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Probability

Checkpoint (Page 257)

1. If P(A) denotes the probability of an event A, then
(*a*) $P(A) > 1$ (*b*) $P(A) < 0$
(*c*) $-1 \le P(A) \le 1$ (*d*) $0 \le P(A) \le 1$

Sol. (*d*) $0 \le P(A) \le 1$

2. If A is a certain event, then
(*a*) $P(A) = 0$ (*b*) $P(A) = 1$
(*c*) $P(A) = -1$ (*d*) $P(A) > 1$

Sol. (*b*) $P(A) = 1$

3. A die is thrown once. The probability of getting a prime number is
(*a*) $\frac{1}{2}$ (*b*) $\frac{2}{3}$
(*c*) $\frac{1}{3}$ (*d*) $\frac{1}{4}$

Sol. (*a*) Total number of possible outcomes = 6
Number of favourable outcomes = {2, 3, 5} = 3
$\therefore$ P(getting a prime number)
$$= \frac{\text{Favourable outcomes}}{\text{Possible outcomes}}$$
$$= \frac{3}{6} = \frac{1}{2}$$

4. A bag contains 5 white and 7 red balls. A ball is drawn at random from the bag. Then the probability of getting a white ball is
(*a*) $\frac{1}{2}$ (*b*) $\frac{2}{3}$
(*c*) $\frac{5}{12}$ (*d*) $\frac{7}{12}$

Sol. (*c*) Total number of possible outcomes = 5 + 7 = 12
Number of white balls = 5
$\therefore$ P(white balls) = $\frac{5}{12}$

5. In a lucky draw, there are 5 prizes and 20 blanks. What is the probability of getting a prize?

Sol. Total number of possible outcomes = 5 + 20 = 25
Number of favourable outcomes = 5
$\therefore$ P(getting a prize) = $\frac{5}{25} = \frac{1}{5}$

6. If the probability of an event happening is p where $p < 1$, then what is the probability of the event not happening?

Sol. Probability of getting an event = p
Since the probability of a sure event is 1.
$\therefore$ Probability of not getting an event = $1 - p$

7. What is the probability of getting a number greater than 6 in the throwing of a die?

Sol. Total number of possible outcomes = 6
Number of favourable outcome = 0
$\therefore$ Probability of getting a number greater than 6 in the throwing of a die = $\frac{0}{6} = 0$

8. What is the probability of getting an even number more than 2 in the throwing of a die once?

Sol. Total number of possible outcomes = 6
Number of favourable outcomes = {4, 6} = 2
$\therefore$ P (getting an even number more than 2 in the throwing of a die) = $\frac{2}{6} = \frac{1}{3}$

9. In tossing a coin, what is the sum of the probability of getting a head and a tail?

Sol. Total number of possible outcomes = 2
Number of favourable outcomes = {H, T} = 2
P(sum of getting a head and a tail) = $\frac{2}{2} = 1$

10. Out of a deck of 52 cards, a card is drawn at random. What is the probability of getting a card which is king?

Sol. Since there are 4 kings out of deck of 52 cards

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

$$= \frac{4}{52} = \frac{1}{13}$$

Check Your Progress

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Multiple-Choice Questions

1. If a die is thrown once, the probability of getting an even prime number is

(*a*) $\frac{1}{2}$ (*b*) $\frac{2}{6}$

(*c*) $\frac{1}{6}$ (*d*) $\frac{2}{3}$

Sol. (*c*) $\frac{1}{6}$

Favourable outcomes of event "getting an even prime number" is 2.

$\therefore$ Number of favourable outcome = 1

Total number of possible outcomes = 6

Hence, P (even prime number)

$$= \frac{\text{Number of favourable outcome}}{\text{Total number of possible outcomes}} = \frac{1}{6}$$

2. A card is drawn from a well-shuffled deck of 52 cards. The probability that the card will not be an ace is

(*a*) $\frac{12}{13}$ (*b*) $\frac{1}{13}$

(*c*) $\frac{1}{4}$ (*d*) $\frac{10}{13}$ **[CBSE 2011]**

Sol. (*a*) $\frac{12}{13}$

P(not an ace)

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

$$= \frac{52-4}{52} = \frac{48}{52} = \frac{12}{13}$$

3. A die is thrown once. Find the probability of getting a number less than 7.

(*a*) $\frac{5}{6}$ (*b*) 1

(*c*) $\frac{1}{6}$ (*d*) 0 **[CBSE 2023 Basic]**

Sol. (*b*) 1

Favourable outcomes = 1, 2, 3, 4, 5, 6

$\therefore$ Number of favourable outcomes = 6

Total number of possible outcomes = 6

Hence, P(getting a number less than 7)

$$= \frac{\text{Number of favourable outcomes}}{\text{Total number of possible outcomes}} = \frac{6}{6} = 1$$

4. A card is drawn at random from a well-shuffled deck of 52 playing cards. The probability of getting an ace of spade is

(*a*) $\frac{1}{13}$ (*b*) $\frac{3}{52}$

(*c*) $\frac{1}{26}$ (*d*) $\frac{1}{52}$ **[CBSE 2023 Basic]**

Sol. (*d*) $\frac{1}{52}$

There is only one ace of spade card.

$\therefore$ Number of favourable outcome = 1

Total number of possible outcomes = 52

$\therefore$ P(getting an ace of spade) = $\frac{1}{52}$

5. A die is rolled once. The probability that a composite number comes up is

(*a*) $\frac{1}{2}$ (*b*) $\frac{2}{3}$

(*c*) $\frac{1}{3}$ (*d*) 0

Sol. (*c*) $\frac{1}{3}$

The composite numbers are 4 and 6.

Number of favourable outcomes = 2

Total number of possible outcomes = 6

Hence, P(a composite number)

$$= \frac{\text{Number of favourable outcomes}}{\text{Total number of possible outcomes}} = \frac{2}{6} = \frac{1}{3}$$

6. From a well-shuffled deck of 52 playing cards, a card is drawn at random. What is the probability of getting a red queen?

(*a*) $\frac{1}{52}$ (*b*) $\frac{1}{26}$

(*c*) $\frac{1}{13}$ (*d*) $\frac{12}{13}$

Sol. (*b*) $\frac{1}{26}$

There are 2 red queen in a deck of 52 playing cards.

Number of favourable outcomes = 2

Total number of possible outcomes = 52

Hence, P(getting a red queen) = $\frac{2}{52} = \frac{1}{26}$

7. One card is drawn at random from a well-shuffled deck of 52 playing cards. What is the probability of getting '4 of hearts'?

(*a*) $\frac{1}{52}$ (*b*) $\frac{1}{13}$

(*c*) $\frac{1}{26}$ (*d*) $\frac{1}{6}$

Sol. (*a*) $\frac{1}{52}$

There is only one 4 of hearts.

$\therefore$ Number of favourable outcome = 1

Total number of possible outcomes = 52

Hence, P(getting 4 of hearts) = $\frac{1}{52}$

8. An unbiased die is thrown. The probability of getting an odd prime number is

(*a*) $\frac{1}{6}$ (*b*) $\frac{1}{2}$

(*c*) $\frac{2}{3}$ (*d*) $\frac{1}{3}$

Sol. (*d*) $\frac{1}{3}$

Odd prime numbers are 3 and 5.

$\therefore$ Number of favourable outcomes = 2

Total number of possible outcomes = 6

Hence, P(getting an odd prime number)

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

9. 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 (*d*) 750

[CBSE 2023 Standard]

Sol. (*c*) 480

Probability of winning = 0.08

Total tickets sold = 6000

Total number of possible outcomes = 6000

Number of tickets bought = Number of favourable outcomes

$\therefore \quad 0.08 = \frac{\text{Number of tickets bought}}{6000}$

$\therefore$ Number of tickets bought = $0.08 \times 6000 = 480$

10. A bag contains 100 cards numbered 1 to 100. A card is drawn at random from the bag. What is the probability that the number on the card is a perfect cube?

(*a*) $\frac{1}{20}$ (*b*) $\frac{3}{50}$

(*c*) $\frac{1}{25}$ (*d*) $\frac{7}{100}$

[CBSE 2023 Standard]

Sol. (*c*) $\frac{1}{25}$

Perfect cubes between 1 and 100 = 1, 8, 27, 64

Number of favourable outcomes = 4

Total number of possible outcomes = 100

Hence, P(number on the card is a perfect cube)

$= \frac{4}{100} = \frac{1}{25}$

11. If three coins are tossed simultaneously, what is the probability of getting at most one tail?

(*a*) $\frac{3}{8}$ (*b*) $\frac{4}{8}$

(*c*) $\frac{5}{8}$ (*d*) $\frac{7}{8}$

[CBSE 2023 Standard]

Sol. (*b*) $\frac{4}{8}$

The possible outcomes are HHH, HHT, HTH, THH, HTT, THT, TTH, TTT.

Number of favourable outcomes = 4

Total number of possible outcomes = 8

Hence, P(getting at most one tail) = $\frac{4}{8}$

12. A bag contains 5 pink, 8 blue and 7 yellow balls. One ball is drawn at random from the bag. What is the probability of getting neither a blue or a pink ball?

(*a*) $\frac{1}{4}$ (*b*) $\frac{2}{5}$

(*c*) $\frac{7}{20}$ (*d*) $\frac{13}{20}$

Sol. (*c*) $\frac{7}{20}$

Probability of getting neither a blue of a pink ball

= Probability of getting a yellow ball = $\frac{7}{20}$

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

(a) 52% (b) $\frac{1}{3}$ %

(c) 0.99 (d) $\frac{1}{0.99}$ **[CBSE 2024 Basic]**

Sol. (d) $\frac{1}{0.99}$

The probability of an even always lies between 0 and 1.

14. Two dice are thrown together. The probability of getting the difference of numbers on their upper faces equals to 3 is

(a) $\frac{1}{9}$ (b) $\frac{2}{9}$

(c) $\frac{1}{6}$ (d) $\frac{1}{12}$

Sol. (c) $\frac{1}{6}$

All possible outcomes under two dice are thrown together, are as follows:

(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)

Hence, the total number of possible outcomes

= 36

The favourable outcomes are

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

$\therefore$ $P = \frac{6}{36} = \frac{1}{6}$

15. Two dice are rolled together. The probability of getting the sum of the two numbers to be more than 10, is

(a) $\frac{1}{9}$ (b) $\frac{1}{6}$

(c) $\frac{7}{12}$ (d) $\frac{1}{12}$

[CBSE 2024 Standard]

Sol. (d) $\frac{1}{12}$

All possible outcomes when two dice are rolled together, are as follows:

(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)

Hence, the total number of possible outcomes

= 36

The favourable outcomes are as follows:

(5, 6) (6, 5) (6, 6)

$\therefore$ $P = \frac{3}{36} = \frac{1}{12}$

16. From the data 1, 4, 7, 9, 16, 21, 25, if all the even numbers are removed, then the probability of getting at random a prime number from the remaining is

(a) $\frac{2}{5}$ (b) $\frac{1}{5}$

(c) $\frac{1}{7}$ (d) $\frac{2}{7}$

[CBSE 2024 Standard]

Sol. (b) $\frac{1}{5}$

After removing all the even numbers the data is 1, 7, 9, 21, 25.

Prime number is only one, that is 7.

$\therefore$ $P = \frac{1}{5}$

17. The probability of guessing the correct answer to a certain test question is $\frac{x}{6}$. If the probability of not guessing the correct answer to this question is $\frac{2}{3}$, then the value of x is

(a) 2 (b) 3

(c) 4 (d) 6 **[CBSE 2024 Standard]**

Sol. (a) 2

The sum of all probabilities is 1.

$\therefore$ $\frac{x}{6} + \frac{2}{3} = 1$

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

$\Rightarrow$ $x = \frac{6}{3}$

$\therefore$ $x = 2$

18. For an event E, if $P(E) + P(\bar{E}) = q$, then the value of $q^2 - 4$ is

(a) –3 (b) 3

(c) 5 (d) –5

Sol. (a) –3

Given $P(E) + P(\overline{E}) = q$

But $P(E) + P(\overline{E}) = 1$

$\therefore \quad q = 1$

$\Rightarrow \quad q^2 - 4 = 1 - 4 = -3$

Very Short Answer Type Questions

19. A number which is a multiple of 4 is selected at random from the numbers 1, 2, 3, 4, 5, …, 15. Find the probability of selecting this number.

Sol. Total number of possible outcomes = 15

Outcomes favourable to the event "Multiple of 4 from the numbers 1, 2, 3, …, 15" are 4, 8, 12

$\therefore$ Number of favourable outcomes = 3

Hence, P (multiple of 4 from selected numbers)

$$= \frac{3}{15} = \frac{1}{5}$$

20. Find the probability of getting a number which is neither a prime nor a composite from the numbers 1, 4, 7, 13, 16 and 25.

Sol. Total number of possible outcomes = 6

Outcomes favourable to the event = 1

$\therefore$ Number of favourable outcomes = 1

Hence, P (neither a prime nor a composite from selected numbers) = $\frac{1}{6}$

21. 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 a number divisible by 5. **[CBSE 2017, SP 2011]**

Sol. Total number of possible outcomes = 90

Number divisible by 5 from 1 to 90 are 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85, 90.

Thus, the number of favourable ways of "getting a number divisible by 5" = 18

Hence, P (a number divisible by 5) = $\frac{18}{90} = \frac{1}{5}$

22. 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, find the number of blue balls in the bag.

Sol. Given number of red balls = 5

Let the number of blue balls be x.

Probability of drawing a red ball = $\frac{5}{x+5}$

$\therefore$ As per given condition,

$$\text{P(blue ball)} = 2\left(\frac{5}{x+5}\right)$$

$$\Rightarrow \quad \frac{x}{x+5} = \frac{10}{x+5}$$

$$\Rightarrow \quad x = 10$$

$\therefore$ Number of blue balls in the bag = 10

23. From a well-shuffled deck of 52 playing cards, all diamonds cards are removed. Now, a card is drawn from the remaining pack at random. Find the probability that the selected card is a king. **[CBSE 2023 Basic]**

Sol. Number of cards left in the deck = 52 – 13 = 39

Number of kings remaining = 3

$$\text{P(selected card in a king)} = \frac{3}{39} = \frac{1}{13}$$

24. A bag contains 4 red, 5 white and some yellow balls. If probability of drawing a red ball at random is $\frac{1}{5}$, then find the probability of drawing a yellow ball at random.

Sol. Let the number of yellow balls = x

Total number of balls = $4 + 5 + x = 9 + x$

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

$$\Rightarrow \quad \frac{4}{9+x} = \frac{1}{5}$$

$$\Rightarrow \quad x = 11$$

$$\therefore \quad \text{P(yellow)} = \frac{11}{9+11} = \frac{11}{20}$$

25. 15 defective pens are accidently mixed with 145 good ones. One pen is taken out at random from this lot. Determine the probability that the pen taken out is a good one. **[CBSE 2024 Basic]**

Sol. Number of defective pens = 15

Number of good pens = 145

Total number of pens = 15 + 145 = 160

$\therefore$ P(good pen) = $\frac{145}{160} = \frac{29}{32}$

26. A carton consists of 60 shirts of which 48 are good, 8 have major defects and 4 have minor defects. Nigam, a trader, will accept the shirts which are good but Anmol, another trader, will only reject the shirts which have major defects. One shirt is drawn at random from the carton. Find the probability that it is acceptable to Anmol. **[CBSE 2024 Standard]**

Sol. Total number of shirts = 60

Number of good shirts = 48

Number of shirts with major defects = 8

Number of shirts with minor defects = 4.

Anmol will reject shirts with major defects.

Number of good shirts + shirts with minor defects

$= 48 + 4 = 52$

$\therefore$ P(Anmol) $= \frac{52}{60} = \frac{13}{15}$

Short Answer Type Questions

27. In a single throw of two dice, find the probability that the total number of dots obtained is a multiple of 3.

Sol. The possible outcomes when two dice are thrown are as follows:

(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)

$\therefore$ Total number of possible outcomes = 36

Favourable outcomes to the event = (1, 2), (1, 5), (2, 1), (2, 4), (3, 1), (3, 6), (4, 2), (4, 5), (5, 1), (5, 4), (6, 3), (6, 6)

$\therefore$ Total number of favourable outcomes =12

Hence, P (total number of dots is a multiple of 3)

$= \frac{12}{36} = \frac{1}{3}$

28. 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. 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?

[CBSE SP 2011]

Sol. If the queen drawn is put aside, then the number of well-shuffled cards left = 4

Out of 4 well-shuffled cards, one card can be drawn in 4 ways.

$\therefore$ Total number of possible outcomes = 4

(*a*) There is only one ace in the remaining 4 cards.

$\therefore$ Number of favourable outcomes = 1

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

(*b*) If the queen drawn is put aside, then the four remaining well-shuffled cards do not contain any queen

$\therefore$ Number of favourable outcomes = 0

Hence, P(a queen) $= \frac{0}{4} = 0$

29. Two dice are tossed simultaneously. Find the probability of getting

(*a*) an even number on the both the dice

(*b*) the sum of two numbers more than 9.

[CBSE 2024 Basic]

Sol. All possible outcomes when two dice are tossed simultaneously, are as follows:

(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)

Total number of possible outcomes = 36.

(*a*) The favourable outcomes are = (2, 2) (2, 4) (2, 6) (4, 2) (4, 4) (4, 6) (6, 2) (6, 4) (6, 6)

Number of favourable outcomes = 9

$\therefore$ P(even number of both the dice) $= \frac{9}{36} = \frac{1}{4}$

(*b*) The favourable outcomes are (4, 6) (5, 5) (5, 6) (6, 4) (6, 5) (6, 6)

$\therefore$ Number of favourable outcomes = 6.

$\therefore$ P $= \frac{6}{36} = \frac{1}{6}$

30. Three coins are tossed simultaneously. What is the probability of getting

(*a*) at least one head? (*b*) exactly two tails?

(*c*) at most one tail? **[CBSE 2024 Standard]**

Sol. When three coins are tossed simultaneously, the possible outcomes are HHH, HHT, HTH, THH, HTT, THT, TTH and TTT.

$\therefore$ Total number of possible outcomes = 8.

(*a*) at least one head.

The favourable outcomes are HHH, HHT, HTH, THH, HTT, THT, TTH

P(at least one head) $= \frac{7}{8}$

(*b*) exactly two tails.

The favourable outcomes are HTT, THT, TTH

P(at least two tails) $= \frac{3}{8}$

(*c*) at most one tail.

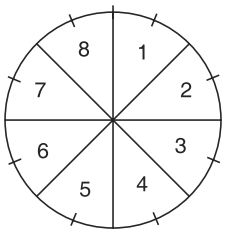
The favourable outcomes are HHH, HHT, HTH, THH

P(at most one tail) $= \frac{4}{8} = \frac{1}{2}$

Long Answer Type Questions

31. 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 and these are equally likely outcomes. What is the probability that it will point at



(*a*) 8

(*b*) an odd number

(*c*) a number greater than 2

(*d*) a number less than 9? **[CBSE SP 2011]**

Sol. The arrow can come to rest pointing at any one of the numbers 1, 2, 3, 4, 5, 6, 7, 8.

$\therefore$ Total number of possible outcomes = 8

(*a*) Number 8 is marked only once.

Thus, the number of favourable ways of 'arrow pointing at 8' is 1.

Hence, P(arrow will point at 8) = $\frac{1}{8}$

(*b*) There are four odd numbers namely 1, 3, 5, 7.

Thus, the number of favourable ways of 'arrow pointing at an odd number' = 4

Hence, P(arrow will point at an odd number)

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

(*c*) There are six numbers greater than 2, namely 3, 4, 5, 6, 7, 8

Thus, the number of favourable ways of 'arrow pointing at a number greater than 2' = 6

Hence, P(arrow will point at a number greater than 2) = $\frac{6}{8} = \frac{3}{4}$

(*d*) There are eight numbers less than 9, namely 1, 2, 3, 4, 5, 6, 7, 8.

Thus, the number of favourable ways of 'arrow pointing at a number less than 9' = 8

Hence, P(arrow will point at a number less than 9) = $\frac{8}{8} = 1$

32. 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 lose otherwise. Calculate the probability that Hanif will lose the game. **[CBSE 2009 C, SP 2011, 2016]**

Sol. When a coin is tossed three times, possible outcomes are

HHH, HHT, HTH, THH, HTT, THT, TTH, TTT

$\therefore$ Total number of possible outcomes = 8

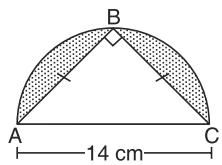
Hanif will lose the game if all the tosses do not give the same result, i.e. three heads or three tails.

So, favourable outcomes are HHT, HTH, THH, HTT, THT, TTH

Thus, the number of favourable outcomes = 6

Hence, P(Hanif will lose the game) = $\frac{6}{8} = \frac{3}{4}$

33. The figure given below shows a semicircle, in which an isosceles right triangle is drawn with its hypotenuse on the diameter of the semicircle. The diameter of the semicircle is 14 cm. A point is selected at random inside the semicircle. Find the probability that the point lies in the shaded region.



Sol. Diameter = 14 cm

$\therefore$ Radius of semicircle = $\frac{14}{2}$ cm = 7 cm

Area of semicircle = $\frac{r^2}{2}$

$= \frac{1}{2} \times \frac{22}{7} \times 7 \times 7 \text{ cm}^2$

$= 77 \text{ cm}^2$

Since ΔABC is a right triangle.

$\therefore$ By Pythagoras' Theorem

$AC^2 = AB^2 + BC^2$

$\Rightarrow \quad 14^2 = AB^2 + AB^2 \quad [\because AB = BC]$

$\Rightarrow \quad 14^2 = 2AB^2$

$\Rightarrow \quad AB^2 = \frac{14 \times 14}{2} \text{ cm}^2 = 98 \text{ cm}^2$

$\Rightarrow \quad AB = 7\sqrt{2} \text{ cm}$

$\therefore \quad AB = AC = 7\sqrt{2} \text{ cm}$

Area of isosceles right triangle

$= \frac{1}{2} \times \text{base} \times \text{height}$

$= \frac{1}{2} \times 7\sqrt{2} \text{ cm} \times 7\sqrt{2} \text{ cm}$

$= 49 \text{ cm}^2$

Area of shaded region

= Area of semicircle – Area of triangle

= 77 cm^2 – 49 cm^2

= 28 cm^2

Hence, the required probability that the point lies in the shaded region

$$= \frac{\text{Area of shaded region}}{\text{Area of semicircle}}$$

$$= \frac{28\ cm^2}{77\ cm^2} = \frac{4}{11}$$

Higher Order Thinking Skills (HOTS) Questions

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1. In the simultaneous throw of a pair of dice, find the probability of getting

(*a*) an even number on the first die

(*b*) 7 as the sum

(*c*) a sum greater than 10

(*d*) a sum less than 5

(*e*) an even number on one and a multiple of 3 on the other

(*f*) a doublet

(*g*) a doublet of prime numbers.

Sol. When two dice are throw, the possible outcomes are

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

$\therefore$ Total number of possible outcomes = 36

(*a*) Outcomes favourable to the event 'an even number on the first die' are (2, 1), (2, 2), (2, 3), (2, 4), (2, 5), (2, 6), (4, 1), (4, 2), (4, 3), (4, 4), (4, 5), (4, 6), (6, 1), (6, 2), (6, 3), (6, 4), (6, 5), (6, 6)

$\therefore$ Number of favourable outcomes = 18

Hence, P(an even number on the first die)

$$= \frac{18}{36} = \frac{1}{2}$$

(*b*) Outcomes favourable of the event '7 as the sum' are (1, 6), (6, 1), (2, 5), (5, 2), (3, 4), (4, 3)

$\therefore$ Number of favourable outcomes = 6

Hence, P(7 as the sum) = $\frac{6}{36} = \frac{1}{6}$

(*c*) Outcomes favourable to the event 'a sum greater than 10' are (5, 6), (6, 5), (6, 6)

$\therefore$ Number of favourable outcomes = 3

Hence, P (a sum greater than 10) = $\frac{3}{36} = \frac{1}{12}$

(*d*) Outcomes favourable to the event 'a sum less than 5' are (1, 1), (1, 2), (1, 3), (2, 1), (2, 2), (3, 1)

$\therefore$ Number of favourable outcomes = 6

Hence, P (a sum less than 5) = $\frac{6}{36} = \frac{1}{6}$

(*e*) Outcomes favourable to the event 'an even number on one and a multiple of 3 on the other' are (2, 3), (2, 6), (4, 3), (4, 6), (6, 3), (6, 6), (3, 2), (6, 2), (3, 4), (6, 4), (3, 6)

$\therefore$ Number of favourable outcomes = 11

Hence, P(an even number on one and a multiple of 3 on the other) = $\frac{11}{36}$

(*f*) Outcomes favourable to the event 'a doublet' are (1, 1), (2, 2), (3, 3), (4, 4), (5, 5), (6, 6)

$\therefore$ Number of favourable outcomes = 6

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

(*g*) Outcomes favourable to the event 'a doublet of prime numbers' are (2, 2), (3, 3), (5, 5)

$\therefore$ Number of favourable outcomes = 3

Hence, P(a doublet of prime number) = $\frac{3}{36}$

$= \frac{1}{12}$

2. Three identical coins are tossed together. What is the probability of obtaining

(*a*) all heads

(*b*) exactly two heads

(*c*) exactly one head

(*d*) at least one head

(*e*) at least two heads

(*f*) all tails?

Sol. When three identical coins are tossed, possible outcomes are HHH, HHT, HTH, THH, HTT, THT, TTH, TTT.

$\therefore$ Total number of possible outcomes = 8

(*a*) Outcome favourable to the event 'all heads' is HHH

$\therefore$ Number of favourable outcome = 1

Hence, P(all heads) = $\frac{1}{8}$

(*b*) Outcomes favourable to the event 'exactly two heads' are HHT, HTH, THH.

$\therefore$ Number of favourable outcome = 3

Hence, P(exactly two heads) = $\frac{3}{8}$

(*c*) Outcomes favourable to the event "exactly one head" are HTT, THT, TTH

$\therefore$ Number of favourable outcomes = 3

Hence, P(exactly one head) = $\frac{3}{8}$

(*d*) Outcomes favourable to the event 'at least one head 'are HHH, HHT, HTH, THH, HTT, THT, TTH

$\therefore$ Number of favourable outcomes = 7

Hence, P(at least one head) = $\frac{7}{8}$

(*e*) Outcomes favourable to the event 'atleast two heads' are HHH, HHT, HTH, THH

$\therefore$ Number of favourable outcomes = 4

Hence, P(atleast two heads) = $\frac{4}{8} = \frac{1}{2}$

(*f*) Outcome favourable to the event 'all tails" is TTT

$\therefore$ Number of favourable outcome = 1

Hence, P(all tails) = $\frac{1}{8}$

3. What is the probability that a leap year has 53 Sundays and 53 Mondays?

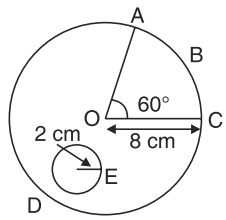
Sol. Leap year has 366 days = 52 weeks + 2 days possibility of remaining 2 days can be

(*i*) Monday and Tuesday,
(*ii*) Tuesday and Wednesday,
(*iii*) Wednesday and Thursday,
(*iv*) Thursday and Friday,
(*v*) Friday and Saturday,
(*vi*) Saturday and Sunday,
(*vii*) Sunday and Monday.

$\therefore$ The total number of pairs = 7 of which only 1 pair of days certain Sunday and Monday

Hence, the required probability that a leap year has 53 Sundays and 53 Mondays = $\frac{1}{7}$.

4. The figure given below shows a circle with centre O and radius 8 cm. The radius of the smaller circle is 2 cm and $\angle AOC = 60°$. A point is selected at random inside the larger circle ABCD. Find the probability that the point lies neither in the sector AOCB nor in the smaller circle E.



Sol. Area of larger circle of radius 8 cm = πr^2

$= \pi \times 8^2$

$= 64\pi$

Area of sector AOCB = $\frac{\theta}{360} \times \pi r^2$

$= \frac{60°}{360°} \times \pi \times 8^2$

$= \frac{\pi}{6} \times 64$

$= \frac{32\pi}{3}$

Area of smaller circle of radius 2 cm = $\pi \times 2^2 = 4\pi$

$\therefore$ Desired area = Area of larger circle – [Area of sector + Area of smaller circle]

$= 64\pi - \left[\frac{32\pi}{3} + 4\pi\right]$

$= 64\pi - \frac{44\pi}{3}$

$= \frac{148\pi}{3}$

Hence, probability that the point lies neither in the sector AOCB nor in the smaller circle F

$= \frac{\text{Desired area}}{\text{Total area}}$

$= \frac{\frac{148\pi}{3}}{64\pi} = \frac{37}{48}$

Hence, probability that the point lie neither in the sector AOCB nor in the smaller circle E is $\frac{37}{48}$.

Self-Assessment
(Page 265)

Multiple-Choice Questions

1. The probability of getting a vowel from the word "Mathematics", chosen at random, is

(*a*) $\frac{4}{11}$ (*b*) $\frac{3}{11}$

(*c*) $\frac{3}{10}$ (*d*) $\frac{2}{11}$

Sol. (*a*) $\frac{4}{11}$

Total number of letters in the word "MATHEMATICS" = 11

$\therefore$ Total number of possible outcomes = 11

Outcomes favourable to the event are A, E, A, I.

Thus, the number of favourable outcomes = 4

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

$$= \frac{4}{11}$$

2. A die is thrown once. Then the probability of getting a number between 2 and 6 is

(*a*) $\frac{1}{6}$ (*b*) $\frac{1}{3}$

(*c*) $\frac{2}{3}$ (*d*) $\frac{1}{2}$

Sol. (*d*) $\frac{1}{2}$

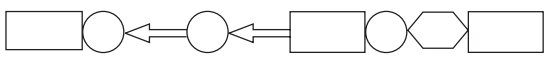
In a throw of a die, any one of the six faces may face upwards.

$\therefore$ The total number of possible outcomes = 6

Outcomes favourable to the event are 3, 4 and 5.

$\therefore$ P(a number between 2 and 6) = $\frac{3}{6} = \frac{1}{2}$

3. During the drawing class, Madhu made the following pattern.



If she chooses a shape to colour at random, what is the probability that she will colour an arrow?

(*a*) $\frac{1}{9}$ (*b*) $\frac{2}{9}$

(*c*) $\frac{4}{9}$ (*d*) $\frac{7}{9}$

Sol. (*b*) $\frac{2}{9}$

Number of figures = 9

Number of arrows = 2

$\therefore$ P(arrow) = $\frac{2}{9}$

4. In a housing complex, the houses are of the following three types — 1 BHK, 2 BHK and 3 BHK. The probability of a randomly picked house being a 2 BHK is 2/5. If the total number of houses being 20, what is the number of 2 BHK houses in the complex?

(*a*) 2 (*b*) 4

(*c*) 6 (*d*) 8

Sol. (*d*) 8

Let the number of 2 BHK house be x

$$\frac{x}{20} = \frac{2}{5}$$

$$\therefore \quad x = \frac{2 \times 20}{5} = 8$$

5. A card is drawn at random from a well-shuffled deck of 52 cards. The probability of getting a red card is

(*a*) $\frac{1}{26}$ (*b*) $\frac{1}{13}$

(*c*) $\frac{1}{4}$ (*d*) $\frac{1}{2}$ **[CBSE 2023 Basic]**

Sol. (*d*) $\frac{1}{2}$

Number of red cards = 26

$\therefore$ P(red card) = $\frac{26}{52} = \frac{1}{2}$

6. In a group of 20 people, 5 can't swim. If one person is selected at random, then the probability that she/he can swim, is

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

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

[CBSE 2023 Standard]

Sol. (*a*) $\frac{3}{4}$

Persons who cannot swim = 5

Persons who can swim = 15

$\therefore$ P(she/he can swim) = $\frac{15}{20} = \frac{3}{4}$

7. If the probability of a player winning a game is 0.79, then the probability of his losing the same game is

(*a*) 1.79 (*b*) 0.31

(*c*) 0.21% (*d*) 0.21

Sol. (*d*) 0.21

Sum of all probabilities = 1

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

$$P(\overline{W}) = 1 - 0.79 = 0.21$$

8. Two dice are rolled together. The probability of getting a doublet is

(*a*) $\frac{2}{36}$ (*b*) $\frac{1}{36}$

(*c*) $\frac{1}{6}$ (*d*) $\frac{5}{6}$ **[CBSE 2024 Basic]**

Sol. (*c*) $\frac{1}{6}$

All possible outcomes, when two dice are rolled together, are as follows:

(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)

Hence, the total number of possible outcomes = 36.

The favourable outcomes are (1, 1) (2, 2) (3, 3) (4, 4) (5, 5) (6, 6).

$\therefore$ P (a doublet) = $\frac{6}{36} = \frac{1}{6}$

9. A box contains cards numbered 6 to 55. A card is drawn at random from the box. The probability that the drawn card has a number which is a perfect square, is

(*a*) $\frac{7}{50}$ (*b*) $\frac{7}{55}$

(*c*) $\frac{1}{10}$ (*d*) $\frac{5}{49}$

Sol. (*c*) $\frac{1}{10}$

Total number of cards = 50

The cards having a number which is a perfect square

= 9, 16, 25, 36, 49

$\therefore$ P(a perfect square) = $\frac{5}{50} = \frac{1}{10}$

10. Two dice are tossed simultaneously. The probability of getting odd numbers on both the dice is

(*a*) $\frac{6}{36}$ (*b*) $\frac{3}{36}$

(*c*) $\frac{12}{36}$ (*d*) $\frac{9}{36}$

[CBSE 2024 Standard]

Sol. (*d*) $\frac{9}{36}$

All possible outcomes, when two dice are rolled together, are as follows:

(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)

Hence, the total number of possible outcomes = 36.

The favourable outcomes are (1, 1) (1, 3) (1, 5) (3, 1) (3, 3) (3, 5), (5, 1), (5, 3), (5, 5)

$\therefore$ P (odd numbers on both dice) = $\frac{9}{36}$

Fill in the Blanks

11. If an event cannot occur, then its probability is **0**.

12. The sum of the probabilities of all the events of an experiment is **1**.

13. If $\overline{E}$ denotes the complementary or negation of an event E, then the value of $P(\overline{E}) + P(E)$ is **1**.

14. If E is an event such that $P(E) = \frac{3}{7}$, then the value of P(not E) is $\mathbf{\frac{4}{7}}$.

Assertion-Reason Type Questions

Directions (Q. Nos. 15 to 19): Each of these questions contains an assertion followed by reason. Read them carefully, and answer the question on the basis of the following options, select the one that best describes the two statements.

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

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

(c) Assertion (A) is true but Reason (R) is false.

(d) Assertion (A) is false but Reason (R) is true.

15. **Assertion (A):** Probability of getting an odd number when a die is thrown is 1/2.

Reason (R): There are 3 odd numbers from 1 to 6.

Sol. (*a*) When a dice is thrown, there are 6 possible outcomes out of which 3 are odd numbers. So, probability is $\frac{3}{6}$ or $\frac{1}{2}$. Thus both Assertion and Reason are correct and Reason is proper explanation of the Assertion.

16. **Assertion (A):** A card is drawn randomly from a pack of 52; probability that it would be a heart is 1/4.

Reason (R): Each card has a probability of 1/52 to be drawn.

Sol. (*b*) There are 4 types of cards, so each type will have probability of $\frac{1}{4}$. Individually, each card

will have probability of $\frac{1}{52}$, but it does not explain why probability of hearts is $\frac{1}{4}$. Thus both Assertion and Reason are correct but Reason is not a proper explanation of the Assertion.

17. **Assertion (A):** A ball is drawn randomly from a box containing 4 red and 5 black balls; the drawn ball will certainly be black.

Reason (R): Probability of drawing a black ball from a mix of 4 red and 5 black balls is $\frac{5}{9}$.

Sol. (*d*) Probability of drawing a back ball from a mix of 4 red and 5 black balls is $\frac{5}{9}$. Thus, probability of drawing a black ball is higher but it is not 100%. Thus Assertion is wrong but Reason is correct.

18. **Assertion (A):** The probability of getting number 8 on rolling a die is zero (0).

Reason (R): The possibility of an impossible event is zero (0). **[CBSE 2024 Basic]**

Sol. (*a*) A die has six faces which are numbered from 1 to 6. Therefore, probability of getting number 8 on rolling a die is zero. Hence, assertion is correct. Reason is correct explanation of assertion. The correct option is (*a*).

19. **Assertion (A):** In a cricket match, a batsman hits a boundary 9 times out of 45 balls he plays. The probability that in a given ball, he does not hit the boundary is 4/5.

Reason (R): P(E) + P(not E) = 1

[CBSE 2024 Standard]

Sol. (*a*) P(hitting a boundary) = $\frac{9}{45} = \frac{1}{5}$

P(not hitting a boundary) = $1 - \frac{1}{5} = \frac{4}{5}$

$\therefore$ Assertion is correct. Reason is correct explanation of assertion. The correct answer is (*a*).

Case Study Based Questions

20. A teacher conducted a fun activity in the class. She put the cards numbered from 1 to 17 in a box and mixed thoroughly. She randomly selected one student and asked to draw a card from the box.

Based on the above activity, answer the following questions.

(*a*) What is the probability that the number on the card is odd?

Ans. $\frac{9}{17}$

(*b*) What is the probability that the number on the card is a prime number?

Ans. $\frac{7}{17}$

(*c*) (*i*) What is the probability that the number on the card is divisible by 3?

Ans. $\frac{5}{17}$

or

(*ii*) What is the probability that the number on the card is divisible by 3 and 2 both?

Ans. $\frac{2}{17}$

21. Three friends Ekta, Ritika and Pooja were fighting to get first chance in a game. Ekta says, "Let us toss two coins. If both tails appear, Ritika will take first chance. If both heads appear, Pooja will take first chance. If one head and one tail appear, I will get the chance." Based on the above situation, answer the following questions.

(*a*) What is the probability of Ekta getting the first chance?

Ans. $\frac{1}{2}$

(*b*) What is the probability of Ritika getting the first chance?

Ans. $\frac{1}{4}$

(*c*) (*i*) What is the probability of certain event?

Ans. 1

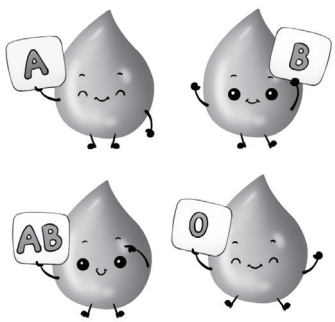
or

(*ii*) What is the probability of Pooja getting the first chance?

Ans. $\frac{1}{4}$

22. Blood group describes the type of blood a person has. It is a classification of blood based on the presence or absence of inherited antigenic substances on the surface of red blood cells. Blood types predict whether a serious reaction will occur in a blood transfusion.

In a sample of 50 people, 21 had type O blood, 22 had type A, 5 had type B and rest had type AB blood group.



Based on the above, answer the following questions:

(*a*) What is the probability that a person chosen at random had type O blood?

Sol. P(type O blood) = $\frac{21}{50}$

(*b*) What is the probability that a person chosen at random had type AB blood group?

Sol. People having AB blood group

$= 50 - 21 - 22 - 5 = 2$

$\therefore$ P(AB blood group) = $\frac{2}{50} = \frac{1}{25}$

(*c*) (*i*) What is the probability that a person chosen at random had neither type A nor type B blood group?

Sol. Number of people type A and type B blood group

$= 22 + 5 = 27$

$\therefore$ P(having type A or type B blood group)

$= \frac{27}{50}$

$\therefore$ P(neither type A nor type B blood group)

$= 1 - \frac{27}{50} = \frac{23}{50}$

or

(*ii*) What is the probability that person chosen at random had either type A or type B or type O blood group? **[CBSE 2023 Basic]**

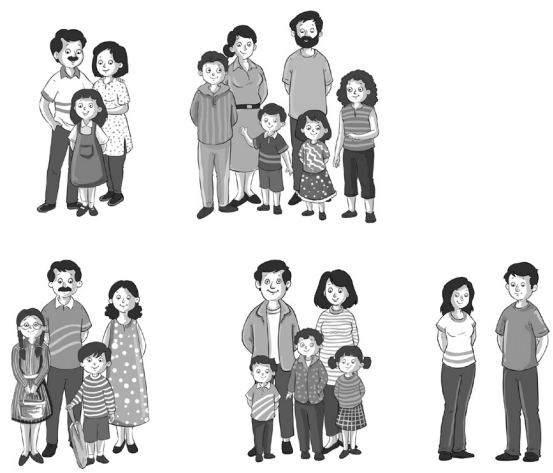
Sol. Number of people having either type A or type B or type O blood group

$= 22 + 5 + 21 = 48$

$\therefore$ P(either type A or type B or type O blood group)

$= \frac{48}{50} = \frac{24}{25}$

23. **Family structure:** In a recent survey of this year, 51% of the families in the United States of America had no children, 20% had one child, 19% had two children, 7% had three children and 3% had four or more children.



A family is selected at random.

Based on the above information, answer the following questions:

(*a*) Find the probability that the selected family has two or three children.

Sol. Total number of families = 100

Families having no children = 51

Families having one child = 20

Families having two children = 19

Families having three children = 7

Families having four or more children = 3

P(two or three children) = $\frac{19+7}{100} = \frac{26}{100} = \frac{13}{50}$

(*b*) Find the probability that the selected family has more than one child.

Sol. P(more than one child) = $\frac{19+7+3}{100} = \frac{29}{100}$

(*c*) (*i*) Find the probability that the selected family has less than three children.

Sol. P(less than three children)

$$= \frac{51+20+19}{100} = \frac{90}{100} = \frac{9}{10}$$

or

(*ii*) Find the probability that the selected family has more than two children.

[CBSE 2024 Basic]

Sol. P(more than two children) = $\frac{7+3}{100} = \frac{10}{100} = \frac{1}{10}$

24. Computer-based learning (CBL) refers to any teaching methodology that makes use of computers for information transmission. At an elementary school level, computer applications can be used to display multimedia lesson plans. A survey was done on 1000 elementary and secondary schools of Assam and they were classified by the number of computers they had.

Numbers of computers	*Number of schools*
1 – 10	250
11 – 20	200
21 – 50	290
51 – 100	180
101 and more	80

One school is chosen at random. Then:

(*a*) Find the probability that the school chosen at random has more than 100 computers.

Sol. Total number of school surveyed = 1000

P(more than 100 computers) = $\frac{80}{1000} = \frac{8}{100} = 0.08$

(*b*) (*i*) Find the probability that the school chosen at random has 50 or fewer computers.

Sol. P(50 or fewer computers) = $\frac{250+200+290}{1000}$

$$= \frac{740}{1000} = 0.74$$

or

(*ii*) Find the probability that the school chosen at random has no more than 20 computers.

Sol. P(no more than 20 computers)

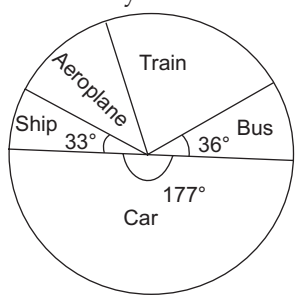
$$= \frac{250+200}{1000} = \frac{450}{1000} = 0.45$$

(*c*) Find the probability that the school chosen at random has 10 or less than 10 computers.

[CBSE 2023 Standard]

Sol. P(10 or less than 10 computers) = $\frac{250}{1000} = 0.25$

25. In a survey on holidays, 120 people were asked to state which type of transport they used on their last holiday. The following pie chart shows the results of the survey.



Observe the pie chart and answer the following questions:

(*a*) If one person is selected at random, find the probability that he/she travelled by bus or ship.

Sol. Total number of people = 120

People using bus or ship = 33° + 36° = 69°

$$= \frac{69}{360} \times 120 = 23$$

$\therefore$ P(bus or ship) = $\frac{23}{120}$

(*b*) Which is most favourite mode of transport and how many people used it?

Sol. The most favourite mode of transport is car.

Number of people using car = $\frac{177}{360} \times 120 = 59$

(*c*) (*i*) A person is selected at random. If the probability that he did not use train is 4/5, find the number of people who used train.

Sol. P(did not use train) = $\frac{4}{5}$

P(use train) = $1 - \frac{4}{5} = \frac{1}{5}$

Let number of people who use train = x

$\therefore \quad \frac{x}{120} = \frac{1}{5}$

$\Rightarrow \quad x = \frac{120}{5} = 24$

or

(*ii*) The probability that randomly selected person used aeroplane is 7/60. Find the revenue collected by air company at the rate of ₹ 5,000 per person.

[CBSE 2024 Standard]

Sol. P(used aeroplane) = $\frac{7}{60}$

Let number of persons who used aeroplane = x

$\therefore \quad \frac{x}{120} = \frac{7}{60}$

$\Rightarrow \quad x = \frac{7}{60} \times 120 = 14$

Revenue collected by air company

$= 14 \times ₹\ 5000 = ₹\ 70000$

Very Short Answer Type Questions

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

(*a*) an orange-flavoured candy

(*b*) a lemon-flavoured candy?

Sol. Let the number of lemon flavoured candy = x

Since the bag contains lemon flavoured candies only.

$\therefore$ There is no chance of getting orange – flavoured candy from the bag

(*a*) Number of favourable outcome = 0

Total number of possible outcomes = x

Hence, P(an orange flavoured candy)

$= \frac{0}{x} = 0$

(*b*) Number of favourable outcomes = x

Total number of possible outcomes = x

Hence, P (a lemon flavoured candy) = $\frac{x}{x}$

$= 1$

27. A lot of 20 bulbs contain 4 defective ones. One bulb is drawn at random from the lot once. What is the probability that it is not defective?

Sol. Total number of electric bulbs = 20

Out of 20 bulbs, one bulb can be taken out in 20 ways.

$\therefore$ Total number of possible outcomes = 20

Number of defective bulbs = 4

$\therefore$ Number of non-defective bulbs = 20 – 4 = 16

Thus, the number of favourable ways of 'getting a non-defective bulb' = 16

$\therefore$ P (non-defective bulb) = $\frac{16}{20} = \frac{4}{5}$

28. A card is drawn at random from a well-shuffled deck of 52 cards. Find the probability that the card drawn is neither a king nor a queen.

[CBSE 2006]

Sol. Total number of possible outcomes = 52

There are 4 kings and 4 queens in a deck of 52 cards.

So, the number of cards which are neither king nor queen = 52 – 4 – 4 = 44

Hence, P(neither a king nor a queen) = $\frac{44}{52} = \frac{11}{13}$

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

(*a*) 5 will come up at least once

(*b*) 5 will not come up either time?

[CBSE 2009, SP 2011]

Sol. (*a*) When two dice are thrown, the possible outcomes are

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

$\therefore$ Total number of possible outcomes = 36

Let E be the event '5 will come up at least once'.

(1, 5), (2, 5), (3, 5), (4, 5), (5, 1), (5, 2)

(5, 3), (5, 4), (5, 5), (5, 6) and (6, 5)

Thus, the number of outcomes favourable to E is 11.

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

Hence, P(5 will come up at least once) = $\frac{11}{36}$

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

$\therefore$ P(5 will not come up either time)

$= 1 - P(5 \text{ will come up atleast once})$

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

30. In a pack of 52 playing cards, one card is lost. From the remaining cards, a card is drawn at

random. Find the probability that the drawn card is queen of heart, if the lost card is a black card.

[CBSE 2023 Basic]

Sol. Total number of playing cards = 52 – 1 = 51

There is only one queen of heart.

$\therefore$ P(queen of heart) = $\frac{1}{51}$

Short Answer Type Questions

31. In a single throw of three dice, what is the probability of getting a total of 17 or 18?

Sol. Total number of possible outcomes in a single throw of three dice = $6^3 = 216$

Outcomes favourable to the event "getting a total of 17 or 18" are (5, 6, 6) (6, 5, 6) (6, 6, 5) and (6, 6, 6).

Thus, the number of favourable outcomes = 4

$\therefore$ P (a total of 17 or 18)

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

$$= \frac{4}{216} = \frac{1}{54}$$

32. A bag contains 24 balls out of which y are blue.

(a) If one ball is drawn at random, what is the probability that it will be a blue ball?

(b) If 12 more blue balls are put in the bag, the probability of drawing a blue ball will be double that in (a). Find y.

Sol. (a) Total number of balls in the bag = 24

Out of 24 balls, one ball can be drawn in 24 ways.

$\therefore$ Total number of possible outcomes = 24

There are y blue balls in the bag.

So, the number of favourable outcomes = y

$\therefore$ P(blue ball) = $\frac{y}{24}$

(b) Total number of balls in the bag = 24 + 12 = 36

Out of 36 balls, one ball can be drawn in 36 ways.

Total number of possible outcomes = 36

Now, there are (y + 12) blue balls in the bag.

So, the number of favourable ways of 'drawing a blue ball' = y + 12

Hence, P (blue ball) = $\frac{y+12}{36}$

According to the problem;

$$\frac{y+12}{36} = 2\left(\frac{y}{24}\right)$$

$$\Rightarrow \quad \frac{y+12}{36} = \frac{2y}{24}$$

$$\Rightarrow \quad y = 6$$

Thus, y (initial number of blue balls in the bag) = 6

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

(a) 2-digit number less than 40.

(b) number divisible by 5 and greater than 50.

(c) a perfect square number.

[CBSE 2024 Standard]

Sol. (a) Total number of outcomes = 90

2-digit number less than 40

= 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39

Favourable number of outcomes = 30

$\therefore$ P(2-digit number less than 40) = $\frac{30}{90} = \frac{1}{3}$

(b) Numbers divisible by 5 and greater than 50

= 55, 60, 65, 70, 75, 80, 85, 90

Number of favourable outcomes = 8

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

(c) Numbers which are perfect square

= 4, 9, 16, 25, 36, 49, 64, 81

Number of favourable outcomes = 8

$\therefore$ P(perfect square) = $\frac{8}{90} = \frac{4}{45}$

Long Answer Type Questions

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

(a) a non-face card **[CBSE 2016]**

(b) a black king or a red queen **[CBSE 2016]**

(c) a card of spade or an ace **[CBSE 2015]**

(d) neither a king nor a queen. **[CBSE 2015]**

Sol. (a) Total number of cards = 52

Face cards = 12

$\therefore$ Non-face cards = 52 – 12 = 40

Hence, P(non-face card) = $\frac{40}{52} = \frac{10}{13}$

(*b*) There are 2 black kings and 2 red queens in a deck of playing cards.

$\therefore$ Number of favourable outcomes = 4

Hence, P (a black king or a red queen) = $\frac{4}{52}$

$= \frac{1}{13}$

(*c*) There are 13 spade cards and 4 ace cards in a deck of playing cards

$\therefore$ Number of favourable outcomes = 16

Hence, P (a card of spade or an ace) = $\frac{16}{52}$

$= \frac{4}{13}$

(*d*) There are 4 kings and 4 queens is a deck of playing cards.

$\therefore$ Number of favourable outcomes = 8

Hence, P(neither a king nor a queen)

= 1 – P (either a king or a queen)

$= 1 - \frac{8}{52}$

$= 1 - \frac{2}{13} = \frac{11}{13}$

35. A letter is chosen at random from the English alphabet. Find the probability that the letter is

(*a*) a vowel

(*b*) a consonant

(*c*) a letter of the word 'noble'.

[CBSE SP 2011, 2015]

Sol. (*a*) Total number of possible outcome = 26

Number of vowels = 5, i.e. {a, e, i, o, u}

$\therefore$ P (a vowel) = $\frac{5}{26}$

(*b*) Total number of possible outcomes = 26

Number of consonants = 21

Number of favourable outcomes = 21

$\therefore$ P (a consonant) = $\frac{21}{26}$

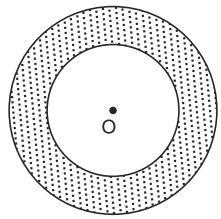
(*c*) Total number of possible outcomes = 26

Number of letter in word noble = 5

Number of favourable outcomes = 5

$\therefore$ P (a letter of word noble) = $\frac{5}{26}$

36. A practice target consists of two concentric circles whose circumferences are 44 cm and 88 cm respectively. A dart is thrown at the target. Find the probability that the dart will land in the shaded region.



Sol. Let '*r*' and '*R*' be the radius of smaller and larger circle respectively.

Given, circumference of smaller circle = 44 cm

$\Rightarrow \quad 2\pi r = 44 \text{ cm}$

$\Rightarrow \quad r = \frac{44}{2\pi} \text{ cm}$

$\Rightarrow \quad r = 7 \text{ cm}$

Area of smaller circle = πr^2

$= \frac{22}{7} \times 7 \times 7 \text{ cm}^2$

$= 154 \text{ cm}^2$

Again, circumference of larger circle = 88 cm

$\Rightarrow \quad 2\pi R = 88 \text{ cm}$

$\Rightarrow \quad R = \frac{88}{2\pi} \text{ cm}$

$\Rightarrow \quad R = 14 \text{ cm}$

$\therefore$ Area of larger circle = πR^2

$= \frac{22}{7} \times 14 \times 14 \text{ cm}^2$

$= 616 \text{ cm}^2$

$\therefore$ Area of shaded region

= Area of larger circle – Area of smaller circle

$= 616 \text{ cm}^2 - 154 \text{ cm}^2$

$= 462 \text{ cm}^2$

Hence, P(dart land in the shaded region)

$= \frac{\text{Area of shaded region}}{\text{Area of larger circle}} = \frac{462 \text{ cm}^2}{616 \text{ cm}^2} = \frac{3}{4}$

Let's Compete

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Multiple-Choice Questions

1. In a family of 8 children, the probability of at least one boy is

(*a*) $\frac{7}{8}$ (*b*) $\frac{1}{8}$

(*c*) $\frac{5}{8}$ (*d*) $\frac{3}{4}$ **[CBSE 2014]**

Sol. (*a*) $\frac{7}{8}$

Number of favourable outcomes = 7

Total number of possible outcomes = 8

Hence, P(at least one boy)

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

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

2. A bag contains 4 green balls and some white balls. If the probability of drawing a white ball is thrice that of a green ball, then the number of white balls in the bag is

(*a*) 8 (*b*) 6

(*c*) 12 (*d*) 10

Sol. (*c*) 12

Let the number of white ball be x

and the number of green balls = 4

Total number of balls = $x + 4$

$\therefore$ P(green ball) = $\frac{4}{x+4}$

According to condition,

$$\text{P(white ball)} = 3\left(\frac{4}{x+4}\right)$$

$$\Rightarrow \quad \frac{x}{x+4} = 3\left(\frac{4}{x+4}\right)$$

$$\Rightarrow \quad x = 12$$

Hence, the number of white balls in the bag = 12

3. Two dice are tossed together. Then the probability that the sum of numbers appearing on the two dice is 5 is

(*a*) $\frac{2}{3}$ (*b*) $\frac{1}{9}$

(*c*) $\frac{5}{9}$ (*d*) $\frac{2}{9}$

Sol. (*b*) $\frac{1}{9}$

When two dice are thrown, the possible outcomes are

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

$\therefore$ Total number of possible outcomes = 36

Outcomes favourable to the event "sum of number appearing on two dice is 5" are {(1, 4), (2, 3), (3, 2), (4, 1)}.

$\therefore$ Number of favourable outcomes = 4

Hence, P (sum of number is 5) = $\frac{4}{36} = \frac{1}{9}$

4. The probability that a leap year, selected at random, will have 53 Tuesdays is

(*a*) $\frac{4}{7}$ (*b*) $\frac{3}{7}$

(*c*) $\frac{1}{7}$ (*d*) $\frac{2}{7}$

Sol. (*d*) $\frac{2}{7}$

Leap year has 366 days = 52 weeks + 2 days. Possibility of remaining 2 days can be

(*i*) Monday and Tuesday,

(*ii*) Tuesday and Wednesday,

(*iii*) Wednesday and Thursday

(*iv*) Thursday and Friday,

(*v*) Friday and Saturday,

(*vi*) Saturday and Sunday,

(*vii*) Sunday and Monday,

The total number of pairs = 7 out of which only two pairs of days contain Tuesday, i.e. Monday and Tuesday, and Tuesday and Wednesday.

$\therefore$ Probability of getting 53 Tuesdays = $\frac{2}{7}$

5. Ankita and Reema are neighbours. They were both born in 1989. Then the probability that they have the same birthday is

(*a*) $\frac{365}{366}$ (*b*) $\frac{1}{366}$

(*c*) $\frac{1}{365}$ (*d*) $\frac{364}{365}$

Sol. (*c*) $\frac{1}{365}$

Year 1989 is a non-leap year, i.e. 365 days.

$\therefore$ Total number of possible outcomes = 365

If Ankita's birthday is on a same day as Reema's birthday, then number of favourable outcomes = 1

$\therefore$ P (same birthday) = $\frac{1}{365}$

6. The probability of selecting a rotten apple randomly from a heap of 900 apples is 0.18. Then the number of rotten apples in the heap is

(*a*) 150 (*b*) 152

(*c*) 160 (*d*) 162

Sol. (*d*) 162

P(rotten apples) = 0.18

Total number of apples = 900

$$P(\text{rotten apples}) = \frac{\text{Number of rotten apples}}{\text{Total number of apples}}$$

$$\Rightarrow \quad 0.18 = \frac{\text{Number of rotten apples}}{900}$$

Hence, number of rotten apples = $0.18 \times 900 = 162$

7. In a joint family, the number of girls are 3 more than the number of boys. The father asks one of his children at random to go to the market. If he is equally likely to have asked one of his children and the probability that he asked a girl is $\frac{3}{5}$, then the number of boys and the number of girls are respectively

(*a*) 4, 7 (*b*) 6, 9

(*c*) 3, 6 (*d*) 2, 5

Sol. (*b*) 6, 9

Let number of boys = x

$\therefore$ Number of girls = $x + 3$

$\therefore$ Total possible outcomes = $x + x + 3 = 2x + 3$

Given, P (he asked a girl) = $\frac{3}{5}$

$$\Rightarrow \quad \frac{x+3}{2x+3} = \frac{3}{5}$$

$$\Rightarrow \quad 3(2x + 3) = 5(x + 3)$$

$$\Rightarrow \quad x = 6$$

Hence, number of boys = 6

and number of girls = $x + 3 = 6 + 3 = 9$

8. The probability of selecting a red ball at random from a jar that contains only red, blue and orange balls is $\frac{1}{4}$. The probability of selecting a blue ball at random from the same jar is $\frac{1}{3}$. If the jar contains 10 orange balls, then the total number of all the balls in the jar is

(*a*) 24 (*b*) 25

(*c*) 30 (*d*) 20

Sol. (*a*) 24

Let the total number of balls in the jar = x

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

$$P(\text{blue ball}) = \frac{1}{3}$$

Number of orange balls = 10

P(red ball) + P(blue ball) + P (orange ball) = 1

$$\Rightarrow \quad \frac{1}{4} + \frac{1}{3} + \frac{10}{\text{Total number of balls}} = 1$$

$$\Rightarrow \quad \frac{7}{12} + \frac{10}{\text{Total number of balls}} = 1$$

$$\Rightarrow \quad \frac{10}{\text{Total number of balls}} = 1 - \frac{7}{12}$$

$$\Rightarrow \quad \frac{10}{\text{Total number of balls}} = \frac{5}{12}$$

$$\Rightarrow \quad \text{Total number of balls} = \frac{10 \times 12}{5}$$

$$= 24$$

Hence, total number of balls = 24.

9. Wooden balls marked with numbers 2 to 101 are placed in a box and is mixed thoroughly. One ball is drawn from the box. The probability that the number on the ball is a perfect cube is

(*a*) $\frac{5}{100}$ (*b*) $\frac{11}{100}$

(*c*) $\frac{3}{100}$ (*d*) $\frac{9}{100}$

Sol. (*c*) $\frac{3}{100}$

Numbers from 2 to 101 are 2, 3, 4, …, 101

$\therefore$ Total number of possible outcomes = 100

Favourable outcome to the event "number is a perfect cube" are 8, 27 and 64.

$\therefore$ Number of favourable outcomes = 3

Hence, P (number is perfect cube) = $\frac{3}{100}$

10. Tickets numbered from 1 to 20 are mixed up in a box and then a ticket is picked up at random. The probability that the ticket has a number which is a multiple of 3 or 7 is

(*a*) $\frac{3}{5}$ (*b*) $\frac{2}{5}$

(*c*) $\frac{7}{20}$ (*d*) $\frac{9}{20}$

Sol. (*b*) $\frac{2}{5}$

Total number of possible outcome = 20

Numbers which are a multiple of 3 or 7 from 1 to 20 are 3, 6, 7, 9, 12, 14, 15, 18

Number of favourable outcomes = 8

Hence, P (multiple of 3 or 7) = $\frac{8}{20} = \frac{2}{5}$

Life Skills

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1. A group consists of 12 persons, of which 3 are extremely patient, other 6 are extremely honest and rest are extremely kind. A person from the group is selected at random. Assuming that each person is equally likely to be selected, find the probability of selecting a person who is

(*a*) extremely patient

(*b*) extremely kind or honest.

Sol. Total persons = 12

Patient persons = 3

Honest persons = 6

Kind persons = 3

(*a*) P(extremely patient) = $\frac{3}{12} = \frac{1}{4}$

(*b*) P(extremely kind or honest) = $\frac{9}{12} = \frac{3}{4}$

2. A student holds free adult literacy classes once in a week in a leap year. What is the probability that he holds 53 classes in that year?

Sol. Number of days in a leap year is 366.

$\therefore$ In a leap year, there are 52 weeks and 2 more days.

For the day over 52 weeks to be a Sunday, the total number of possible outcomes = 7.

Number of favourable outcomes = 2

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

P(53 Sundays) = $\frac{2}{7}$

Hence, P (student holds 53 classes) = $\frac{2}{7}$

3. In a class, there are 25 boys and 15 girls. One student at random has to be selected to look after the cleanliness of the class.

What is the probability that the child selected is a girl?

Sol. Total number of children = (25 + 15) = 40

Number of girls = 15

P(child is a girl) = $\frac{15}{40} = \frac{3}{8}$

4. 80 senior citizens of a colony become the members of a senior citizen club. 30% of the members go for regular morning walks, 20% go for yoga and 25% go to the gymnasium.

(*a*) Find the number of senior citizens who have not joined any physical fitness programme.

(*b*) If a senior citizen club member is chosen at random, then find the probability that he is a part of physical fitness programme.

Sol. (*a*) Total number of members of the senior citizen club = 80.

Percentage of senior citizen who participate in any one of the physical fitness programmer = (30 + 20 + 25)% = 75%

$\therefore$ Percentage of senior citizens who do not participate in any one of the physical fitness programme = (100 – 75)% = 25%

$\therefore$ Number of senior citizens who do not participate in any physical fitness programme = 25% of 80 = $\frac{25 \times 80}{100} = 20$

(*b*) Number of senior citizens who participate in any one of the physical fitness programme = 75% of 80 = $\frac{75}{100} \times 80 = 60$

Hence, P (member is part of physical fitness programme) = $\frac{60}{80} = \frac{3}{4}$