MATHEMATICS

Class-IX

Topic-14

PROBABILITY

INDEX		
S. No.	**Topic**	**Page No.**
1.	**Theory**	**1 – 4**
2.	**Exercise (Board Level)**	**5 – 6**
3.	**Exercise-1**	**6 – 9**
4.	**Answer Key**	**10 – 11**

CH-14
PROBABILITY

A. PROBABILITY

(a) Experiment

The word **experiment** means an operation, which can produce well defined outcomes. There are two types of experiment :

(i) Deterministic experiment (ii) Probabilistic or Random experiment

(i) Deterministic Experiment : Those experiment which when repeated under identical conditions, produce the same results or outcome are known as **deterministic experiment**. For example, Physics or Chemistry experiments performed under identical conditions.

(ii) Probabilistic or Random Experiment : In an experiment, when repeated under identical conditions don't produce the same outcomes every time. For example, in tossing a coin, one is not sure that if a head or tail will be obtained. So it is a **random experiment**.

Sample space : The set of all possible outcomes of a random experiment is called a **sample space** associated with it and is generally denoted by **S**. For example, When a dice is tossed then S = { 1, 2, 3, 4, 5, 6 }.

Event : A subset of sample space associated with a random experiment is called an **event**. For example, In tossing a dice getting an even number is an event.

Favourable Event : Let S be a sample space associated with a random experiment and **A** be event associated with the random experiment. The elementary events belonging to **A** are known as **favourable events** to the event A.
For example : In throwing a pair of dice, A is defined by "Getting 8 as the sum". Then following elementary events are as out comes : (2, 6) ,(3, 5), (4, 4) (5, 3), (6, 2). So, there are 5 elementary events favourable to event A.

(b) Empirical Probability :

Suppose we perform an experiment, and let n be the total number of trials. The empirical probability of happening of an event E is defined as

$$\text{Thus, } P(E) = \frac{\text{number of trials in which the event happened}}{\text{total number of trials}}$$

And $0 \le P(A) \le 1$
If, $P(A) = 0$, then A is called **impossible event**
If, $P(A) = 1$, then A is called **sure event**

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

Where $P(A)$ = probability of occurrence of A.

$P(\bar{A})$ = probability of non - occurrence of A.

Solved Examples

Example. 1

Two coins are tossed simultaneously 500 times and we get :
Two heads: 105 times ; one head: 275 times and no head: 120 times.
Find the probability of occurrence of each of these events.

Sol. Total number of possible cases : 500

(i) Two heads
Total number of favourable cases : 105

$$P(2 \text{ heads}) = \frac{105}{500} = \frac{21}{100} = 0.21$$

(ii) One head
Total number of favourable cases : 275

$$P(1 \text{ head}) = \frac{275}{500} = \frac{55}{100} = 0.55$$

(iii) No head

Total number of favourable cases : 120

$$P(\text{no head}) = \frac{120}{500} = \frac{24}{100} = 0.24.$$

Example. 2

On one page of a telephone directory there were 200 telephone numbers. The frequency distribution of their unit place digit (for example, in the number 25828573, the unit place digit is 3) is given in following table:

Digit	0	1	2	3	4	5	6	7	8	9
Frequency	22	26	22	22	20	10	14	28	16	20

Without looking at the page the pencil is placed on one of these numbers i.e., the number is chosen at random. What is the probability that the digit in its unit place is 6.

Sol. Total number of pages = 200.

Total number of favourable cases = 14

$$\therefore P(\text{digit in the unit place is 6}) = \frac{14}{200} = \frac{7}{100} = 0.07.$$

Example. 3

1500 families with 2 children were selected randomly and the following data were recorded :

No. of girls in a family	2	1	0
No. of families	475	814	211

Compute the probability of a family chosen at random, having

(i) 2 girls **(ii)** 1 girl **(iii)** no girl.

Also, check whether the sum of these probabilities is 1 or not.

Sol. Here, total number of families = 1500.

(i) The number of families which have 2 girls = 475,

$$\therefore \quad P(2 \text{ girls}) = \frac{475}{1500} = \frac{19}{60}$$

(ii) The number of families which have 1 girl = 814,

$$\therefore \quad P(1 \text{ girl}) = \frac{814}{1500} = \frac{407}{750}.$$

(iii) The number of families which have no girl = 211.

$$\therefore \quad P(\text{no girl}) = \frac{211}{1500}.$$

Now, sum of these probabilities:

$$= \frac{19}{60} + \frac{407}{750} + \frac{211}{1500} = \frac{475+814+211}{1500} = \frac{1500}{1500} = 1.$$

Hence, the sum of these probabilities is 1.

Example. 4

A die is thrown 1500 times with the following frequencies for the outcomes 1, 2, 3, 4, 5 and 6 as given below

Outcome :	1	2	3	4	5	6
Frequency :	279	250	157	249	275	290

Find the Probability of getting :

(i) prime number **(ii)** even number

(iii) number greater than 4 **(iv)** odd number

Sol. Total number of possible cases = 1500

(i) Favourable cases = { 2, 3, 5 }
Total number of favourable cases = 250 + 157 + 275 = 682

$$P(\text{prime number}) = \frac{682}{1500} = \frac{341}{750}.$$

(ii) Favourable cases = { 2, 4, 6 }
Total number of favourable cases = 250 + 249 + 290 = 789

$$P(\text{even number}) = \frac{789}{1500} = \frac{263}{500}.$$

(iii) Favourable cases = { 5, 6 }
Total number of favourable cases = 275 + 290 = 565

$$P(\text{number greater than 4}) = \frac{565}{1500} = \frac{113}{300}.$$

(iv) Favourable cases = { 1, 3, 5 }
Total number of favourable cases = 279 + 157 + 275 = 711

$$P(\text{odd number}) = \frac{711}{1500} = \frac{237}{500}.$$

Example.5

In a cricket match, a batsman hits a boundary 6 times out of 90 balls he plays. Find the probability that he (i) hit a boundary (ii) did not hit a boundary.

Sol. We have
Total number of trials = 90
(i) Number of trials in which the batsman hit a boundary = 6.
∴ Probability that the batsman hit a boundary

$$= \frac{\text{Number of times he hit the boundary}}{\text{Total number of trials}} = \frac{6}{90} = \frac{1}{15}.$$

(ii) Number of trials in which the batsman did not hit a boundary = 90 – 6 = 84.
∴ Probability that the batsman did not hit a boundary

$$= \frac{\text{No. of times he did not hit the boundary}}{\text{Total number of trials}} = \frac{84}{90} = \frac{14}{15}.$$

Example. 6

The record of a weather station shows that out of the past 250 consecutive days, weather forecast were correct 175 times. What is the probability that on a given days **(i)** it was correct ? **(ii)** it was not correct ?

Sol. We have,
Total number of days for which the weather forecast was made = 250.

(i) Number of days for which the forecast was correct = 175.
Probability that the forecast was correct on a given day

$$= \frac{\text{Number of days for which the forecast was correct}}{\text{Number of days for which the forecast was made}} = \frac{175}{250} = 0.7$$

(ii) Number of days for which the forecast was not correct = 250 – 175 = 75
Probability that the forecast was not correct on a given day

$$= \frac{\text{Number of days for which the forecast was not correct}}{\text{Number of days for which the forecast was made}} = \frac{75}{250} = 0.3.$$

Example. 7

Fifty seeds were selected at random from each of 5 bags of seeds, and were kept under standardized conditions favourable to germination. After 20 days the number of seeds which had germinated in each collection were counted and recorded as follows :

Bag	1	2	3	4	5
Number of seeds germinated	40	48	42	39	41

What is the probability of germination :

(i) more than 40 seeds is a bag ? **(ii)** 49 seeds in a bag ?

(iii) more than 35 seeds in a bag ? **(iv)** at least 40 seeds in a bag ?

(v) at most 40 seeds in a bag ?

Sol. Total number of bags = 5.

(i) Number of bags in which more than 40 seeds germinated out of 50 seeds = 3

$\therefore$ Probability of germination of more than 40 seeds in a bag = $\frac{3}{5}$

(ii) Number of bags in which 49 seeds germinated = 0

$\therefore$ Probability of germination of 49 seeds = $\frac{0}{5}$ = 0.

(iii) Number of bags in which more than 35 seeds germinated = 5

$\therefore$ Probability of germination of more than 35 seeds = $\frac{5}{5}$ = 1.

(iv) Number of bags in which at least 40 seeds germinated = 4

$\therefore$ Probability of germination of at least 40 seeds = $\frac{4}{5}$

(v) Number of bags in which at most 40 seeds germinated = 2

$\therefore$ Probability of germination of at most 40 seeds = $\frac{2}{5}$.

Check Your Level

1. Which of the below numbers cannot be the probability of an event ?
–0.2, 11/3, 0.678, 2/3, 0, 1, 44/55, 55/44

2. A jar contains 3 red marbles, 7 green marbles and 10 white marbles. If a marble is drawn from the jar at random, what is the probability that this marble is white?

3. The blood groups of 200 people is distributed as follows: 50 have type **A** blood, 65 have **B** blood type, 70 have **O** blood type and 15 have type **AB** blood. If a person from this group is selected at random, what is the probability that this person has **O** blood type?

4. A spinner disc has numbers 0 to 7 printed at equidistant intervals like a clock dial. What is the probability that the spinner (a) will stop on 5? (b) will not stop at 5?

5. In an experiment , E and F are the only two possible outcomes. If P(E)=0.72, then find P(F).

Answers

1. –0.2, 11/3, 55/44 **2.** 1/2 **3.** 7/20

4. **(a)** 1/8 **(b)** 7/8 **5** 0.28

Exercise Board Level

TYPE (I) : VERY SHORT ANSWER TYPE QUESTIONS : [01 MARK EACH]

1. In a sample study of 642 people, it was found that 514 people have a high school certificate. If a person is selected at random, Find the probability that the person has a high school certificate.

2. In a survey of 364 children aged 19-36 months, it was found that 91 liked to eat potato chips. If a child is selected at random, Find the probability that he/she does not like to eat potato chips.

3. In a medical examination of students of a class, the following blood groups are recorded:

Blood group	A	AB	B	O
Number of students	10	13	12	5

A student is selected at random from the class. Find the probability that he/she has blood group B.

TYPE (II) : SHORT ANSWER TYPE QUESTIONS : [02 MARKS EACH]

4. 80 bulbs are selected at random from a lot and their life time (in hrs) is recorded in the form of a frequency table given below :

Life time (in hours)	300	500	700	900	1100
Frequency	10	12	23	25	10

One bulb is selected at random from the lot. Find the probability that its life is 1150 hours.

5. Refer to the above question
Find the probability that bulbs selected randomly from the lot has life less than 900 hours.

TYPE (III) : LONG ANSWER TYPE QUESTIONS: [03 MARK EACH]

6. Here is an extract from a mortality table.

Age (in years)	**Number of persons surviving out of a sample of one million**
60	16090
61	11490
62	8012
63	5448
64	3607
65	2320

(i) Based on this information, what is the probability of a person 'aged 60' of dying within a year ?
(ii) What is the probability that a person 'aged 61' will live for 4 years?

7. Bulbs are packed in cartons each containing 40 bulbs. Seven hundred cartons were examined for defective bulbs and the results are given in the following table:

Number of defective bulbs	0	1	2	3	4	5	6	more than 6
Frequency	400	180	48	41	18	8	3	2

One carton was selected at random. What is the probability that it has
(i) no defective bulb?
(ii) defective bulbs from 2 to 6?
(iii) defective bulbs less than 4?

8. Over the past 200 working days, the number of defective parts produced by a machine is given in the following table

Number of defective parts	0	1	2	3	4	5	6	7	8	9	10	11	12	13
Days	50	32	22	18	12	12	10	10	10	8	6	6	2	2

Determine the probability that tomorrow's output will have

(i) no defective part
(ii) atleast one defective part
(iii) not more than 5 defective parts
(iv) more than 13 defective parts

9. A recent survey found that the ages of workers in a factory is distributed as follows:

Age (in years)	20 - 29	30 - 39	40 - 49	50 - 59	60 and above
Number of workers	38	27	86	46	3

If a person is selected at random, find the probability that the person is:

(i) 40 years or more
(ii) under 40 years
(iii) having age from 30 to 39 years
(iv) under 60 but over 39 years

Exercise-1

SUBJECTIVE QUESTIONS

Subjective Easy, only learning value problems

Section (A) : Probability

A-1. If the probability of having rain on a certain day is $\frac{2}{5}$, find the probability of not having rain on that day.

A-2. A coin is tossed 750 times with the following frequencies. Head : 500 ; Tail : 250.
Compute the probability for each event.

A-3. A die is thrown once, find the probability of getting an even number & odd number.

A-4. An integer is chosen random from 1 to 10 positive integers. Find the probability that the integers is prime.

A-5. The following data about girls in a family was recorded. A family is chosen at random.

Number of girls in a family	2	1	0
Number of families	475	514	11

Find the probability of having 2 girls chosen in a family.

A-6. A die is thrown 100 times and following observations were recorded :

Number on die	1	2	3	4	5	6
Frequency	12	18	14	26	14	16

Find the probability that die shows.

(i) A number less than 3.

(ii) A number greater than 4

(iii) An even number

A-7. Following frequency distribution gives the weights of 38 students of a class :

Weight in Kg	31 – 35	36 – 40	41 – 45	46 – 50	51 – 55	56 – 60	61– 65	66 – 70	71 – 75
Number of Students	9	5	14	3	1	2	2	1	1

Find the probability that weight of a student in the class is :

(i) at most 60 kg

(ii) at least 36 kg

(iii) not more than 50 kg

A-8. The percentage of marks obtained by a student in monthly unit tests are given below :

Unit test	**I**	**II**	**III**	**IV**	**V**
Percentage of marks obtained	**60**	**71**	**73**	**68**	**75**

Find the probability that the student gets :

(i) more than 70% marks.

(ii) less than 70% marks.

(iii) a distinction (at least 75% marks).

A-9. A bag contains 5 red balls, 8 white balls, 4 green balls and 7 black balls. If one ball is drawn at random, find the probability that it is :

(i) Black **(ii)** Not red

(iii) Green **(iv)** Neither white nor black

A-10. A card is drawn from a well- shuffled deck of playing cards. Find the probability of drawing :

(i) a face card **(ii)** a red card

(iii) black king **(iv)** number 4 of spade

A-11. A letter is chosen at random from the letters of the word 'ASSASSINATION'. Find the probability that the letter chosen is a vowel.

A-12. Given below is the frequency distribution of wages (in Rs.) of 30 workers in a certain factory :

Wages (in Rs)	110 – 130	130 – 150	150 – 170	170 – 190	190 – 210	210 – 230	230 – 250
No. of workers	3	4	5	6	5	4	3

A worker is selected at random. Find the probability that his wages are :

(i) less than Rs.150

(ii) at least Rs. 210

(iii) more than or equal to 150 but less than Rs. 210.

A-13. Cards marked with the numbers 2 to 101 are placed in a box and mixed thoroughly. One card is drawn from this box, find the probability that the number on card is :

(i) An even number
(ii) A number less than 14
(iii) A number which is a perfect square
(iv) A prime number less than 20

A-14. The following table gives the life time of 400 neon lamps :

Life time (in hours)	300 – 400	400 – 500	500 – 600	600 – 700	700 – 800	800 – 900	900 – 1000
Number of lamps	14	56	60	86	74	62	48

A bulb is selected at random. Find the probability that the life time of the selected bulb is :

(i) less than 400 hours.
(ii) between 300 to 800 hours.
(iii) at least 700 hours.

A-15. A company selected 2400 families at random and survey them to determine a relationship between income level and the number of vehicles in a home. The information gathered is listed in the table below :

Monthly income (in Rs)	**Vehicles per family**			
	0	1	2	Above 2
Less than 7000	10	160	25	0
7000 – 10000	30	305	27	2
10000 – 13000	1	535	29	1
13000 – 16000	2	469	29	25
16000 or more	1	579	82	88

If a family is chosen, find the probability that the family is :

(i) earning Rs. 10000 – 13000 per month and owning exactly 2 vehicles.
(ii) earning Rs. 16000 or more per month and owning exactly 1 vehicle.
(iii) earning less than Rs. 7000 per month and does not own any vehicle.
(iv) earning Rs. 13000 – 16000 per month and owning more than 2 vehicle.
(v) owning not more than 1 vehicle.
(vi) owning at least one vehicle.

A-16. The table given below shows the age of 75 teachers in a school

Age (in years)	18-29	30-39	40-49	50-59
Number of Teachers	3	27	37	8

A teacher from this school is chosen at random.
What is the probability that the selected teachers is

(i) 40 or more than 40 yr old? **(ii)** Of an age lying between 30-39 yr (including both)?
(iii) 18 yr or more old? **(iv)** Above 60 yr of age?

A-17. In 1000 families, 650 families have 1 child, 250 families have 2 children and rest of families have more than two children. Find the probability of having

(i) 1 child **(ii)** 2 children
(iii) More than two children. **(iv)** What value represents from this data?

A-18. In a school, 100 students took part in Van Mahotsava and helped each other in planting the trees.

Name of Plant	Rose	Marigold	Chameli	Jasmine
Number of Plants	32	28	16	24

Find the probability of planting

(i) Rose **(ii)** Jasmine

(iii) Marigold **(iv)** Which value are represented here?

OBJECTIVE QUESTIONS

Single Choice Objective, straight concept/formula oriented

Section (A) : Probability

A-1. In a cricket match, a batswoman hits a boundary 6 times out of 30 balls she plays. Find the probability that she did not hit a boundary.

(A) 0.8 (B) 0.6 (C) 0.5 (D) 0.2

A-2. A bag contains three green marbles, four blue marbles, and two orange marbles. If a marble is picked at random, then the probability that it is not an orange marble is :

(A) $\frac{1}{4}$ (B) $\frac{1}{3}$ (C) $\frac{4}{9}$ (D) $\frac{7}{9}$

A-3. A number is selected from numbers 1 to 27. The probability that it is prime is :

(A) $\frac{2}{3}$ (B) $\frac{1}{6}$ (C) $\frac{1}{3}$ (D) $\frac{2}{9}$

A-4. If P(E) = 0.05, then P(not E) =

(A) – 0.05 (B) 0.5 (C) 0.9 (D) 0.95

A-5. A bulb is taken out at random from a box of 600 electric bulbs that contains 12 defective bulbs. Then the probability of a non-defective bulb is :

(A) 0.02 (B) 0.98 (C) 0.50 (D) None

A-6. The probability of guessing the correct answer to a certain question is x/2. If the probability of not guessing the correct answer to this question is 2/3, then x equals :

(A) 3 (B) 2/3 (C) 1/3 (D) 2

A-7. A bag contains 12 balls out of which x are white.If 6 more white balls are put in the box then the probability of drawing a white ball will be double, then the value of x is :

(A)6 (B)3 (C)12 (D)9

A-8. Which of the following can not be the probability of any event :

(A) 1 (B) 0 (C) $\frac{2011}{2012}$ (D) $\frac{2012}{2011}$

A-9. If $E_1, E_2, E_3 \ldots E_{N-1}, E_N$ are the N elementary event associate to a random experiment then $P(E_1) + P(E_2) + P(E_3) + \ldots + P(E_{N-1}) + P(E_N) =$

(A) 1 (B) 0 (C) $\frac{1}{2}$ (D) None of these

A-10. In $a^2 - b^2$ trials of a random experiment, if an event A happens a + b times then the probability of happening of event A is given by :

(A) a – b (B) $\frac{1}{a+b}$ (C) a + b (D) $\frac{1}{a-b}$

Answer Key

Exercise Board Level

TYPE (I)

1. 0.8 **2.** 0.75 **3.** $\frac{3}{10}$

TYPE (II)

4. 0 **5.** $\frac{9}{16}$

TYPE (III)

6. **(i)** $\frac{460}{1609}$ **(ii)** $\frac{232}{1149}$

7. **(i)** 4/7 **(ii)** 59/350 **(iii)** 669/700

8. **(i)** 0.25 **(ii)** 0.75 **(iii)** 0.73 **(iv)** 0

9. **(i)** 0.675 **(ii)** 0.325 **(iii)** 0.135 **(iv)** 0.66

Exercise-1

SUBJECTIVE QUESTIONS

Section (A)

A-1. $\frac{3}{5}$ **A-2.** $\frac{1}{3}$ **A-3.** $\frac{3}{6}$ **A-4.** $\frac{2}{5}$ **A-5.** $\frac{19}{40}$

A-6. **(i)** $\frac{3}{10}$ **(ii)** $\frac{3}{10}$ **(iii)** $\frac{6}{10}$

A-7. **(i)** $\frac{17}{19}$ **(ii)** $\frac{29}{38}$ **(iii)** $\frac{31}{38}$

A-8. **(i)** 0.6 **(ii)** 0.4 **(iii)** 0.2

A-9. **(i)** $\frac{7}{24}$ **(ii)** $\frac{19}{24}$ **(iii)** $\frac{1}{6}$ **(iv)** $\frac{3}{8}$

A-10. **(i)** $\frac{3}{13}$ **(ii)** $\frac{1}{2}$ **(iii)** $\frac{1}{26}$ **(iv)** $\frac{1}{52}$

A-11. $\frac{6}{13}$

A-12. **(i)** $\frac{7}{30}$ **(ii)** $\frac{7}{30}$ **(iii)** $\frac{8}{15}$

A-13. **(i)** $\frac{1}{2}$ **(ii)** $\frac{3}{25}$ **(iii)** $\frac{3}{25}$ **(iv)** $\frac{2}{25}$

A-14. **(i)** $\frac{7}{200}$ **(ii)** $\frac{29}{40}$ **(iii)** $\frac{23}{50}$

A-15. **(i)** $\frac{29}{2400}$ **(ii)** $\frac{579}{2400}$ **(iii)** $\frac{1}{240}$ **(iv)** $\frac{1}{96}$
(v) $\frac{523}{600}$ **(vi)** $\frac{589}{600}$

A-16. **(i)** 0.6 **(ii)** 0.36 **(iii)** 1 **(iv)** 0

A-17. **(i)** $\frac{650}{1000}$ **(ii)** $\frac{250}{1000}$ **(iii)** $\frac{100}{1000}$

A-18. **(i)** $\frac{32}{100}$ **(ii)** $\frac{24}{100}$ **(iii)** $\frac{28}{100}$

OBJECTIVE QUESTIONS

Section (A)

A-1. (A) **A-2.** (D) **A-3.** (C) **A-4.** (D) **A-5.** (B)

A-6. (B) **A-7.** (B) **A-8.** (D) **A-9.** (A) **A-10.** (D)