

Chapter 14: Probability

Class 10 Math Chapter 14 Solutions (English Medium)

Exercise 14.1

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 is greater than or equal to _____ and less than or equal to _____.

(i) Probability of an event E + Probability of the event 'not E ' = **1**. (Since $P(E) + P(\bar{E}) = 1$)

(ii) The probability of an event that cannot happen is **0**. Such an event is called an **impossible event**.

(iii) The probability of an event that is certain to happen is **1**. Such an event is called a **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**. ($0 \leq P(E) \leq 1$)

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.

(i) Not equally likely: A car starting depends on various factors like fuel, engine condition, etc., not just chance. Therefore, the outcomes are not equally likely.

(ii) Not equally likely: Shooting a basketball depends on the player's skill, the distance from the basket, etc. It is not purely a matter of chance.

(iii) Equally likely: In a true–false question, there are only two possible outcomes (right or wrong), and both have an equal 50% chance of being selected in a random guess.

(iv) Equally likely: When a baby is born, biologically the chances of it being a boy or a girl are equal.

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?

When a coin is tossed, there are only two possible outcomes: Head (H) or Tail (T).

These outcomes are equally likely, meaning both have an exact 50% chance of occurring.

Because the result of tossing a coin is completely unpredictable and unbiased, it is considered a fair way to decide.

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

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

We know that the probability of any event must always be between 0 and 1, inclusive. ($0 \leq P(E) \leq 1$)

Probability cannot be a negative number. Option (B) is -1.5, which is negative.

Therefore, the correct answer is (B) -1.5.

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

Given: $P(E) = 0.05$

We know that $P(E) + P(\text{not } E) = 1$

Therefore, $P(\text{not } E) = 1 - P(E)$

$P(\text{not } E) = 1 - 0.05 = 0.95$

Hence, the probability of 'not E' is 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?

(i) Probability of an orange flavoured candy:

Since the bag contains ONLY lemon flavoured candies, taking out an orange candy is an **impossible event**.

Therefore, its probability is 0.

(ii) Probability of a lemon flavoured candy:

All the candies in the bag are lemon flavoured, so taking out a lemon candy is a **sure event**.

Therefore, its probability is 1.

Q 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?

Let E = Event that 2 students have the same birthday.

Then \bar{E} = Event that 2 students do NOT have the same birthday.

Given: $P(\bar{E}) = 0.992$

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

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

$$P(E) = 1 - 0.992 = 0.008$$

Hence, the probability that the 2 students have the same birthday is 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?

Number of red balls = 3

Number of black balls = 5

Total number of balls (Total possible outcomes) = $3 + 5 = 8$

(i) Probability that the ball drawn is red:

Number of favorable outcomes (red balls) = 3

$$P(\text{Red}) = \frac{\text{Number of favorable outcomes}}{\text{Total number of outcomes}} = \frac{3}{8}$$

(ii) Probability that the ball drawn is not red:

A ball that is not red must be a black ball.

$$P(\text{Not Red}) = 1 - P(\text{Red}) = 1 - \frac{3}{8} = \frac{8-3}{8} = \frac{5}{8}$$

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?

Number of red marbles = 5

Number of white marbles = 8

Number of green marbles = 4

Total number of marbles (Total possible outcomes) = $5 + 8 + 4 = 17$

(i) Probability of getting a red marble:

$$P(\text{Red}) = \frac{5}{17}$$

(ii) Probability of getting a white marble:

$$P(\text{White}) = \frac{8}{17}$$

(iii) Probability of getting a marble that is not green:

Number of green marbles = 4

$$P(\text{Green}) = \frac{4}{17}$$

$$P(\text{Not Green}) = 1 - P(\text{Green}) = 1 - \frac{4}{17} = \frac{17-4}{17} = \frac{13}{17}$$

(Alternatively: Marbles that are not green are either red or white = $5 + 8 = 13$.)

Thus, probability is $\frac{13}{17}$.)

Q 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 bank is turned upside down, what is the probability that the coin

(i) will be a 50 p coin ?

(ii) will not be a ₹ 5 coin?

Number of 50p coins = 100

Number of ₹ 1 coins = 50

Number of ₹ 2 coins = 20

Number of ₹ 5 coins = 10

Total number of coins (Total possible outcomes) = $100 + 50 + 20 + 10 = 180$

(i) Probability of getting a 50p coin:

Number of 50p coins = 100

$$P(\text{50p coin}) = \frac{100}{180} = \frac{5}{9}$$

(ii) Probability of not getting a ₹ 5 coin:

Number of ₹ 5 coins = 10

Number of coins that are not ₹ 5 coins = $180 - 10 = 170$

$$P(\text{Not a ₹ 5 coin}) = \frac{170}{180} = \frac{17}{18}$$

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 fish and 8 female fish (see Fig. 14.4). What is the probability that the fish taken out is a male fish?

Number of male fish = 5

Number of female fish = 8

Total number of fish (Total possible outcomes) = $5 + 8 = 13$

Number of favorable outcomes (male fish) = 5

$$P(\text{Male fish}) = \frac{\text{Number of favorable outcomes}}{\text{Total number of outcomes}} = \frac{5}{13}$$

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. 14.5), 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 ?

Total possible outcomes = $\{1, 2, 3, 4, 5, 6, 7, 8\}$

Total number of outcomes = 8

(i) Probability that it points at 8:

Favorable outcome = $\{8\}$ (Only 1 number)

$$P(\text{Pointing at 8}) = \frac{1}{8}$$

(ii) Probability that it points at an odd number:

Odd numbers = $\{1, 3, 5, 7\}$ (Total 4 numbers)

$$P(\text{Odd number}) = \frac{4}{8} = \frac{1}{2}$$

(iii) Probability that it points at a number greater than 2:

Numbers greater than 2 = $\{3, 4, 5, 6, 7, 8\}$ (Total 6 numbers)

$$P(\text{Number} > 2) = \frac{6}{8} = \frac{3}{4}$$

(iv) Probability that it points at a number less than 9:

Numbers less than 9 = $\{1, 2, 3, 4, 5, 6, 7, 8\}$ (Total 8 numbers)

$$P(\text{Number} < 9) = \frac{8}{8} = 1$$

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.

Total possible outcomes when a die is thrown = $\{1, 2, 3, 4, 5, 6\}$

Total number of outcomes = 6

(i) Probability of getting a prime number:

Prime numbers = $\{2, 3, 5\}$ (Total 3 numbers)

$$P(\text{Prime number}) = \frac{3}{6} = \frac{1}{2}$$

(ii) Probability of getting a number lying between 2 and 6:

Numbers between 2 and 6 = $\{3, 4, 5\}$ (Total 3 numbers)

$$P(\text{Number between 2 and 6}) = \frac{3}{6} = \frac{1}{2}$$

(iii) Probability of getting an odd number:

Odd numbers = $\{1, 3, 5\}$ (Total 3 numbers)

$$P(\text{Odd number}) = \frac{3}{6} = \frac{1}{2}$$

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

Total number of cards in a deck = 52

(i) A king of red colour:

There are 2 red kings (one heart, one diamond).

$$P(\text{Red king}) = \frac{2}{52} = \frac{1}{26}$$

(ii) A face card:

Face cards = 4 kings + 4 queens + 4 jacks = 12

$$P(\text{Face card}) = \frac{12}{52} = \frac{3}{13}$$

(iii) A red face card:

Out of 12 face cards, 6 are red and 6 are black.

$$P(\text{Red face card}) = \frac{6}{52} = \frac{3}{26}$$

(iv) The jack of hearts:

There is only 1 jack of hearts.

$$P(\text{Jack of hearts}) = \frac{1}{52}$$

(v) A spade:

There are 13 spades in the deck.

$$P(\text{A spade}) = \frac{13}{52} = \frac{1}{4}$$

(vi) The queen of diamonds:

There is only 1 queen of diamonds.

$$P(\text{Queen of diamonds}) = \frac{1}{52}$$

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?

Total number of cards = 5 (ten, jack, queen, king, ace)

(i) Probability that the card is the queen:

Number of queens = 1

$$P(\text{Queen}) = \frac{1}{5}$$

(ii) If the queen is drawn and put aside:

Now, remaining number of cards = $5 - 1 = 4$ (ten, jack, king, ace)

(a) Probability of getting an ace:

Number of aces = 1

$$P(\text{Ace}) = \frac{1}{4}$$

(b) Probability of getting a queen:

There is no queen left among the 4 cards, so favorable outcome = 0

$$P(\text{Queen}) = \frac{0}{4} = 0$$

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.

Number of defective pens = 12

Number of good pens = 132

Total number of pens = $132 + 12 = 144$

Number of favorable outcomes (good pen) = 132

$$P(\text{Good pen}) = \frac{132}{144} = \frac{11}{12}$$

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 ?

(i) Probability that the bulb is defective:

Total number of bulbs = 20

Number of defective bulbs = 4

$$P(\text{Defective bulb}) = \frac{4}{20} = \frac{1}{5}$$

(ii) Probability that the bulb is not defective (if the first bulb was not defective and is kept aside):

Since the first drawn bulb was not defective (i.e., it was a good bulb) and not replaced:

Remaining total number of bulbs = $20 - 1 = 19$

Initial number of good bulbs = $20 - 4 = 16$. After keeping one good bulb aside, remaining good bulbs = $16 - 1 = 15$

$$P(\text{Not defective bulb}) = \frac{15}{19}$$

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.

Total number of discs (Total possible outcomes) = 90

(i) A two-digit number:

Single-digit numbers from 1 to 90 are 1 to 9 (Total 9).

Therefore, number of two-digit numbers = $90 - 9 = 81$

$$P(\text{Two-digit number}) = \frac{81}{90} = \frac{9}{10}$$

(ii) A perfect square number:

Perfect square numbers from 1 to 90 = {1, 4, 9, 16, 25, 36, 49, 64, 81} (Total 9)

$$P(\text{Perfect square number}) = \frac{9}{90} = \frac{1}{10}$$

(iii) A number divisible by 5:

Numbers divisible by 5 = {5, 10, 15, ..., 90}

$$\text{Total such numbers} = \frac{90}{5} = 18$$

$$P(\text{Number divisible by 5}) = \frac{18}{90} = \frac{1}{5}$$

Q 19. A child has a die whose six faces show the letters as given below: A, B, C, D, E, A

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

Total number of faces on the die (Total possible outcomes) = 6

(i) Probability of getting A:

The letter 'A' appears on 2 faces. Favorable outcomes = 2

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

(ii) Probability of getting D:

The letter 'D' appears on 1 face. Favorable outcome = 1

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

Q 20*. Suppose you drop a die at random on the rectangular region shown in Fig. 14.6 (length 3 m and width 2 m). What is the probability that it will land inside the circle with diameter 1m?

Here, the probability is calculated based on the area.

Total area of the rectangular region (Total possible outcome space)
= Length \times Width = 3 m \times 2 m = 6 m²

Diameter of the circle = 1 m, so radius $r = \frac{1}{2}$ m

Area of the circle (Favorable outcome space) = $\pi r^2 = \pi \left(\frac{1}{2}\right)^2 = \frac{\pi}{4}$ m²

$$P(\text{Die landing inside the circle}) = \frac{\text{Area of the circle}}{\text{Area of the rectangle}} = \frac{\frac{\pi}{4}}{6} = \frac{\pi}{24}$$

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?

Total number of pens = 144

Number of defective pens = 20

Number of good pens = 144 - 20 = 124

(i) Probability that she will buy it:

She will buy the pen only if it is good. Favorable outcomes (good pens) = 124

$$P(\text{She buys it}) = \frac{124}{144} = \frac{31}{36}$$

(ii) Probability that she will not buy it:

She will not buy the pen if it is defective. Favorable outcomes (defective pens)
= 20

$$P(\text{She will not buy it}) = \frac{20}{144} = \frac{5}{36}$$

Q 22. (i) Complete the following table for the 'Sum on 2 dice' when two dice are thrown simultaneously:

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.

(i) Completing the table:

When two dice are thrown, total possible outcomes = $6 \times 6 = 36$.

Sum	Favorable Outcomes	Probability
2	(1,1) → 1	$\frac{1}{36}$
3	(1,2), (2,1) → 2	$\frac{2}{36} = \frac{1}{18}$
4	(1,3), (2,2), (3,1) → 3	$\frac{3}{36} = \frac{1}{12}$
5	(1,4), (2,3), (3,2), (4,1) → 4	$\frac{4}{36} = \frac{1}{9}$
6	(1,5), (2,4), (3,3), (4,2), (5,1) → 5	$\frac{5}{36}$
7	(1,6), (2,5), (3,4), (4,3), (5,2), (6,1) → 6	$\frac{6}{36} = \frac{1}{6}$
8	(2,6), (3,5), (4,4), (5,3), (6,2) → 5	$\frac{5}{36}$
9	(3,6), (4,5), (5,4), (6,3) → 4	$\frac{4}{36} = \frac{1}{9}$
10	(4,6), (5,5), (6,4) → 3	$\frac{3}{36} = \frac{1}{12}$
11	(5,6), (6,5) → 2	$\frac{2}{36} = \frac{1}{18}$
12	(6,6) → 1	$\frac{1}{36}$

(ii) Answer to the student's argument:

No, we **do not agree** with this argument.

Reason: The 11 outcomes (sums 2 to 12) are **not equally likely**. For instance, there is only 1 way to get a sum of 2 (1,1), but there are 6 ways to get a sum of 7. Since their individual probabilities are different, the probability of each outcome cannot be $\frac{1}{11}$.

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.

Total possible outcomes when a coin is tossed 3 times (8 outcomes):

$$S = \{HHH, HHT, HTH, THH, HTT, THT, TTH, TTT\}$$

Total number of outcomes = 8

Hanif wins if all outcomes are same (HHH or TTT). Favorable outcomes for winning = 2

Hanif loses if the outcomes are not all the same.

Favorable outcomes for losing = $8 - 2 = 6$

$$\{HHT, HTH, THH, HTT, THT, TTH\}$$

$$P(\text{Hanif loses}) = \frac{6}{8} = \frac{3}{4}$$

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?

Total possible outcomes when a die is thrown twice = $6 \times 6 = 36$.

The outcomes in which 5 comes up at least once are:

$$(1, 5), (2, 5), (3, 5), (4, 5), (5, 5), (6, 5), \\ (5, 1), (5, 2), (5, 3), (5, 4), (5, 6)$$

Total such outcomes = 11

(ii) 5 will come up at least once:

Favorable outcomes = 11

$$P(5 \text{ comes up at least once}) = \frac{11}{36}$$

(i) 5 will not come up either time:

$$\text{Favorable outcomes} = \text{Total outcomes} - (\text{Outcomes with 5}) = 36 - 11 = 25$$

$$P(5 \text{ will not come up either time}) = \frac{25}{36}$$

$$(\text{Or } P(\text{not } E) = 1 - P(E) = 1 - \frac{11}{36} = \frac{25}{36})$$

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 $\frac{1}{2}$.

(i) Incorrect argument:

Reason: When two coins are tossed, there are 4 possible outcomes: (H,H), (H,T), (T,H), (T,T).

$$\text{Probability of two heads (H,H)} = \frac{1}{4}$$

$$\text{Probability of two tails (T,T)} = \frac{1}{4}$$

$$\text{Probability of one of each (H,T or T,H)} = \frac{2}{4} = \frac{1}{2}$$

Since these three grouped outcomes are not equally likely, the probability of each is not $\frac{1}{3}$.

(ii) Correct argument:

Reason: When a die is thrown, the 6 outcomes are {1, 2, 3, 4, 5, 6}.

Among these, there are 3 odd numbers (1, 3, 5) and 3 even numbers (2, 4, 6).

$$\text{Probability of getting an odd number} = \frac{3}{6} = \frac{1}{2}$$

The argument is correct because the event of getting an odd number and getting an even number are equally likely.