans. It is given that the total number of cards

$= 5$

i.e., $n(S) = 5$

(i) Let E be the favourable outcome of getting a queen, then

$E = [1]$

$\Rightarrow \quad n(E) = 1$

Therefore,

$$P(E) = \frac{n(E)}{n(S)} = \frac{1}{5}$$

(ii) If the queen is drawn and put aside then possible outcomes become 4

i.e., $n(S) = 4$

(a) Let A be the favourable outcome that the picked up ward is an arc, then

$n(A) = [1]$

Therefore,

$$P(A) = \frac{n(A)}{n(S)} = \frac{1}{4}$$

(b) Let B be the favourable outcome that the picked up card is a queen, then

$n(B) = 0$

Therefore,

$$P(B) = \frac{n(B)}{n(S)} = \frac{0}{4} = 0$$

Q.16. 12 defective pens are accidentally mixed with 132 good ones. It is not possible to just look at a pen and tell whether or not it is defective. One pen is taken out at random from this lot. Determine the probability that the pen taken out is a good one.

Ans. Number of defective pens = 12

Number of non-defective pens = 132

Total number of pens = 12 + 132

= 144

Let 'A' be the favourable outcome of getting the pen taken out is a good one. Then,

$n(A) = 132$

Therefore, $P(A) = \frac{n(A)}{n(S)} = \frac{132}{144} = \frac{11}{12}$

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

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

Ans. (i) Total number of bulbs = 20

i.e., $n(S) = 20$

Let A be the favourable outcomes of getting defective bulbs. Then

$n(A) = 4$

Therefore, $P(A) = \frac{n(A)}{n(S)} = \frac{4}{20} = \frac{1}{5}$

(ii) Total number of bulbs = 19

Let B be the favourable outcome of getting non defective bulbs., Then

$n(B) = 19 - 4 = 15$

Therefore, $P(B) = \frac{n(B)}{n(S)} = \frac{15}{19}$

Q.18. A box contains 90 discs which are numbered from 1 to 90. If one disc is drawn at random from the box, find the probability that it bears (i) a two-digit number (ii) a perfect square number (iii) a number divisible by 5.

Ans. Total number of discs in the box = 90

i.e., $n(S) = 90$

(i) Let A be favourable outcome of getting a two digit number. Then

$n(A) = 81$

Therefore, $P(A) = \frac{n(A)}{n(S)} = \frac{81}{90} = \frac{9}{10}$

(ii) Let B be the favourable outcome of getting a perfect square number. Then

$B = [1, 4, 9, 16, 25, 36, 49, 64, 81]$

i.e., $n(B) = 9$

Therefore, $P(B) = \frac{n(B)}{n(S)} = \frac{9}{90} = \frac{1}{10}$

(iii) Let C be the favourable outcomes of setting a number divisible by 5.

Then, $n(C) = 18$

Therefore, $P(C) = \frac{n(C)}{n(S)} = \frac{18}{90} = \frac{1}{5}$

Q.19. 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?

Ans. Total number of faces in a die = 6

i.e., $n(S) = 6$

(i) Let E be the favourable outcome of setting A. Then,

$n(E) = 2$

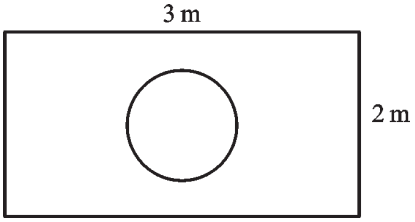
Therefore , $P(E) = \frac{n(E)}{n(S)} = \frac{2}{6} = \frac{1}{3}$

(ii) Let A be the favourable outcome of getting D. Then

$n(D) = 1$

Therefore, $P(D) = \frac{n(D)}{n(S)} = \frac{1}{6}$

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



Ans. Area of rectangular region

$= 3 \times 2 = 6m^2$

Diameter of the circle = 1m

$\therefore$ Radius = $\frac{1}{2}$ m

So, Area = $\pi r^2 = \pi \left(\frac{1}{2}\right)^2 = \frac{\pi}{4} m^2$

Now, Probability that the die will land inside the

circle = $\frac{\frac{\pi}{4}}{6} = \frac{\pi}{24}$.

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

(i) She will buy it ?

(ii) She will not buy it ?

Ans. Total number of ball pens = 144

i.e., $n(S) = 144$

(i) Let A be the favourable outcomes of buying a ball pen by her. Then

$n(A) = 144 - 20 = 124$

Therefore, $P(A) = \frac{n(A)}{n(S)} = \frac{124}{144} = \frac{31}{36}$.

(ii) Let B be the favourable outcomes of not buying a ball pen. Then,

$$P(B) = 1 - P(A)$$

$$= 1 - \frac{31}{36} = \frac{5}{36}$$

Q.22. Refer to Example 13. (i) Complete the following table:

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

(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.

Ans. Total number of possibel outcomes = 36

i.e. $n(S) = 36$

(a) Let A be the favourable outcome of getting the sum as 2. Then

$$A = (1, 1)$$

i.e., $n(A) = 1$

Therefore, $P(A) = \frac{n(A)}{n(S)} = \frac{1}{36}$

(b) Let B be the favourable outcome of getting the sum as 3. Then

$$B = (1, 2), (2, 1)$$

i.e. $n(B) = 2$

Therefore, $P(B) = \frac{n(B)}{n(S)} = \frac{2}{36} = \frac{1}{18}$

(c) Let C be the favourable outcome of getting the sum as 4. Then

$$C = (2, 2), (1, 3), (3, 1)$$

i.e., $n(C) = 3$

Therefore, $P(C) = \frac{n(C)}{n(S)} = \frac{3}{36} = \frac{1}{12}$

(d) Let D be the favourable outcome of getting the sum as 5. Then

$$D = \{(1, 4), (4, 1), (2, 3), (3, 2)\}$$

(e) Let E be the favourable outcome of getting the sum as 6. Then

$$E = \{(1,5), (5, 1), (2, 4), (4, 2), (3, 3)\}$$

i.e., $n(E) = 5$

Therefore, $P(E) = \frac{n(E)}{n(S)} = \frac{5}{36}$

(f) Let F be the favourable outcome of getting the sum as 7. Then

$$F = \{(1, 6), (6, 1), (2, 5), (5, 2), (3, 4), (4, 3)\}$$

i.e., $n(F) = 6$

Therefore, $P(F) = \frac{n(F)}{n(S)} = \frac{6}{36} = \frac{1}{6}$

(g) Let G be the favourable outcome of getting the sum as 8. Then

$$G = (2, 6), (6, 2), (3, 5), (5, 3), (4, 4)$$

i.e., $n(G) = 5$

Therefore, $P(G) = \frac{n(G)}{n(S)} = \frac{5}{36}$

(h) Let H be the favorable outcome of getting the sum as 9. Then

$$H = (3, 6), (6, 3), (4, 5), (5, 4)$$

i.e., $n(H) = 4$

Therefore, $P(H) = \frac{n(H)}{n(S)} = \frac{4}{36} = \frac{1}{9}$

(i) Let I be the favourable outcome of getting the sum as 10. Then

I = (4, 6), (6, 4), (5, 5)

i.e., n(I) = 3

Therefore, $P(I) = \frac{n(I)}{n(S)} = \frac{3}{36} = \frac{1}{12}$

(j) Let J be the favourable outcome of getting the sum as 11. Then

J = (6, 5), (5, 6)

i.e., n(J) = 2

Therefore, $P(J) = \frac{n(J)}{n(S)} = \frac{2}{36} = \frac{1}{18}$

(k) Let K be the favourable outcome of getting the sum as 12. Then.

K = (6, 6)

i.e., n(K) = 1

Therefore, $P(K) = \frac{n(K)}{n(S)} = \frac{1}{36}$

(ii) No, we do not agree with the argument because these events are not equally likely.

Q.23. A game consists of tossing a one rupee coin 3 times and noting its outcome each time. Hanif wins if all the tosses give the same result i.e., three heads or three tails, and loses otherwise. Calculate the probability that Hanif will lose the game.

Ans. The total possible outcomes on tossing a coin three times

= {(HHH), (HHT), (HTH), (THH), (HTT), (THT), (TTH), (TTT)}

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

i.e., {(HHT), (HTH), (THH), (HTT), (THT), (TTH)}

$\therefore$ Required probability = $\frac{6}{8} = \frac{3}{4}$

Q.24. A die is thrown twice. What is the probability that (i) 5 will not come up either time? (ii) 5 will come up at least once?

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

Ans. (i) Total number of cases, $n(S) = 6^2 = 36$.

Let $\overline{E}$ = Event that 5 will come up either time

= {(1,5), (2,5), (3,5), (4,5), (5,5), (6,5), (5,1), (5,2), (5,3), (5,4), (5,6)}

$\Rightarrow$ $n(\overline{E}) = 11$

and E = Event that 5 will not come up either time

$\therefore$ $n(E) = 36 - 11 = 25$

$\therefore$ Probability that 5 will not come up either time

$$= \frac{n(E)}{n(S)} = \frac{25}{36}$$

(ii) Probability that, 5 will come up atleast once

$$= \frac{n(\overline{E})}{n(S)} = \frac{11}{36}$$

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

(i) If two coins are tossed simultaneously there are three possible outcomes—two heads, two tails or one of each. Therefore, for each of these outcomes, the probability is $\frac{1}{3}$, (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 $\frac{1}{2}$.

Ans. (i) If two coins are tossed at the same time the possible outcomes are :

S = (H,H), (H,T), (T,H), (T,T)

i.e., $n(S) = 4$

So, the probability of each occurrence = $\frac{1}{4}$

Thus, the given statement is wrong.

(ii) If a die is thrown once, the possible outcomes are

S = {1, 2, 3, 4, 5, 6}

i.e., $n(S) = 6$

Let A be the favourable outcomes of getting odd number. Then

A = {1, 3, 5}

i.e., $n(S) = 3$

Therefore, $P(A) = \frac{n(A)}{n(S)} = \frac{3}{6} = \frac{1}{2}$

Thus, the given statement is correct.

EXERCISE 15.2 (Optional)

Q.1. Two customers Shyam and Ekta are visiting a particular shop in the same week (Tuesday to Saturday). Each is equally likely to visit the shop on any day as on another day. What is the probability that both wi ll visit the shop on (i) the same day? (ii) consecutive days? (iii) different days?

Ans. Number of days from Tuesday to Saturday = 5

Total number of possible outcomes = $5 \times 5 = 25$

(i) If both visit the shop on the same day, then number of favourable cases.

$n(E) = 5$

$\therefore$ P (both will visit on the same day)

$$= \frac{5}{25} = \frac{1}{5}$$

(ii) If they visits the shop on consecutive days, then number of cases

= 8 (T, W : W, Th : Th, F : F, S : S, F : F, Th : Th, W : W, T)

$\therefore$ P (both will visit on consecutive days) = $\frac{8}{25}$

(iii) P (both will visit on different days) = 1 – P(both will visit on the same day)

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

Q.2. A die is numbered in such a way that its faces show the numbers 1, 2, 2, 3, 3, 6. It is thrown two times and the total score in two throws is noted. Complete the following table which gives a few values of the total score on the two throws:

+	1	2	2	3	3	6
1	2	3	3	4	4	7
2	3	4	4	5	5	8
2					5	
3						
3			5			9
6	7	8	8	9	9	12

What is the probability that the total score is (i) even? (ii) 6? (iii) at least 6?

Ans. The complete table is

Number in first throw

+	1	2	2	3	3	6
1	2	3	3	4	4	7
2	3	4	4	5	5	8
2	3	4	4	5	5	8
3	4	5	5	6	6	9
3	4	5	5	6	6	9
6	7	8	8	9	9	12

Total number of possible outcomes = 36

(i) Let E_1 = event that total score is even

$\therefore$ $n(E_1) = 18$

$$\text{P(total score is even)} = \frac{18}{36} = \frac{1}{2}$$

(ii) Let E_2 = event that total score is 6

$\therefore$ $n(E_2) = 4$

$$\text{P(total score is 6)} = \frac{4}{36} = \frac{1}{9}$$

(iii) Let E_3 = event that total score is at least 6. i.e., 6, 7, 8, 9, 12

$\therefore$ $n(E_3) = 15$

$$\text{P (total score is at least 6)} = \frac{15}{36} = \frac{5}{12}$$

Q.3. A bag contains 5 red balls and some blue balls. If the probability of drawing a blue ball is *double* that of a red ball, determine the number of blue balls in the bag.

Ans. Number of red balls in the bag = 5

Let number of blue balls in the bag = x

Total number of balls in the bag = x + 5

i.e., $n(S) = x + 5$

Let A be the favourable outcome of getting red balls, then

$n(A) = 5$

Therefore, $P(A) = \frac{n(A)}{n(S)} = \frac{5}{x+5}$

Let B be the favourable outcome of getting blue balls, then

$n(B) = x$

Therefore, $P(B) = \frac{n(B)}{n(S)} = \frac{x}{x+5}$

According to question ,

$P(B) = 2P(A)$

$$\Rightarrow \quad \frac{x}{x+5} = 2 \times \frac{5}{x+5}$$

$$\Rightarrow \quad \frac{x}{x+5} = \left(\frac{10}{x+5}\right)$$

$$\Rightarrow \quad x = 10$$

Q.4. A box contains 12 balls out of which *x* are black. If one ball is drawn at random from the box, what is the probability that it will be a black ball? If 6 more black balls are put in the box, the probabili ty of drawing a black ball is now double of what it was before. Find *x*.

Ans. Given number of black balls = x

and total number of balls = 12

$\therefore$ Probability of drawning a ball which is black

$$P_1 = \frac{Number\ of\ black\ balls}{Total\ number\ of\ balls} = \frac{x}{12}$$

If 6 more black balls are put in the box, then total numbr of black balls = $x + 6$ and total number of balls = $12 + 6 = 18$.

$\therefore$ Probability of drawing a black ball, $P_2 = \frac{x+6}{18}$

Now, according to the question.

$$P_2 = 2P_1$$

$$\Rightarrow \quad \frac{x+6}{18} = 2 \times \frac{x}{12}$$

$$\Rightarrow \quad \frac{x+6}{18} = \frac{x}{6}$$

$$\Rightarrow \quad 6(x+6) = 18x$$

$$\Rightarrow \quad x + 6 = 3x \Rightarrow 2x\,6 \Rightarrow x = 3$$

Q.5. A jar contains 24 marbles, some are green and others are blue. If a marble is drawn at random from the jar, the probability that it is green is 2/3. Find the number of blue balls in the jar.

Ans. Let number of green marbles = *x*

Then, number of blue marbles = $24 - x$

Total number of marbles = 24

Now, probability of drawing a marble which is given

$$= \frac{Number\ of\ green\ marbles}{Total\ number\ of\ marbles} = \frac{2}{3} \text{ (Given)}$$

$$\Rightarrow \quad \frac{x}{24} = \frac{2}{3}$$

$$\Rightarrow \quad 3x = 24 \times 2$$

$$\Rightarrow \quad x = \frac{24 \times 2}{3}$$

$$\Rightarrow \quad x = 16$$

$\therefore$ Number of green marbles = 16

Hence, number of blue marbles = 24 – 16 = 8.

Additional Questions

Q.1. Two dice are thrown at the same time. Find the probability of getting :

(i) same number on both dice.

(ii) different number on both dice.

Ans. Number of possible events = 6 × 6 = 36.

(i) Same number on both dice is 11, 22, 33, 44, 55, 66.

Number of favourable events = 6

$$P(\text{Same number of both dice}) = \frac{6}{36} = \frac{1}{6}$$

(ii) P(different nunber on both dice)

$$= 1 - \frac{1}{6} = \frac{5}{6}$$

Q.2. If you toss a coin 6 times and it comes down heads on each occasion. Can you say that the probability of getting a head is 1? Give reasons.

Ans. No, the outcomes 'head' and 'tall' are equally likely every time regardless of what you get in a few tosses.

Q.3.Two dice are thrown at the same time. Determine the probability that the difference of the numbers on the two dice is 2.

Ans. Number of possible outcomes = 6 × 6 = 36.

Favourable events are : (1,3), (2, 4), (3,1), (3,5), (4,2) ,(4,6), (5, 3), (6, 4)

N umber of favourable events = 8

P(Difference of the numbers on the two dice is 2)

$$= \frac{8}{36} = \frac{2}{9}$$

Q.3. 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 from the remaining cards. Determine the probability that the card is :

(i) a heart, (ii) a king

Ans. Total number of cards = 52 – (1 +1+1) = 49

(i) Number of heart cards = 13

$$P(\text{a heart}) = \frac{13}{49}$$

(ii) Number of kings in the cards = 3

$$P(\text{a king}) = \frac{3}{49}$$

Q.4. In 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 this correct? Justify your answer.

Ans. No. The probability of each is not $\frac{1}{4}$ because the probability of no girl in three children is zero and probability of three girls in three children is one.

Justification : So these events are not equally likely as outcome one girl, means gbb, bgb, bbg i.e., outcome one girl is possible in only one way whereas outcome one boy is possible in two ways.

Q.5. Kanishka throws two dice once and completes the product of the numbers appearing on the dice. Peehu throws one dice and squares the number that appears on it. Who has the better chance of getting the number 36? Why ?

Ans. Kaniskha throws two dice once.

So total number of outcomes = 36

Number of outcomes for getting produce 36 = 1 (6× 6)

$$\therefore \quad \text{Probability of Kanishka} = \frac{1}{36}$$

Also, Peehu throws one die,

So total numbr of outcomes = 6

Number of outcomes for getting square 36 = 1($6^2 = 36$)

$$\therefore \quad \text{Probability of Peehu} = \frac{1}{6} = \frac{6}{36}$$

Hence, Peehu has better chance to getting the number 36.

Q.6. When we toss a coin, there are two possible outcomes – Head or Tail. Therefore, the probability of each outcome is $\frac{1}{2}$. Justify your answer.

Ans. Yes, Probability of each outcome is $\frac{1}{2}$ because head and tail both are equally likely events.

Q.7. Two dice are thrown at the same time. Determine the probability that the difference of the numbers on the two dice is 2.

Ans. The total number of sample space in two dice, n(S) = 6 × 6 = 36.

Let E = Event of getting the difference of the two numbers is 2.

= {(1, 3), (2, 4), (3,5), (4,6), (3,1), 4,2), 5,3), (6,4)}

$\therefore \quad n(E) = 8$

$$\therefore \quad P(E) = \frac{n(E)}{n(S)} = \frac{8}{36} = \frac{2}{9}$$

Q.8. An integer is chosen between 0 and 100. What is the probability that it is

(i) divisible by 7?

(ii) not divisible by 7?

Ans. The number of integers between 0 and 100 is

$$n(S) = 99$$

(i) Let E_1 = Event of choosing an integer which is divisible by 7

= Event of choosing an integer which is multiply of 7

= [7, 14, 21, 28, 35, 42, 49, 56, 63, 70, 77, 84, 91, 98]

$\therefore \quad n(E_1) = 14$

$$\therefore \quad P(E_1) = \frac{n(E_1)}{n(S)} = \frac{14}{99}$$

Q.9. A lot consists of 48 mobile phones of which 42 are good, 3 have only minor defects and 3 have major defects. 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

Ans. Total number of mobiles phones = 48

(i) Number of good phone, which Varnika can buy = 42

P(Phone is acceptable to Varnika)

$$= \frac{42}{48} = \frac{7}{8}$$

(ii) Number of good phones which are acceptable to trader = 42

+ 3 = 45.

P(Phone is acceptable to trader)

$$= \frac{45}{48} = \frac{15}{16}$$

Q.10. At a fate, cards bearing numbers 1 to 1000, one number on one card, are put in a box. Each player selects one card at random and that card is not

replaced. If the selected card has a perfect square greater than 500, the player wins a prize, what is the probability that :

(i) the first player wins a prize?

(ii) the second player wins a prize, if the first has won?

Ans. Number of total cards = 1000

(i) Cards bearing Numbers are favourable

= 576, 625, 676, 729, 784, 841, 900, 961, 1000

Number of favourable events = 9

P(the first player wins a prize)

$$= \frac{9}{1000} = 0.009$$

(ii) For the second player, total number of cards = 999

Number of favourable events = 8 (after first card is taken one)

P(second player wins the game) = $\frac{8}{999}$

Multiple Choice Questions

Q.1. An event is very unlikely to happen. Its probability is closest to

(a) 0.0001 (b) 0.001

(c) 0.01 (d) 0.1

Ans. (a)

Q.2. The probability expressed as a percentage of a particular occurrence can never be

(a) less than 100 (b) less than 0

(c) greater than 1

(d) any thiong but a whole number

Ans. (b)

Q.3. A girl calculates that the probability of her winning the first prize in a lottery is 0.08., If 6000 tickets are sold, how many tickets has she bought ?

(a) 40 (b) 240

(c) 480 (c) 750

Ans. (c)

Q.4. The probability of getting a bad egg in a lot of 400 is 0.035. The number of bad egg in the lot is

(a) 7 (b) 14

(c) 21 (d) 28

Ans. (b)

Q.5. A card is drawn from a deck of 52 cards the event E is that card is not an ace of hearts. The number of outcomes favourable to E is

(a) 4 (b) 13

(c) 48 (d) 51

Ans. (d)

Q.6. A card is selected from a deck of 52 cards. The probability of its being a red face card is

(a) $\frac{3}{26}$ (b) $\frac{3}{13}$

(c) $\frac{2}{13}$ (d) $\frac{1}{2}$

Ans. (a)

Q.7. One ticket is drawn at random from a bag containing ticks numbered 1 to 40. The probability that the selected ticket has a number which is a multiple of 5 is

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

(c) $\frac{4}{5}$ (d) $\frac{1}{5}$

Ans. (a)

Q.8. If an event cannot occur, then its probability is

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

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

Ans. (d)

Q.9. If the probability of an event is P, the probability of its completmentary event will be

(a) P – 1 (b) P

(c) 1 – P (d) 1 – 1/P

Ans. (c)

Q.10. Which of the following cannot be the probability of an event ?

(a) $\frac{1}{3}$ (b) 0.1

(c) 3 (d) $\frac{17}{16}$

Ans. (d)