CHAPTER

# 14 Probability

## Level - 1 CORE SUBJECTIVE QUESTIONS

### MULTIPLE CHOICE QUESTIONS (MCQs) (1 Mark)

**1.** Option (A) is correct

**Explanation:** Total number of possible outcomes when rolling two dice: $6 \times 6 = 36$.

List the favourable outcomes for each sum:

Sum of 2: (1, 1)

Sum of 3: (1, 2), (2, 1)

Sum of 5 : (1, 4), (2, 3), (3, 2), (4, 1)

Count the number of favourable outcomes:

$1 + 2 + 4 = 7$

Probability $= \frac{7}{36}$.

**2.** Option (D) is correct

**Explanation:** Probability of the player winning is 0.79

Probability of losing = 1 – Probability of winning

Probability of losing = 1 – 0.79 = 0.21.

**3.** Option (B) is correct

**Explanation:** A standard deck of 52 playing cards

26 red cards (13 hearts and 13 diamonds)

26 black cards (13 spades and 13 clubs)

There are 2 red aces in the deck: the ace of hearts and the ace of diamonds.

one card is drawn from a deck of 52 cards, the total number of possible outcomes is 52.

There are 2 favourable outcomes (the red aces).

$$\text{Probability} = \frac{\text{Favourable outcomes}}{\text{Total outcomes}}$$

$$= \frac{2}{52} = \frac{1}{26}$$

**4.** Option (B) is correct

**Explanation:** Given numbers: 1, 4, 7, 9, 16, 21, 25

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

Prime Number is 7

Thus, Total outcome = 5

and, Favourable outcome = 1

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

**5.** Option (C) is correct

**Explanation:** The cards are numbered from 6 to 55, $55 - 6 + 1 = 50$ cards in total. The perfect squares in the range of 6 to 55 are:

$$3^2 = 9$$
$$4^2 = 16$$
$$5^2 = 25$$
$$6^2 = 36$$
$$7^2 = 49$$

Thus, the perfect squares between 6 and 55 are: 9, 16, 25, 36, 49

There are 5 perfect squares.

Thus, the number of favourable outcomes (perfect squares) is 5 , and the total number of outcomes (cards) is 50.

$$\therefore \quad \text{Probability} = \frac{5}{50} = \frac{1}{10}$$

**6.** Option (A) is correct

**Explanation:** The total number of attempts is $y$, and the number of correct guesses is $x$.

Probability that the student guesses the answer wrong is $\frac{2}{3}$.

If the probability of guessing wrong is $\frac{2}{3}$, the probability of guessing the correct answer $1 - \frac{2}{3} = \frac{1}{3}$ ...(i)

The probability of guessing the correct answer is $\frac{x}{y}$. ...(ii)

On comparing (i) and (ii)

$$\frac{x}{y} = \frac{1}{3}$$

Thus, $y = 3x$

**7.** Option (B) is correct

**Explanation:** Let the first two coins picked up by Pratik are blue and green.

Therefore, the third coin picked up by Pratik will definitely be either blue or green.

Therefore, the minimum number of coins Pratik needs to pick to definitely get a pair of blue or green coins is 3.

**8.** Option (C) is correct

**Explanation:** The total number of shots made by the player is 35.

Three-point shots = 5

Two-point shots = 9

Total two-point and three-point shots = 5 + 9 = 14.
Shots neither = Total shots – Total of two-point and three-point shots = 35 – 14 = 21.

Probability (neither)

$$= \frac{\text{Number of shots neither}}{\text{Total shots}} = \frac{21}{35}$$

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

**9.** Option (A) is correct

**Explanation:**

Let $p$ be the probability of an event happening.
Let $q$ be the probability of the event not happening (the complement of $p$).
The relationship between $p$ and $q$

$$p + q = 1$$
$$q = 1 - p$$

**10.** Option (C) is correct

**Explanation:** P(winning)

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

The probability of winning the first prize is given as P(Winning) = 0.08, and the total number of tickets sold is 6000.
Let, $x$ be the number of tickets she has bought.
On substituting values in above formula we get,

$$0.08 = \frac{x}{6000}$$
$$x = 0.08 \times 6000$$
$$x = 480$$

**11.** Option (C) is correct

**Explanation:** The perfect cubes of integers are:

$$1^3 = 1$$
$$2^3 = 8$$
$$3^3 = 27$$
$$4^3 = 64$$
$$5^3 = 125 \quad \text{(which exceeds 100 )}$$

The perfect cubes between 1 and 100 are: 1, 8, 27, and 64. This gives us a total of 4 perfect cubes.
The probability P of drawing a card with a perfect cube can be calculated using the formula

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

The number of favorable outcomes is 4 (the perfect cubes), and the total number of outcomes is 100 (the total cards).

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

**12.** Option (D) is correct

**Explanation:** Three coins are tossed, each coin has 2 possible outcomes: heads (H) or tails (T). the total number of outcomes when tossing three coins
Total outcomes = $2^n$
$n$ is the number of coins. Here, $n = 3$
Total outcomes = $2^3 = 8$
The possible outcomes when tossing three coins are:
1 {HHH}, {HHT}, {HTH}, {THH}, {HTT}, {THT}, {TTH},

"At most one tail" means we can have either 0 tails or 1 tail. We will count the outcomes that meet this criterion.
Outcomes with 0 tails (all heads):
HHH (1 outcome)
Outcomes with 1 tail:
HHT
HTH
THH (3 outcomes)
Adding these, we have:
Outcomes with 0 tails: 1
Outcomes with 1 tail: 3
Total outcomes with at most 1 tail: 1 + 3 = 4
The probability P of an event

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

The number of favorable outcomes (at most 1 tail) is 4, and the total number of outcomes is 8.

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

**13.** Option (C) is correct

**Explanation:** The sample space (S) =
{(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)}
Event of getting the numbers whose difference is 3.
∴ A = {(1, 4), (2, 5), (3, 6), (4, 1), (5, 2), (6, 3)}
$n$ (A) = 6

$$\therefore \text{Required probability} = \frac{n(A)}{n(S)}$$
$$= \frac{6}{36}$$
$$= \frac{1}{6}$$

**14.** Option (C) is correct

**Explanation:** G represents a girl and B represents a boy.
Total number of outcomes are BB, BG, GB, GG.
A be the event of choosing at least one girl.
Thus, the possible outcomes favourable to A are BG, GB, GG.
Number of possible outcomes favourable to A = 3

$$\therefore P(A) = \frac{\text{Number of outcomes favourable to A}}{\text{number of all possible outcomes}}$$
$$= \frac{3}{4}$$

**15.** Option (A) is correct

**Explanation:** number of outcomes throwing two dice
Total Outcomes = 6 × 6 = 36
Favourable Outcomes
(4, 6)
(5, 5)
(6, 4)

Probability

$$P(E) = \frac{\text{Number of Favourable Outcome}}{\text{Total Outcomes}}$$

$$P(E) = \frac{3}{36} = \frac{1}{12}$$

**16.** Option (B) is correct

**Explanation:** English alphabets = 26 letters (5 vowels + 21 consonants)

Total number of outcomes = $n(S) = 26$

A be the event of choosing an English alphabet, which is a consonant.

$n(A) = 21$

$$P(A) = \frac{n(A)}{n(S)} = \frac{21}{26}$$

$$\text{Probability} = \frac{21}{26}$$

**17.** Option (C) is correct

**Explanation:** Total number of possible outcomes

A be the event that $x^2 < 2$

Now, $(-2)^2 = 4, (-1)^2 = 1, 0^2 = 0, 1^2 = 1, 2^2 = 4,$

For the event A to occur, $x$ can take the values –1, 0, 1

Thus, number of outcomes favourable to A = 3

$$P(A) = \frac{\text{number of outcomes favourable to A}}{\text{total number of possible outcomes}}$$

$$\Rightarrow P(x^2 < 2) = \frac{3}{5}$$

**18.** Option (C) is correct

**Explanation:** Total number of outcomes: 2 outcomes (Heads or Tails).

$$2 \times 2 = 4$$

The possible outcomes are HHHT, TH, TT

Number of favorable outcomes for at least one head: HH, HT, TH

Thus, there are 3 favourable outcomes.

P(at least one head)

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

$$= \frac{3}{4} = 75\%$$

**19.** Option (C) is correct

**Explanation:** A coin is tossed and a die is rolled, the total possible outcomes

Coin = {Head (H), Tail (T)}

Die : {1, 2, 3, 4, 5, 6}

The total number of outcomes in the sample space

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

= 12 possible outcomes.

Probability of getting either a head or an even number on the die.

Event A (Head): Getting a head = {(H, 1), (H, 2), (H, 3), (H, 4), (H, 5), (H, 6)}. So, there are 6 favourable outcomes in event A.

Event B(Even) : Getting an even number = {(H, 2), (H, 4), (H, 6), (T, 2), (T, 4), (T, 6)}.

So, there are 6 favourable outcomes in event B.

Some outcomes satisfy both conditions (a head and an even number):

$A \cap B$ = {(H, 2) (H, 4), (H, 6)}

So, there are 3 outcomes in the overlap.

The probability of either event occuring is given by the formula.

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

$$P(A) = \frac{6}{12} = 0.5$$

$$P(B) = \frac{6}{12} = 0.5$$

$$P(A \cap B) = \frac{3}{12} = 0.25$$

Now, applying the formula:

$$P(A \cup B) = 0.5 + 0.5 - 0.25 = 0.75$$

**20.** Option (C) is correct

**Explanation:** For a fair coin, the probability of getting heads on any single flip is always $\frac{1}{2}$, regardless of what happened in previous flips.

The probability of getting heads in the next coin flip is $\frac{1}{2}$ or 0.5.

**21.** Option (A) is correct

**Explanation:** A leap year has 366 days, 52 weeks +2 days.

The 2 days can be (Sun, Mon) (Mon, Tue) (Tue, Wed) (Wed, Thur) (Thur, Fri) (Fri, Sat) (Sat, Sun).

No. of favourable outcomes = (Sun, Mon) = 1

Total number of possible outcomes = 7

Probability of 53 Sundays and 53 Mondays, is $\frac{1}{7}$

**22.** Option (D) is correct

**Explanation:** Total set = {1, 2, 3, 4...., 25} = 25 This determines size of set

Prime number in it = {2, 3, 5, 7, 11, 13, 17, 19, 23}

Total prime numbers = 9

$$\text{Probability} = \frac{9}{25}$$

**23.** Option (A) is correct

**Explanation:** People cannot swim out of 20, the number of people who can swim is 20 – 5 = 15

$$P(\text{Who can swim}) = \frac{\text{Fovourable outcome}}{\text{Total number of people}}$$

$$\therefore \quad \text{Probability} = \frac{15}{20} = \frac{3}{4}$$

**24.** Option (B) is correct

**Explanation:** The probability of any event must lie between 0 and 1, inclusive. This means that:

$$0 \leq P(E) \leq 1$$

P(E) represents the probability of not happening of an event

$$= \frac{7}{0.01}$$

## ASSERTION-REASONS Questions (1 Mark)

1. Option (A) is correct.
**Explanation:** Assertion : Probability (Hitting the boundary)

$$= \frac{9}{45} = \frac{1}{5}$$

Probability (not hitting)

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

∴ Assertion is true.
Reason is also true as P(E) + P(not E) = 1
Thus, Both assertion and reason are true and reason correctly explains the assertion.

2. Option (B) is correct
**Explanation:** Assertion : When a die is thrown, all possible outcomes are 1, 2, 3, 4, 5, 6. Prime number in these outcomes are 2, 3, 5
The total no. of possible outcomes = 6
No. of favourable outcomes (getting prime number) = 3

$$P(E) = \frac{\text{No. of favourable outcomes}}{\text{Total no. of outcomes}}$$

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

**Reason:** A prime number is defined as a natural number greater than 1 that has exactly two distinct factors: 1 and the number itself.
Thus, both the assertion and reason are true, but reason is not the correct explanation for the assertion.

3. Option (A) is correct
**Explanation:** Assertion (A) : The probabilities of Sania and Ashnam wining are given as 0.79 and 0.21, respectively.
Sania winning and Ashnam winning are complementary events because either Sania wins or Ashnam wins, but not both.
∴ The sum of these probabilities is:
0.79 + 0.21 = 1
**Reason** is a standard probability rule.
So, Reason (R) is also true.
Thus, both Assertion (A) and Reason (R) are true and Reason is the correct explanation of Assertion.

4. Option (C) is correct
**Explanation:** Assertion (A) is true but Reason (R) is false. (Total number of days in a leap year = 366
Total number of days in a week = 7
∴ Number of Sundays in a leap year
= 52 Sundays + 2 days
Total number of possible outcomes with 2 days = 7 {(Sunday, Monday), (Monday, Tuesday), (Tuesday, Wednesday), (Wednesday, Thursday), (Thursday, Friday), (Friday, Saturday), (Saturday, Sunday)}
∴ Required probability

$$= \frac{\text{No. of favourable outcomes}}{\text{Total number of outcomes}}$$

$$= \frac{2}{7}$$

∴ Assertion is true.
Also, Total number of days in a non-leap year =365
Total number of days in a week = 7
∴ Number of Sundays in a non-leap year
= 52 Sundays + 1 days
1 day can be Sunday, Monday, Tuesday, Wednesday, Thursday, Friday, Saturday the probability of getting 53 Sundays = $\frac{1}{7}$
Thus, Assertion is true and Reason is false.

5. Option (A) is correct
**Explanation:** 1 to 100, half numbers are even and half numbers are odd i.e., 50 numbers ( 2, 4, 6, 8,…, 96, 98, 100 ) are even and 50 numbers (1, 3, 5, 7,…97, 99) are odd.
So, Probability of getting even number = $\frac{50}{100} = \frac{1}{2}$
So, Assertion (A) is true.
Reason (R):

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

Thus, Reason (R) is also true.
Thus, both Assertion and Reason are true and reason is the correct explanation of assertion.

6. Option (A) is true.
**Explanation:** Assertion (A): The probability of getting a bad egg is given as $p$ =0.035.
The number of bad eggs is:
Number of bad eggs = 0.035 × 400 = 14
Number of good eggs =400 – 14 = 386
This matches the information given in the assertion.
∴ Assertion (A) is true.
**Reason (R) :** The probability of the complementary event is always 1 – $p$.
Thus, Both Assertion and Reason are true and Reason is the correct explanation of A.
∴ Reason (R) is also true.

## VERY SHORT ANSWER TYPE QUESTIONS (2 Marks)

1. Total number of cards = 52
After loosing 1 black card, number of cards left = 52 – 1 = 51
Thus, total possible outcomes = 51.
As, only 1 Queen of Hearts is present in the deck.
The, Probability of drawing the Queen of Hearts, given that the lost card is black, is:

$$P = \frac{1}{51}$$

2. Total balls = 4 (red) + 3 (blue) + 2(yellow)=9
(i) Probability of drawing a red ball:
The number of red balls is 4.

Now, Total Possible outcomes = 9
Total number of favourable outcomes = 4

$\therefore$ P(Red) = $\frac{\text{Number of red balls}}{\text{Total number of balls}} = \frac{4}{9}$

(ii) Probability of drawing a yellow ball:
The number of yellow balls is 2 .
$\therefore$ Total number of favourable outcomes = 2

Thus, P(Yellow) = $\frac{\text{Number of yellow balls}}{\text{Total number of balls}} = \frac{2}{9}$

**3.** The possible outcomes a coin is tossed 2 times is
S = {(HH), (TT), (HT), (TH)}
Let E = Event of getting at most one head
= {(TT), (HT), (TH)}

$n(E) = 3$

Probability = $\frac{n(E)}{n(S)} = \frac{3}{4}$

**4.** (i) The numbers on the spinner are: 2, 5, 7, 9, 12, 16.
Out of the 6 numbers, 2 of them ( 9 and 16) are perfect squares

$\therefore$ P (perfect square) = $\frac{2}{6} = \frac{1}{3}$

(ii) Probability of getting a multiple of 2 on a dice
The multiples of 2 from 1, 2, 3, 4, 5 and 6 numbers are: 2 , 4, 6.
The probability of getting a multiple of 2 on the dice is:

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

**5.** The prime numbers between 1 and 10 are: {2, 3, 5, 7}
$\therefore$ The total number of favourable outcomes = 4
The total number of cards (or possible outcomes) is 10.
The probability P (Prime number)

P(Prime number) = $\frac{\text{Number of prime numbers}}{\text{Total number of cards}}$

$= \frac{4}{10} = \frac{2}{5}$

## SHORT ANSWER TYPE QUESTIONS (3 Marks)

**1.** S = {1, 2, 3, 4, ....., 19, 20}.
E = event of getting a multiple of 3 or 5 = {3, 6, 9, 12, 15, 18, 5, 10, 20}.

P(E) = $\frac{n(E)}{n(S)} = \frac{9}{20}$

**2.** (i) P(a face card or a black card)

$= \frac{12}{52} + \frac{26}{52} - \frac{6}{52} = \frac{32}{52}$ or $\frac{8}{13}$

(ii) P (neither an ace nor a king)

= 1 – P (either an ace or a king)

$= 1 - \left(\frac{4}{52} + \frac{4}{52}\right)$

$= 1 - \frac{8}{52} = \frac{44}{52}$ or $\frac{11}{13}$

(iii) P(a jack and a black card) = $\frac{2}{52}$ or $\frac{1}{26}$

**3.** Option 1. Sum of the two numbers on the dice is one of these:
odd + odd = even
odd + even = odd
even + odd = odd
even + even = even
Thus, total number of possible outcomes = 4 and total number of favourable outcomes = 2
Thus, probability of getting an odd number sum on rolling the two dice is a $\frac{1}{2}$

Option 2. The product of the two numbers on the dice is one of these:
odd × odd = odd
odd × even = even
even × odd = even
even × even = even
Thus, total number of possible outcomes = 4 and total number of favourable outcomes =1

Thus, probability of getting an odd number as the product on rolling the two dice = $\frac{1}{4}$.

As, $\frac{1}{2} > \frac{1}{4}$.

$\therefore$ Naima should choose option 1.

**4.** (i) Probability that both their dates in the two formats are the same on that day:
For their dates to be the same, the day and the month must be the same in both formats, This can only happen when
"Possible dates" = {01/01,02/02,03/03,…,12/12}
There are 12 such dates.
$\therefore$ Favrouable outcome = 12
Total possible days in 2022=365 (since 2022 is not a leap year).
Thus, probability that both their dates

P(same date) = $\frac{12}{365}$

(ii) Probability that a date written by Hugh in the format mm/dd is valid in the Indian format dd/mm.
In the USA, the month mm can be any number from 1 to 12 , and the day dd can be any valid day of that month.
For Drish in India, the day dd must correspond to the valid days for the month mm.
We need to ensure that for any date in the USA, the "day" (dd) does not exceed the maximum number of days in the "month" (mm) when reversed for India.
If the USA date is written as mm/dd, when switching to dd/mm, the new "day" in India must be a valid day for the "month" that the USA originally had as the day.
For example, if Hugh writes 03/31 (March 31),

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the day 31 is invalid for the month 3 (March) in the Indian format.

January ( 31 days) $\rightarrow$ Valid as 01/01 to 01/12 (since 12 is the max month).

February (28 days) $\rightarrow$ Valid as 02/01 to 02/12 (since 12 is the max month).

March (31 days) $\rightarrow$ Valid as 03/01 to 03/12.

April (30 days) $\rightarrow$ Valid as 04/01 to 04/12.

May (31 days) $\rightarrow$ Valid as 05/01 to 05/12.

June ( 30 days) $\rightarrow$ Valid as 06/01 to 06/12.

July (31 days) $\rightarrow$ Valid as 07/01 to 07/12.

August (31 days) $\rightarrow$ Valid as 08/01 to 08/12.

September (30 days) $\rightarrow$ Valid as 09/01 to 09/12.

October (31 days) $\rightarrow$ Valid as 10/01 to 10/12.

November (30 days) $\rightarrow$ Valid as 11/01 to 11/12.

December (31 days) $\rightarrow$ Valid as 12/01 to 12/12.

In each month, only the first 12 days are valid when flipped for India. Thus, we calculate the total number of valid dates:

For each month, 12 valid dates = 12 months $\times$12 valid days per month =144 valid dates.

Thus, the probability that the date written by Hugh is valid for Drish is:

$$P(\text{valid date}) = \frac{144}{365}$$

## LONG ANSWER TYPE QUESTIONS (5 Marks)

**1.** (i) Total face cards = 3 × 4 = 12

Total possible outcomes = 52

$$P(\text{face card}) = \frac{\text{Number of face cards}}{\text{Total number of cards}}$$

$$= \frac{12}{52} = \frac{3}{13}$$

(ii) No, Probability of an event cannot be negative

As, $0 \le P(\text{Event}) \le 1$

Where, P=0 means the event is impossible.

and, P=1 means the event is certain.

(iii) A standard deck has 13 diamonds, so after removing all diamonds, we are left with 52 – 13 = 39 cards.

Thus, total number of possible outcomes = 39

and, total number of favourable outcome = 1

$$\therefore P(\text{red jack}) = \frac{1(\text{jack of Hearts})}{39} = \frac{1}{39}$$

(iv) There are 4 Jacks and 4 Aces in a standard deck of 52 cards

Total number of Jacks and Aces " = 4 ( "Jacks ") + 4 ( "Aces ") = 8

$$\therefore \text{Probability (Jack or an ace)} = \frac{8}{52} = \frac{2}{13}$$

**2.** (i) Probability that Leena's doughnut is chocolate

$$P(\text{Event}) = \frac{\text{Number of favorable outcomes}}{\text{Total number of possible outcomes}}$$

For this problem:

The number of favorable outcomes (chocolate doughnuts) =13

The total number of doughnuts =52

$$\therefore P(\text{chocolate}) = \frac{13}{52} = \frac{1}{4}$$

(ii) Probability that Leena's doughnut is not chocolate:

P(not chocolate) = 1 – P(chocolate)

Since, P (chocolate )= $\frac{1}{4}$

$$P(\text{not chocolate}) = 1 - \frac{1}{4} = \frac{3}{4}$$

## Level - 2 ADVANCED COMPETENCY FOCUSED QUESTIONS

## MULTIPLE CHOICE QUESTIONS (MCQs) (1 Mark)

**1.** Option (A) is correct

**Explanation:** A standard deck of cards has 52 cards. Out of these, 26 cards are red (hearts and diamonds) and 26 cards are black (clubs and spades). So, when we draw a card, either it will be red or black. Therefore,

$$P(\text{red or black}) = \frac{\text{Number of favorable out comes}}{\text{Total outcomes}}$$

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

Since the probability is 1, it means this event is sure to happen.

**2.** Option (C) is correct

**Explanation: Event A:** The spinner lands on a multiple of 11.

Multiples of 11 are: 11, 22, 33, etc.

But the spinner only has numbers from 1 to 10.

So, there is no multiple of 11 on the spinner.

Therefore, P(A) = 0 $\rightarrow$ Event A is an impossible event.

**Event B:** The spinner lands on a number less than 11.

All numbers on the spinner (1 to 10) are less than 11.

So, this event always happens.

Therefore, P(B) = 1 $\rightarrow$ Event B is a sure event.

**Event C:** The spinner lands on a number more than 10.

No number on the spinner is more than 10.

Therefore, P(C) = 0 $\rightarrow$ Event C is an impossible event.

**3.** Option (D) is correct

**Explanation:** Given, $P(M \cup D) = 60\%$

Now, probability that the student participates in neither = $1 - P(M \cup D)$

P(Neither) = 1 − 0.60 = 0.40

**4.** Option (A) is correct

**Explanation:** $P(C \cup T) = P(C) + P(T) - P(C \cap T)$

$P(C \cup T) = 48\% + 42\% - 10\% = 80\%$

Probability that a person likes neither:

P(Neither) = 1 − P(C∪T) = 1 − 0.80 = 0.20

**5.** Option (A) is correct

**Explanation:** Probability that all 5 parts are defect-free $= (0.98) \times (0.98) \times (0.98) \times (0.98) \times (0.98) = (0.98)^5$

**6.** Option (A) is correct

**Explanation:** P(Not B) = 1 − P(B)

P(Not B) = 1 − 0.30 = 0.70

**7.** Option (A) is correct

**Explanation:** P(no call in 4 minutes) $= 0.7 \times 0.7 \times 0.7 \times 0.7 = (0.7)^4$

## ASSERTION-REASON QUESTIONS (1 Mark)

**1.** Option (A) is correct

**Explanation:** Assertion is true because if an event is sure (certain to happen), its probability is 1.

Reason is also true because in a sure event, all possible outcomes are favourable. So total outcomes = favourable outcomes.

When favourable outcomes = total outcomes,

$$\text{P(event)} = \frac{\text{Favourable outcomes}}{\text{total outcomes}} = 1$$

Thus, the Reason correctly explains the Assertion.

**2.** Option (A) is correct

**Explanation:** Assertion is true because

$$\text{P(normal report)} = \frac{\text{Favourable outcomes}}{\text{total outcomes}} = \frac{480}{500}$$

= 0.96

Reason is also true because this is the definition of probability in the classical approach.

Both assertion and reason are correct and the reason correctly explains the assertion because the Reason gives the formula that is used to calculate the probability mentioned in the assertion.

**3.** Option (C) is correct

**Explanation:** Assertion is true

$$\text{P(defective)} = \frac{\text{defective bulbs}}{\text{total bulbs}} = \frac{30}{1000} = 0.03$$

Reason is false because even though defectives are rare, the event is not impossible.

An impossible event has probability 0. Here, the probability is 0.03, which means it is unlikely but possible, not impossible.

**4.** Option (A) is correct

**Explanation:** Assertion is true

P(no rain) = 1 – 0.8 = 0.2

Reason is also true because this is the basic complementary rule of probability:

Both assertion and reason are true and the reason directly explains why assertion is true.

## VERY SHORT ANSWER TYPE QUESTIONS (2 Marks)

**1. (i)** Probability that a bulb is non-defective:

P(non-defective)

$$= \frac{\text{Number of non-defective bulbs}}{\text{Total bulbs}} = \frac{485}{500} = 0.97$$

**(ii)** Probability that a bulb is defective:

$$\text{P(defective)} = \frac{\text{Number of defective bulbs}}{\text{Total bulbs}} = \frac{15}{500} = 0.03$$

**2. (i)** Probability that the student was present:

$$\text{P(present)} = \frac{\text{Number of present students}}{\text{Total students}} = \frac{54}{60} = \frac{9}{10} = 0.9$$

**(ii)** Probability that the student was absent:

$$\text{P(absent)} = \frac{\text{Number of absent students}}{\text{Total students}} = \frac{6}{60} = \frac{1}{10} = 0.1$$

**3. (i)** Probability that the person has blood group A:

$$\text{P(A)} = \frac{\text{Number with blood group}}{\text{Total people}} = \frac{40}{100} = 0.4$$

**(ii)** Probability that the person has blood group O or AB:

First, find total number of people with blood group O or AB:

O or AB = 20 + 10 = 30

So,

$$\text{P(O or AB)} = \frac{30}{100} = 0.3$$

**4. (i)** Probability that the selected player is a bowler:

$$\text{P(bowler)} = \frac{\text{Number of bowlers}}{\text{Total players}} = \frac{9}{15} = \frac{3}{5} = 0.6$$

**(ii)** Probability that the selected player is a batsman:

$$\text{P(batsman)} = \frac{\text{Number of batsmen}}{\text{Total players}} = \frac{6}{15} = \frac{2}{5} = 0.4$$

**5. (i)** Probability that he does not get a green light:

P(not green light) = 1 – P(green light)

= 1 – 0.5 = 0.5

**(ii)** Probability that he does not get a red light:

P(not red light) = 1 – P(red light) = 1 – 0.3 = 0.7

**6.** The sample space is:

S = {HH, HT, TH, TT}

So, total number of outcomes = 4.

**(i)** Probability that both coins show heads:

Favourable outcome: {HH}

Number of favourable outcomes = 1

$$P(\text{both heads}) = \frac{1}{4} = 0.25$$

**(ii)** Probability that at least one head appears:

Outcomes with at least one head: {HH, HT, TH}

Number of favourable outcomes = 3

$$P(\text{at least one head}) = \frac{3}{4} = 0.75$$

## SHORT ANSWER TYPE QUESTIONS (3 Marks)

**1. (i)** Probability that the pen is defective:

$$P(\text{defective}) = \frac{\text{Defective pens}}{\text{Total pens}} = \frac{36}{1200} = \frac{3}{100} = 0.03$$

**(ii)** Probability that the pen is non-defective:

$$P(\text{non-defective}) = 1 - P(\text{defective}) = 1 - 0.03 = 0.97$$

**(iii)** Expected number of defective pens in 5000 pens:

The defective rate is 3%, so:

$$\text{Expected defective pens} = 3\% \text{ of } 5000 = \frac{3}{100} \times 5000 = 150$$

**2. (i)** Probability that the student opted for the zoo visit:

P(students opted Zoo)

$$= \frac{\text{Number of students opted zoo visit}}{\text{Total students}} = \frac{25}{80} = \frac{5}{16}$$

**(ii)** Probability that the student opted for the planetarium:

First, find the number of students who opted for planetarium:

$$\text{Students opted Planetarium} = 80 - (40 + 25) = 80 - 65 = 15$$

$$P(\text{Students opted Planetarium}) = \frac{\text{Number of students opted planetarium visit}}{\text{Total students}} = \frac{15}{80} = \frac{3}{16}$$

**(iii)** Probability that the student did not opt for the science museum:

Students who did not opt for science museum

= total students – science museum students

= 80 – 40 = 40

$$P(\text{Students Not opted Science Museum}) = \frac{40}{80} = \frac{1}{2}$$

**3. (i)** Probability that the person has high blood pressure:

$$P(\text{high BP}) = \frac{\text{Number of people with high BP}}{\text{Total people}} = \frac{150}{1000}$$

[∵ Number of people having high BP = 1000 – 850 = 150]

$$= \frac{3}{20} = 0.15$$

**(ii)** Probability that the person has normal blood pressure:

$$P(\text{normal BP}) = \frac{\text{Number with normal BP}}{\text{Total people}} = \frac{850}{1000} = 0.85$$

**(iii)** Probability that two people selected one after the other (with replacement) both have normal blood pressure:

Since selection is with replacement, both events are independent:

P(both normal BP) = P(normal BP) × P(normal BP)

$$= 0.85 \times 0.85 = 0.7225$$

**4. (i)** The probability that it does not rain on that day:

$$P(\text{no rain}) = 1 - P(\text{rain}) = 1 - 0.35 = 0.65$$

**(ii)** The probability that it rains for 2 consecutive days (independent events):

P(rain both days) = P(rain on day 1) × P(rain on day 2)

$$P(\text{rain both days}) = 0.35 \times 0.35 = 0.1225$$

**(iii)** The probability that it does not rain on either of the 2 days:

P(no rain both days) = P(no rain on day 1) × P(no rain on day 2)

$$P(\text{no rain both days}) = 0.65 \times 0.65 = 0.4225$$

**5. (i)** Probability of selecting the correct option:

$$P(\text{correct}) = \frac{1}{4} = 0.25$$

**(ii)** Probability of selecting an incorrect option:

$$P(\text{incorrect}) = \frac{3}{4} = 0.75$$

**(iii)** Probability of selecting the correct option in 2 independent attempts:

Since the attempts are independent:

P(correct both times) = P(correct) × P(correct)

$$= \frac{1}{4} \times \frac{1}{4} = \frac{1}{16} = 0.0625$$

## CASE BASED QUESTIONS (4 Marks)

**1.** (i) Total persons travelling by bus or ship = 36° + 33° = 69°

P(travelling by bus or ship) = $\frac{69}{360} = \frac{23}{120}$

(ii) The most favourite mode of transport is car (177°)

Number of people who used car

$= \frac{177}{360} \times 120 = 59$

(iii) (a) P (Person used train) = $1 - \frac{4}{5} = \frac{1}{5}$

∴ Number of people who used train

$= 120 \times \frac{1}{5} = 24$

**OR**

(b) Number of people who used aeroplane

$= \frac{7}{60} \times 120 = 14$

∴ Revenue collected by air company

= 14 × 5000

= ₹ 70,000

**2.** (i) P(more than 100 computers)

$= \frac{\text{No. of favourable outcomes}}{\text{Total number of possible outcomes}}$

Number of schools with more than 100 computers = 80

Total number of schools = 1000

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

(ii) (a) Schools with 50 or fewer computers = 250 + 200 + 290 = 740

Total number of schools = 1000

Thus, Required probability = $\frac{740}{1000} = 0.74$

(b) Schools with not more than 20 computers = 250 + 200 = 450

Required probability = $\frac{450}{1000} = 0.45$

(iii) Schools with 10 or less than 10 computers = 250

Thus, Required probability = $\frac{250}{1000} = 0.25$

**3.** (i) To find all possible outcomes, we pair each result of Spinner I with each result of Spinner II. There are 3 outcomes from Spinner I and 3 outcomes from Spinner II, so the total number of possible outcomes is:

3 × 3 = 9 outcomes.

The list of nine outcomes is:

{RR, RG, RB, GR, GG, GB, YR, YG, YB}

To find all possible outcomes, we pair each result of Spinner I with each result of Spinner II. There are 3 outcomes from Spinner I and 3 outcomes from Spinner II, so the total number of possible outcomes is:

3 × 3 = 9 outcomes.

the full list of outcomes is:

{RR, RG, RB, GR, GG, GB, YR, YG, YB}

(ii) To Make Purple, outcome RB (Red from Spinner I and Blue from Spinner II).

There is 1 favourable outcome (RB).

The total number of possible outcomes = 9.

∴ P (Making Purple) = $\frac{1}{9}$

(iii) (a) Fund collected with the original reward/punishment scheme:

Out of the 9 possible outcomes, only 1 is a win (RB), and the other 8 outcomes are losses.

The probability of winning = $\frac{1}{9}$.

The probability of losing = $\frac{8}{9}$.

If 99 participants played, Expected number of wins = $\frac{1}{9} \times 99 = 11$ wins.

Expected number of losses = $\frac{8}{9} \times 99 = 88$ losses.

Total amount of money collected by the school:

Each win costs the school ₹ 10 × 11 = ₹ 110.

Each loss earns the school ₹ 5 × 88 = ₹ 440.

Total fund = ₹ 440 (from losses) – ₹ 110 (from wins) = ₹ 330

**OR**

(b) Each win costs ₹ 5 × 11 = ₹ 55

Each loss earns the school ₹ 5 × 88 = ₹ 440

Total fund = ₹ 440 (from losses) – ₹ 55 (from wins)

= ₹ 385

**4.** **(i)** P(non-defective) = 1 – 0.04 = 0.96

**(ii)** Expected defective bulbs = 1000 × P(defective)

= 1000 × 0.04 = 40

**(iii)** (a) Both bulbs are non-defective

Since selection is with replacement, events are independent:

P(both non-defective) = P(non-defective) × P(non-defective)

= 0.96 × 0.96 = 0.9216

The required probability is 0.9216.

**OR**

(b) P(at least one defective) = 1 – P(both non-defective)

P(at least one defective) = 1 – 0.9216 = 0.0784

**5.** **(i)** Students who like both equally

= 500 – (300 + 150) = 500 – 450 = 50

50 students like both equally.

**(ii)** P(fiction)

$= \frac{\text{Number of students who prefer fiction}}{\text{Total students}}$

$= \frac{300}{500} = 0.6$

The required probability is 0.6.

**(iii)** (a) The student does not prefer fiction:

$$P(\text{not fiction}) = 1 - P(\text{fiction}) = 1 - 0.6 = 0.4$$

The required probability is 0.4.

**OR**

(b) Total students who prefer non-fiction or both equally:

$$150 + 50 = 200$$

$$P(\text{non-fiction or both equally}) = \frac{200}{500} = 0.4$$

The required probability is 0.4.

## LONG ANSWER TYPE QUESTIONS (5 Marks)

**1. (i)** The formula for people who like only cricket is:

$$\text{Only Cricket} = n(C) - (C \cap F) - n(C \cap T) + n(C \cap F \cap T)$$

$$\text{Only Cricket} = 400 - 100 - 50 + 30 = 280$$

$$P(\text{only cricket}) = \frac{280}{800} = 0.35$$

**(ii)**

$$\text{Exactly two sports} = n(C \cap F) + n(C \cap T) + n(F \cap T) - 3 \times n(C \cap F \cap T)$$

$$\text{Exactly two sports} = 100 + 50 + 80 - 3 \times 30 = 230 - 90 = 140$$

$$P(\text{exactly two sports}) = \frac{140}{800} = 0.175$$

**(iii)**

$$n(C \cup F \cup T) = n(C) + n(F) + n(T) - (C \cap F) - n(C \cap T) - n(F \cap T) + n(C \cap F \cap T)$$

$$n(C \cup F \cup T) = 400 + 300 + 200 - 100 - 50 - 80 + 30$$

$$n(C \cup F \cup T) = 900 - 230 + 30 = 700$$

$$P(\text{at least one sport}) = \frac{700}{800} = 0.875$$

**2.** First, find the number of employees who know only English and only French:

$$\text{Only English} = n(E) - n(E \cap F) = 320 - 150 = 170$$

$$\text{Only French} = n(F) - n(E \cap F) = 200 - 150 = 50$$

Now, total employees who know at least one language:

$$\text{At least one language} = \text{Only English} + \text{Only French} + \text{Both} = 170 + 50 + 150 = 370$$

Employees who know neither = Total – At least one language

$$= 500 - 370 = 130$$

**(i)** Probability that the employee knows only English

$$P(\text{Only English}) = \frac{170}{500} = 0.34$$

**(ii)** Probability that the employee knows only French

$$P(\text{Only French}) = \frac{50}{500} = 0.10$$

**(iii)** Probability that the employee knows both languages

$$P(\text{Both}) = \frac{150}{500} = 0.30$$

**(iv)** Probability that the employee knows neither English nor French

$$P(\text{Neither}) = \frac{130}{500} = 0.26$$

**(v)** Probability that the employee knows at least one language

$$P(\text{At least one}) = \frac{370}{500} = 0.74$$

**3. (i)** The probability that both balls are red

$$P(\text{both red}) = P(\text{red on 1st draw}) \times P(\text{red on 2nd draw})$$

$$= \left(\frac{10}{30}\right) \times \left(\frac{10}{30}\right)$$

$$= \frac{10}{30} \times \frac{10}{30} = \frac{100}{900}$$

$$= \frac{1}{9} \approx 0.111$$

**(ii)** The probability that both balls are of the same colour

There are 3 possibilities: both red, both blue, or both green.

$$P(\text{same colour}) = P(\text{both red}) + P(\text{both blue}) + P(\text{both green})$$

We already have:

$$P(\text{both red}) = \frac{1}{9} = \frac{100}{900}$$

Now,

$$P(\text{both blue}) = \frac{8}{30} \times \frac{8}{30} = \frac{64}{900}$$

$$P(\text{both green}) = \frac{12}{30} \times \frac{12}{30} = \frac{144}{900}$$

Thus,

$$P(\text{same colour}) = \frac{100}{900} + \frac{64}{900} + \frac{144}{900}$$

$$= \frac{308}{900}$$

$$= \frac{154}{450} = \frac{77}{225} \approx 0.342$$

**(iii)** The probability that both balls are of different colours

$$\text{P(different colours)} = 1 - \text{P(same colour)}$$

$$= 1 - \frac{77}{225} = \frac{225-77}{225}$$

$$= \frac{148}{225} \approx 0.658$$

**(iv)** The probability that at least one ball is green

We use complementary probability:

$$\text{P(at least one green)} = 1 - \text{P(no green in both draws)}$$

Now,

$$\text{P(not green)} = \frac{10+8}{30} = \frac{18}{30} = \frac{3}{5}$$

$$\text{P(no green in both draws)} = \left(\frac{3}{5}\right)^2 = \frac{9}{25}$$

$$\text{P(at least one green)} = 1 - \frac{9}{25} = \frac{16}{25} = 0.64$$

**(v)** The probability that neither ball is green

$$\text{P(neither green)} = \left(\frac{18}{30}\right)^2 = \left(\frac{3}{5}\right)^2$$

$$= \frac{9}{25} = 0.36$$

**4.** (i) Let, Girls of class 6 be represented as $\{G_1, G_2\}$ Boys of class 7 be represented as $\{B_1, B_2]$ and a Girl and boy of class 8 be represented as $\{G_3, B_3\}$.

All possible outcomes of selecting 2 students out of the remaining students, when girl $G_1$ is selected are:

$\{G_2, B_1\}$, $\{G_2, B_2\}$, $\{G_2, G_3\}$ $\{G_2, B_3\}$, $\{B_1, B_2\}$, $\{B_1, G_3\}$, $\{B_1, B_3\}$, $\{B_2, G_3\}$ $\{B_2, B_3\}$ $\{G_3, B_3\}$

Now, the Probability of not selecting both girls or boys for the Duet 1 is

$$= \frac{6}{10} = 0.6$$

(ii) Possible outcomes from step (i) for Duet 1 are $\{B_1, G_3\}$ $\{B_2, G_3\}$

$\Rightarrow$ Probability of selecting one girl and one boy for Duet 1 such that only one student was left in each class.

$$= \frac{2}{10} = 0.2$$

(iii) After selecting $(B_1, G_3)$ and $(B_2, G_3)$ for Duet 1, the remaining in the group would have been.

Either : Class 6 : $G_2$

Class 7 : $B_2$ or Class 7 : $B_1$

Class 8 : $B_3$

Given, Probability $= \frac{2}{3}$

Here, we can observe that the given probability is for boy which is from class 7 or class 8.

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