Probability: Exercise 15.1

Q.1 Complete the statements:
(i) Probability of event E + Probability of 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) Probability of event E + Probability of event 'not E' = **1**
(ii) The probability of an event that cannot happen is **0**. Such an event is called **impossible event**
(iii) The probability of an event that is certain to happen is **0** . Such an event is called **sure or certain event**
(iv) The sum of the probabilities of all the elementary events of an experiment is **1**.
(v) The probability of an event is greater than or equal to **0** and less than or equal to **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.

***Sol.* (i)** In this given experiment, a driver attempts to start a car. The car starts or does not start. We are not justified to assume that each outcome is as likely to occur as the other. Therefore, this experiment has no equally likely outcomes.

(ii) In this given 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. Therefore, the experiment has no equally likely outcomes.

(iii) In this given experiment, a trial is made to answer a true-false question. The answer is right or wrong. We know that the result can lead in one of the two possible ways either right or wrong. We can assume that each outcome, right or wrong, is likely to occur as the other. Therefore, the outcomes right or wrong, are equally likely.

(iv) In this given experiment, a baby is born. It is a boy or a girl. We know that the outcome can lead in one of two possible outcomes either a boy or a girl. We are justified to assume that each outcome, boy or girl, is likely to occur as the other. Therefore, the outcomes boy or girl, are equally likely.

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?

Sol. The tossing of a coin is considered to be a fair way of deciding which team should get the ball at the beginning of a football game. Because, tossing of the coin only land in one of two possible ways, either head up or tail up. So, it can be assumed that each outcome, head or tail, is as likely to occur as the other. The outcomes head and tail are equally likely. So, the result of the tossing of a coin is completely unpredictable.

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

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

Sol. Since, the probability of an event E is P(E) such that $0 \leq P(E) \leq 1$.
So, –1.5 cannot be the probability of an event.
Correct option: (B)

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

Sol. Since, as we know that, P (E) + P (not – E) = 1

P (not – E) = 1 – P (E)

= 1 – 0.05

= 0.95

Q.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 ?

Sol. **(i)** Consider the event related to the taking out of an orange flavoured candy from a bag which contains only lemon flavoured candies.
Since, outcome doesn't give any orange flavoured candy, so, it is an impossible event so its probability is 0.
(ii) Consider the event related to the taking a lemon flavoured candy out of a bag which contains only lemon flavoured candies. Since, this event is a certain event therefore its probability is 1.

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

Sol. Suppose**,** E is the event of having the same birthday

So, P(E) = 0.992

Since, as we know that, $P(E) + P(\overline{E}) = 1$

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

$= 1 - 0.992$

$= 0.008$

Thus, the probability of 2 students have the same birthday = 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?

Sol. Total number of ball in the bag = 3 red + 5 black = 8 balls
Out of these 8 balls, one can be chosen in 8 ways. So, total number of elementary events = 8
(i) Since, the bag contains 3 red balls, so, one red ball can be drawn in 3 ways.
Now, favourable number of outcomes = 3

Thus, P (getting a red ball) = $\frac{3}{8}$

(ii) Since, the bag contains 5 black balls with 3 red ball. So, one black (or not red) ball can be drawn in 5 ways.
Now, favourable number of outcomes = 5

Thus, P (not getting a red ball) = $\frac{5}{8}$.

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?

Sol. We have total number of marbles in the box = 5 (Red) + 8 (White) + 4 (Green) = 17 Marbles
(i) Red marbles in the box = 5
Favourable number outcomes = 5

Thus, P (getting a red marble) = $\frac{5}{17}$

(ii) White marbles in the box = 8
Favourable number of outcomes = 8

Thus, P (getting a white marble) = $\frac{8}{17}$

(iii) Marbles which are not green in the box = 5 (Red) + 8 (White) = 13 Marbles
Favourable number of Outcomes = 13

Thus, P (not getting a green marble) = $\frac{13}{17}$

Q.10 A piggy bank contains hundred 50 p 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 ?

Sol. Total number of coins in a piggy bank = 100 (50p) + 50 (Rs. 1) + 20 (RS. 2) + 10 (Rs. 5) = 180 coins
Total number of outcomes = 180

(i) 50 paise coins in the piggy bank = 100
Favourable number of outcomes = 100

Thus, P (falling out of a 50p coin) = $\frac{100}{180} = \frac{5}{9}$

(ii) Coins other than Rs 5 coin = 100 (50p) + 50 (Rs. 1) + 20 (Rs. 2)= 170 coins
Favourable number of outcomes = 170

Thus, P(falling out of a coin other than Rs 5 coin) = $\frac{170}{180} = \frac{17}{18}$

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

Sol. Total number of fish in the tank = 5 (male) + 8 (female) = 13 fishes
Total number of outcomes = 13
Since, there are 5 male fishes in the tank.
So, favourable number of outcomes = 5

Thus, P (taking out a male fish) = $\frac{5}{13}$

Q.12 A game of chance consists of spinning an arrow which comes to rest pointing at one of the number 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?**

Sol. Since, an arrow can point any of the numbers in 8 ways, out of 8 numbers.
So, total number of outcomes = 8

(i) Since, there is only one '8' number on the spinning plant.
So, favourable number of outcomes = 1

Thus, P (arrow points at 8) = $\frac{1}{8}$

(ii) Since, there are 4 odd numbers (i.e. 1, 3, 5 and 7) on spinning plant.
So, favourable number of outcomes = 4

Thus, P (arrow points at an odd number) = $\frac{4}{8} = \frac{1}{2}$

(iii) Since, there are 6 numbers greater than 2 (i.e. 3, 4, 5, 6, 7 and 8) on spinning plants
So, favourable number of outcomes = 6

Thus, P (arrow points at a number > 2) = $\frac{6}{8} = \frac{3}{4}$

(iv) Since, there are 8 numbers less than 9 (i.e. 1, 2, 3,...8) on spinning plant.
So, favourable number of outcomes = 8

Thus, P (arrow points at a number < 9) = $\frac{8}{8}$ = 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.

Sol. As we know that, in event of a single throw of a die we can get any one of the six numbers 1, 2, 3, 4, 5, 6 marked on its six faces.
So, the total number of outcomes in experiment of throwing a die = 6.

(i) Let A be the event of getting a prime number. Event A occurs if we obtain any one of 2, 3, 5 as an outcome.
So, favourable number of outcomes = 3

Thus, P(A) = $\frac{3}{6} = \frac{1}{2}$

(ii) Let B be the event of getting a number lying between 2 and 6. Event B occurs if we obtain any one of 3, 4, 5 as an outcome.
So, favourable number of outcomes = 3

Thus, P (B) = $\frac{3}{6} = \frac{1}{2}$

(iii) Let C be the event of getting an odd number. Event C occurs if we obtain any one of 1, 3, 5, as an outcome.
So, favourable number of outcomes = 3

Thus, P (A) = $\frac{3}{6} = \frac{1}{2}$

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**

Sol. Since, out of 52 cards, one card can be drawn in 52 ways.
So, total number of outcomes = 52
(i) There are two suits of king of red color cards i.e. diamond and heart. So, favourable number of

outcomes = 2 × 1 = 2

Thus, P (a king of red colour) = $\frac{2}{52} = \frac{1}{26}$

(ii) In a deck of 52 cards, kings, queens and jacks are called face cards. Thus, there are 12 face cards in a deck of 52 cards. So, one face card can be chosen in 12 ways.
So, favourable number of outcomes = 12

Thus, P (a face card) = $\frac{12}{52} = \frac{3}{13}$

(iii) There are two suits of red cards i.e. diamond and heart and each suit contains 3 face cards.
So, favourable number of outcomes = 2 × 3 = 6

Thus, P (a red dace card) = $\frac{6}{52} = \frac{3}{26}$

(iv) There is only one jack of hearts in a deck of 52 cards.
Thus, favourable number of outcomes = 1

Thus, P (the jack of hearts) = $\frac{1}{52}$

(v) There are 13 cards of spade in a deck of 52 cards.
So, favourable number of outcomes = 13

Thus, P (a spade) = $\frac{13}{52} = \frac{1}{4}$

(vi) There is only one queen of diamonds in a deck of 52 cards.
So, favourable number of outcomes = 1

Thus, P (the queen of diamonds) = $\frac{1}{52}$.

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 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?

Sol. Out of five cards, the ten, jack, queen, king and ace of diamonds, one card can be taken in 5 ways. So, total number of outcomes = 5

(i) There is only one queen in five card.
So, favourable number of outcomes = 1

Thus, P (the queen) = $\frac{1}{5}$

(ii) After taking the queen card and keep it aside, we are left with 4 cards. So total number of outcomes now = 4.

(a) There is only one ace in four cards.
So, favourable number of outcomes = 1

Thus, P (an ace) = $\frac{1}{4}$

(b) There is no card as queen.
So, favourable number of outcomes = 0

Thus, P (the queen) = $\frac{0}{4}$ = 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.

Sol. Total number of pens = 132 (good) + 12 (defective) = 144 pens.

Out of 144 pens, one pen can be chosen in 144 ways.
Total number of outcomes = 144
There are 132 good pens out of which one pen can be chosen in 132 ways.
Favourable number of outcomes = 132

Thus, P (getting a good pen) = $\frac{132}{144} = \frac{11}{12}$

Q.17 (i) A lot of 20 bulbs contains 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)** Since, out of 20 bulbs, one bulb can be taken in 20 ways.
So, total number of outcomes = 20
In 20 bulb, 4 defective bulbs out of which one bulb can be taken in 4 ways.

Thus, P (getting a defective bulb) = $\frac{4}{20} = \frac{1}{5}$

(ii) Since, on drawing a non-defective bulb out of 20 bulbs we are left with 19 bulbs including 4 defective bulbs.
So, total number of outcomes = 19
out of 19 bulb, 15 non-defective bulbs out of which one bulb can be drawn in 15 ways.
So, favourable number of outcomes = 15

Thus, P (getting a non – defective bulb) = $\frac{15}{19}$

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.

Sol. Since, there are total 90 discs bearing numbers 1 to 90 in the box and one disc can be drawn in 90 ways.
So, total number of outcomes = 90

(i) Out of 90 discs, 81 (90-9) discs bearing a two – digit number in the box of which one disc can be drawn in 81 ways.
So, favourable number of outcomes = 81

Thus, P (getting a disc bearing a two-digit number) = $\frac{81}{90} = \frac{9}{10}$.

(ii) Numbers from 1 to 90 which are perfect squares are 1, 4, 9, 16, 25, 36, 49, 64, 81 which are squares of 1, 2, 3, 4, 5, 6, 7, 8, and 9 respectively.
So, only 9 discs marked with numbers which are perfect squares.
So, favourable number of outcomes = 9
Thus, P (getting a disc marked with a number which is a perfect square)

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

(iii) Numbers from 1 to 90 which are divisible by 5 are 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85, and 90. There are 18 in number.
So, there are 18 discs marked with the numbers which are divisible by 5.
So, favourable number of outcomes = 18
Thus, P (getting a disc marked with a number which is divisible by 5)

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

Q.19 A child has a die whose six faces show the letters as given below:

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

Sol. In the experiment, throwing a die, we get any one of the six letters A, B, C, D, E, A marked on its faces.
So, total numbers of outcomes = 6.

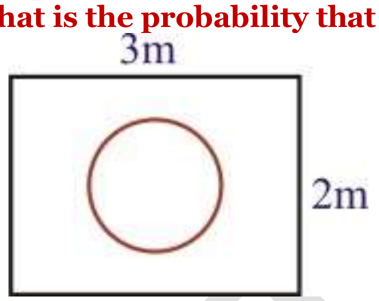
(i) Let E be the event of getting a letter “A”. So, event E occurs on the two faces.
So, favourable number of outcomes = 2

Thus, $P(E) = \frac{2}{6} = \frac{1}{3}$

(ii) Let F be the event of getting a letter “D”. So, event F occurs on the one face.
So, favourable number of outcomes = 1

Thus, $P(F) = \frac{1}{6}$

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



Sol. Total area of the rectangle = Length X Width
$= 3m \times 2m = 6m^2$

So, total number of outcomes = 6 cm^2

Area of the circle $= \pi r^2$

$= \pi \left(\frac{1}{2} m\right)^2$

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

Since, die will land inside the area of circle, so favourable out comes $= \frac{\pi}{4}$

Thus, P (die to 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?**

Sol. Since, there is a lot of 144 ball pens. Out of these 144 ball pens 20 are defective ball pens.
So, number of good pens= 144 – 20 = 124

(i) P (she will buy) = P (a non – defective pen)

$= \frac{124}{144} = \frac{31}{36}$

(ii) P (she will not buy) = P (a defective pen)

$= \frac{20}{144} = \frac{5}{36}$

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

Event : 'Sum of 2 dice'	Probability
2	1/36
3	
4	
5	
6	
7	
8	5/36
9	
10	
11	
12	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. Number of possible outcomes of event 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), (6, 6)

So, total number of outcomes = 6 × 6 = 36
Let A be the event of getting the sum as 3.
The favourable out comes to event A are (1, 2) and (2, 1)
So, favourable number of elementary events = 2

Thus, P(A) = $\frac{2}{36}$

Let B be the event of getting the sum as 4.
The favourable outcomes to event B are (1, 3), (3, 1) and (2, 2)
So, favourable number of outcomes = 3

Thus, P(B) = $\frac{3}{36}$

Let C be the event of getting the sum as 5.
The favourable outcomes to event C are (1, 4), (4, 1), (2, 3) and (3, 4)
So, favourable number of outcomes = 4

Thus, P(C) = $\frac{4}{36} = \frac{1}{9}$

Let D be the event of getting the sum as 6.
The favourable outcomes to event D are (1, 5), (5,1), (2, 4), (4, 2) and (3, 3)
So, favourable number of outcomes = 5

Thus, P(D) = $\frac{5}{36}$

Let E be the event of getting the sum as 7.
The favourable outcomes to event E are (1, 6), (6, 1), (2, 5), (5, 2), (3, 4), (4, 3)
So, favourable number of outcomes = 6

Thus, P (E) = $\frac{6}{36} = \frac{1}{6}$

Let F be the event of getting the sum as 9.
The favourable outcomes to event F are (3, 6), (6, 3), (4, 5) and (5, 4)
So, favourable number of outcomes = 4

Thus, P(F) = $\frac{4}{36} = \frac{1}{9}$

Let G be the event of getting the sum as 10.
The favourable outcome to event G are (4, 6), (6, 4), (5, 5)
So, favourable number of outcomes = 3

Thus, P(G) = $\frac{3}{36} = \frac{1}{12}$

Let H be the event of getting the sum as 11.
The favourable outcomes to event H are (5, 6), (6, 5)
So, favourable number of outcomes = 2

Thus, P(H) = $\frac{2}{36} = \frac{1}{18}$

Hence, the complete table is as under:

Event : 'Sum of 2 dice'	Probability
2	1/36
3	2/36
4	3/36
5	4/36
6	5/36
7	6/36
8	5/36
9	4/36
10	3/36
11	2/36
12	1/36

(ii) We do not agree with the given argument. Justification has already been given in part (i).

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.

Sol. In this experiment, a coin is tossed thrice. The outcomes associated with this experiment are: HHH, HHT, HTH, THH, TTH, HTT, THT, TTT
So, total number of outcomes = 8
Hinif will lose the game if he gets the outcomes: HHT, HTH, THH, TTH, HTT, THT.
So, favourable number of outcomes = 6

Thus, P (Lose the game) = $\frac{6}{8} = \frac{3}{4}$

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?

***Sol.* (i)** Lets consider the following events:
A = first throw shows 5,
B = second throw shows 5

P(A) = $\frac{6}{36}$, P(B) = $\frac{6}{36}$ and P($\overline{B}$) = $\frac{5}{6}$

$\Rightarrow$ P ($\overline{A}$) = $1 - \frac{6}{36} = \frac{30}{36} = \frac{5}{6}$

Thus, P (5 will not come up either time) = $\frac{5}{6} \times \frac{5}{6} = \frac{25}{36}$

(ii) Suppose S is the sample space associated with the random experiment of throwing a die twice.
Then, n(S) = 36
So, A ∩ B = first and second throw show which is getting 5 in each throw.
A = {(5, 1) (5, 2) (5, 3) (5, 4) (5, 5) (5, 6)}
And A = {(1, 5) (2, 5) (3, 5) (4, 5) (5, 6) (6, 5)}
So, $P(A) = \frac{6}{36}$, $P(B) = \frac{6}{36}$ and $P(A \cap B) = \frac{1}{36}$
Thus, P (5 will come up at least once) = Probability that at least one of the two throws shows 5.

$$= P(A \cup B) = P(A) + P(B) - P(A \cap B)$$

$$= \frac{6}{36} + \frac{6}{36} - \frac{1}{36} = \frac{11}{36}$$

Q.25 Which of the following arguments are correct and which are not correct? Give reasons for your answer.
(i) If two cons are tossed simultaneously there are three possible outcomes — tow 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)** This statement is incorrect. Since, we can classify the outcomes like this but they are not then, 'equally likely'. because 'one of each' can result in two ways, case-I:from a head on first coin and tail on the second coin, Case-II: 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) This statement is correct. Because these two outcomes considered in the question are equally likely.