CHAPTER

14

Probability

CLASS 10TH

NCERT EXERCISE AND SOLUTIONS - MATHEMATICS

1. **Complete the following statements:**

(i) **Probability of an event Probability of the event 'not …………….**

(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…………**

SOLUTION:

(i) 1

(ii) 0, impossible event

(iii) 1, sure or certain event

(iv) 1

(v) 0,1

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

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

(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.

SOLUTION:

(i) If a driver attempts to start a car, the two possible outcomes are either starting a car or not starting a car. Thus, it is an experiment with equally likely outcomes.

(ii) If a player attempts to shoot a basketball, the two possible outcomes are either shooting or missing the shot. Hence experiment has equally likely outcomes.

(iii) If a trial is made to answer a true-false question. The two possible outcomes are whether the answer is right or wrong. Thus, this is an experiment with equally likely outcomes.

(iv) When a baby is born the possible outcomes are likely a boy or a girl.

Hence, all events have two possible outcomes so both outcomes are equally likely.

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

SOLUTION:

Tossing a coin is commonly viewed as a fair method for determining which team receives the ball at the start of a football game because it is an event with two equally likely outcomes: heads or tails. Since both outcomes have the same probability, it ensures fairness for both teams.

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

(A) $\frac{2}{3}$ **(B)** –1.5 **(C)** 15% **(D)** 0.7

SOLUTION:

(B) The probability of any event is always a value between 0 and 1 (i.e.,$0 \leq P(E) \leq 1$). This implies that probabilities cannot be less than 0 or greater than 1. Therefore, a value like −1.5, as mentioned in option (B), is not a valid probability.

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

SOLUTION:

P(E) = 0.05

We know that

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

0.05 + P (not E) = 1

P (not E) = 1 − 0.05

P (not E) = 0.95

Thus, the probability of 'not E' is 0.95.

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

(i) an orange flavoured candy?

(ii) a lemon flavoured candy?

SOLUTION :

(i) A bag only contains lemon-flavored candies, meaning there are no orange-flavoured candies. As a result, the probability of picking an orange-flavoured candy is 0.

(ii) Since the bag contains only lemon-flavored candies, so every time she picks a candy it will always be lemon-flavored. Therefore, the probability of drawing a lemon-flavored candy is 1.

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

SOLUTION:

Probability that 2 students not having the same birthday P (not E) = 0.992

Probability that 2 students have the same birthday = 1 – P (not E)

P (E) = 1 − 0.992 = 0.008

Thus, the probability that the 2 students will have the same birthday is 0.008

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

(i) red?

(ii) not red?

SOLUTION:

Given: Number of red balls = 3 and Number of black balls = 5

Let A be the event of drawing red ball and B be the event of drawing black ball.

Number of red balls (i.e.) n(A) = 3

Number of black balls (i.e.) n(B) = 5

Total number of balls = 3 + 5 = 8 (i.e.) n(S) = 8

Probability that the ball is red, $P(A) = \frac{3}{8}\left[\because P(A) = \frac{n(A)}{n(S)}\right]$

Probability that the ball is not red, $P(B) = \frac{5}{8}\left[\because P(B) = \frac{n(B)}{n(S)}\right]$

∴ The probability that the ball drawn is

(i) red $= \frac{3}{8}$ **(ii)** not red $= \frac{5}{8}$

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

SOLUTION:

Let A be the event of taking a red, B be the event of taking a white and C be the event of taking not a green marble respectively.

(i) Number of red marbles n(A) = 5

(ii) Number of white marbles n(B) = 8

(iii) Number of green marbles = 4

Total number of marbles (i.e.) = n(S) = 5 + 8 + 4 = 17

Probability that the marble taken out is red marble (i.e.)

$$P(A) = \frac{5}{17}\left[\because P(A) = \frac{n(A)}{n(S)}\right]$$

Probability that the marble taken out is white marble (i.e.)

$$P(B) = \frac{8}{17}\left[\because P(B) = \frac{n(B)}{n(S)}\right]$$

The marble taken out is other than green (i.e.) red and white (5 + 8) n(C) = 13

Probability that the marble taken out is not green marble (i.e.)

$$P(C)=\frac{13}{17}\left[\because P(C)=\frac{n(C)}{n(S)}\right]$$

$\therefore$ The probability that the marble taken out would be

(i) red $=\frac{5}{7}$

(ii) white $=\frac{8}{17}$

(iii) not green $=\frac{13}{17}$

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

SOLUTION:

Given:

Number of 50 p coins = 100,

Number of ₹1 coins = 50,

Number of ₹2 coins = 20

Number of ₹5 coins = 10

Total number of coins $n(\text{S}) = 100 + 50 + 20 + 10 = 180$

$$\text{Probability of a event } = \frac{\text{Number of favourable outcomes}}{\text{Number of all possibleoutcomes of the experiment}}$$

Let A denote the event that the coin fallen out is 50p coin, (i.e.) $n(\text{A}) = 100$

B denote the event that the coin fallen out will not be ₹5[(i.e.)., the coin is other than ₹5]

(i.e.) $n(\text{B}) = 100 + 50 + 20 = 170$

$$P(A)=\frac{n(A)}{n(S)}=\frac{100}{180}$$

$$=\frac{10}{18}$$

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

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

$$P(B)=\frac{n(B)}{n(S)}=\frac{170}{180}$$

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

∴ The probability that the coin is

(i) 50 p coin $= \frac{5}{9}$

(ii) not a ₹5 coin $= \frac{17}{18}$

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

SOLUTION:

Let A be the event of taking a male fish

Number of male fish n(A) = 5

Number of female fish = 8

Total number of fish n(S) = 5 + 8 = 13

$$\text{Probability of a event} = \frac{\text{Number of favourable outcomes}}{\text{Number of all possibre outcomes of the experiment}}$$

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

$$= \frac{5}{13}.$$

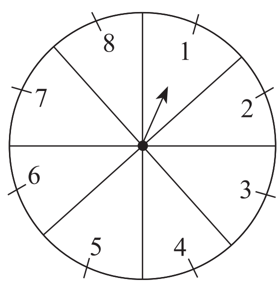
12. A game of chance consists of spinning an arrow which comes to rest pointing at one of the numbers 1, 2, 3, 4, 5, 6, 7, 8 (see Fig.), and these are equally likely outcomes. What is the probability that it will point at

(i) 8?

(ii) an odd number?

(iii) a number greater than 2?

(iv) a number less than 9?



SOLUTION:

Total Number of outcomes when an arrow is spanned $n(S) = 8$

(i) The probability of getting $8 = \frac{1}{8}$

(ii) Number of odd number (i.e.) 1, 3, 5, 7

The probability of getting a odd number $= \frac{4}{8} = \frac{1}{2}$

(iii) Numbers greater than 2 = 3, 4, 5, 6, 7, 8

The probability of getting a number greater than $2 = \frac{6}{8} = \frac{3}{4}$

(iv) Numbers less than 9 = 1, 2, 3, …, 8

The probability of getting a number less than $9 = \frac{8}{8} = 1$

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

SOLUTION:

Sample space = {1, 2, 3, 4, 5, 6}

$n(S) = 6$

Let A denote the event of getting a prime number, $n(A) = 2,3,5 = 3$

B denote the event of getting a number lying between 2 and 6, $n(B) = 3,4,5 = 3$

C denote the probability of getting an odd number, $n(C) = 1,3,5 = 3$

Probability of an event $= \frac{\text{Number of favourable outcomes}}{\text{Number of possible outcomes}}$

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

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

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

Thus, the probability of getting

(i) a prime number $= \frac{1}{2}$

(ii) a number lying between 2 and $6 = \frac{1}{2}$

(iii) an odd number $= \frac{1}{2}$

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

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

SOLUTION:

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

Let A be the event of getting a king of red colour, B be the event of getting a face card, C be the event of getting a red face card, D be the event of getting the jack of hearts, E be the event of getting a spade and F be the event of getting the queen of diamonds.

Number of king of red colour $n(A) = 2$

Number of face card $n(B) = 12$

Number of red face card $n(C) = 6$

Number of jack of hearts $n(D) = 1$

Number of spade $n(E) = 13$

Number of queen of diamonds $n(F) = 1$

$$\text{Probability of an event} = \frac{\text{Number of favourable outcomes}}{\text{Number of all possible outcomes of the experiment}}$$

(i) Probability of getting a king of red colour $P(A) = \frac{2}{52} = \frac{1}{26}$

(ii) Probability of getting a face card $P(B) = \frac{12}{52} = \frac{3}{13}$

(iii) Probability of getting a red face card $P(C) = \frac{6}{52} = \frac{3}{26}$

(iv) Probability of getting a jack of hearts $P(D) = \frac{1}{52}$

(v) Probability of getting a spade $P(E) = \frac{13}{52} = \frac{1}{4}$

(vi) Probability of getting a queen of diamonds $P(F) = \frac{1}{52}$

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

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

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

(a) an ace?

(b) a queen?

SOLUTION:

Number of ten = 1

Number of Jack = 1

Number of queen = 1

Number of king = 1

Number of ace of diamonds = 1

Probability of an event $= \dfrac{\text{Number of favourable outcomes}}{\text{Number of all possible outcomes of the experiment}}$

(i) Probability that the card is queen $= \dfrac{1}{5}$

(ii) If the queen is drawn, then the number of cards available is 4

(a) Probability that the second card is an ace $= \dfrac{1}{4}$

(b) Probability that the second card is an queen = 0 [since it has only one queen card which is already removed so, the number of queen card = 0].

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

SOLUTION:

Given:

Number of defective pens = 12 and Number of good pens = 132

Total number of pens $n(\text{S}) = 12 + 132 = 144$

Let A denote the event of taking a good pen, $n(\text{A}) = 132$

Probability of an event $= \dfrac{\text{Number of favourable outcomes}}{\text{Number of all possible outcomes of the experiment}}$

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

$$= \frac{132}{144} = \frac{11}{12}.$$

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

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

SOLUTION:

Given:

Total number of bulbs = 20 and Number of defective bulb = 4

Total number of bulbs $n(\text{S}) = 20$

(i) Probability of an event $= \dfrac{\text{Number of favourable outcomes}}{\text{Number of all possible}}$

Let A be the event of drawing a defective bulb, $n(A) = 4$

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

$$= \frac{4}{20} = \frac{1}{5}$$

(ii) If suppose the bulb drawn is not defective and is not replaced (i.e.) one good bulb is taken. The number of bulbs will be 19.

Number of good bulbs $= 16 - 1 = 15$

$\therefore$ The probability of the bulb not defective $= \frac{15}{19}$.

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

(i) a two-digit number

(ii) a perfect square number

(iii) a number divisible by 5.

SOLUTION:

Let A denote a two-digit number, B denote a perfect square, and C denote a number divisible by 5

Number of discs in a box, $n(S) = 90$

Two digit number = {10, 11, 12, …, 90}

Number of two digit number, $n(A) = 90 - 9 = 81$

Perfect square number = {1, 4, 9, 16, 25, 36, 49, 64, 81}

Number of perfect square number, $n(B) = 9$

Numbers divisible by 5 = {5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85, 90}

Number of numbers divisible by 5, $n(C) = 18$

(i)

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

$$= \frac{81}{90} = \frac{9}{10}$$

(ii)

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

$$= \frac{9}{90} = \frac{1}{10}$$

(iii)

$$P(C) = \frac{n(C)}{n(S)}$$

$$= \frac{18}{90} = \frac{1}{5}$$

∴ The probability that the disc drawn from the box

(i) a two-digit number $= \dfrac{9}{10}$ **(ii)** a perfect square number $= \dfrac{1}{10}$

(iii) a number divisible by $5 = \dfrac{1}{5}$

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?

SOLUTION:

Letters displayed on the die = {A, B, C, D, E, A}

Number of all possible outcomes = 6

Number of A's = 2

Number of D's = 1

$$\text{Probability of an event} = \frac{\text{Number of favourable outcomes}}{\text{Number of all possible outcomes}}$$

Let A denote the event of getting A 's and B denote the event of getting D 's then

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

$$= \frac{2}{6} = \frac{1}{3}$$

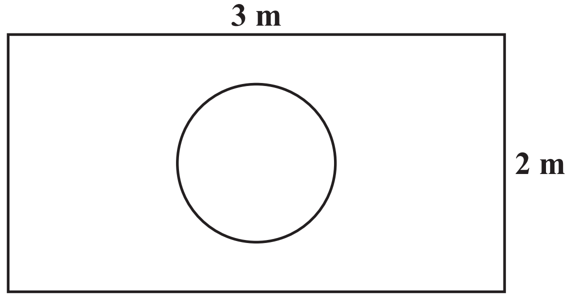
$$P(B) = \frac{n(B)}{n(S)} = \frac{1}{6}$$

∴ The probability of getting

(i) $A = \dfrac{1}{3}$

(ii) $D = \dfrac{1}{6}$

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?



SOLUTION:

Area of the rectangular region = $l \times b = 3 \times 2 = 6 \text{ m}^2$

Area of the circle = πr^2

Diameter of a circle = 1 m

Radius of a circle $= \frac{1}{2}\text{m}$

Area of the circle $= \pi \times \frac{1}{2} \times \frac{1}{2}$

$= \pi \times \frac{1}{2} \times \frac{1}{2}$

$= \frac{\pi}{4}\text{m}^2$

Probability that the die land inside the circle is $= \dfrac{\text{Area of a circle}}{\text{Area of a rectangular region}} = \dfrac{\frac{\pi}{4}}{6} = \dfrac{\pi}{24}$.

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

(i) She will buy it?

(ii) She will not buy it ?

SOLUTION:

Let A be the event of Nuri buying the pen and B be the event of Nuri not buying the pen (since Nuri will buy a pen only if it is good and will not buy the pen if it is defective)

Total number of ball pens n(S) = 144 and Number of defective ball pens n(B) = 20

Number of good pens n(A) = 144 − 20 = 124

Probability of buying a pen $= \dfrac{124}{144} = \dfrac{31}{36}\left[\because P(A) = \dfrac{n(A)}{n(S)}\right]$

Probability of not buying a pen $= 1 - \dfrac{124}{144} = \dfrac{20}{144} = \dfrac{5}{36}\left[\because P(B) = \dfrac{n(B)}{n(S)}\right]$

∴ Probability Nuri will

(i) buy a pen $= \dfrac{31}{36}$

(ii) not buy a pen $= \dfrac{5}{36}$

22. Refer to Example 13.

(i) Complete the following table:

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

(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.

SOLUTION:

(i)

3	4	5	6	7	9	10	11
$\frac{2}{36}$	$\frac{3}{36}$	$\frac{4}{36}$	$\frac{5}{36}$	$\frac{6}{36}$	$\frac{4}{36}$	$\frac{3}{36}$	$\frac{2}{36}$

(ii) No, I don't agree with this argument.

Since there are 11 possible outcomes and all are not equally likely.

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

SOLUTION:

When a one rupee coin is tossed 3 times

All possible outcomes = {(H, H, T), (H, T, H), (T, H, H), (T, T, H), (T, H, T), (H, T, T), (T, T, T), (H, H, H)}

$n(S) = 8$

If Hanif wins all the tosses must give the same result (i.e.) three heads or three tails.

Hanif would win if the outcomes is (T, T, T) and (H, H, H).

$$\text{Probability of an event} = \frac{\text{Number of favourable outcomes}}{\text{Number of all possibte outcomes}}$$

Let A be the event of winning then $\overline{A}$ is the event of losing the game.

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

$$= \frac{2}{8} = \frac{1}{4}$$

The sum of all the probabilities is one

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

$$\Rightarrow P(\overline{A}) = 1 - \frac{1}{4}$$

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

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]

SOLUTION:

The possible outcomes of throwing two dice

= {(1, 1), (1, 2), …,(1, 6), (2, 1), (2, 2),…,(2, 6), (3, 1), (3, 2),….(3, 6), (4, 1), (4, 2)…(4, 6), (5, 1), (5, 2) …(5, 6), (6, 1), (6, 2),…,(6, 6)} $n(S) = 36$

(i) Let A denote the event such that five will not come up either time

A = {(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)}

$$n(A) = 25$$

The probability of an event $= \dfrac{\text{Number of favourable outcomes}}{\text{Number of all possible outcomes}}$

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

(ii) Let $\overline{A}$ denote the event such that five will come up at least once. (i.e.) it is other than (i), thus

$P(A) + P(\overline{A}) = 1$ [sum of all the probabilities]

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

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

$$= \frac{11}{36}$$

∴ The probability

(i) of not getting 5 either time $= \dfrac{25}{36}$

(ii) 5 will come up atleast once $= \dfrac{11}{36}$.

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 $\frac{1}{2}$.

SOLUTION:

If two are tossed simultaneously three possible outcomes - two heads, two tails or one of each.

All possible outcomes = {(H, H), (H, T), (T, H), (T, T)}

$$n(S) = 4$$

Then each of the outcomes (i.e.) two heads, two tails or one of each doesn't have the probability as $\frac{1}{3}$ Because

Probability of an event $= \frac{\text{Number of favourable outcomes}}{\text{Number of all possible outcomes}}$

The probability of getting two heads $= \frac{1}{4}$

The probability of getting two tails $= \frac{1}{4}$

(i) It is not correct. If we want to get the probability of them, we shall classify the outcomes like this but they are not "equally likely". Because "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. The two outcomes considered in this question are equally likely.