

# MATHEMATICS

## Class-VIII

### Topic-18

### PROBABILITY



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# CH-18

## PROBABILITY

### TERMINOLOGIES

Experiment, Deterministic, Random, Sample space, Event, Probability, Impossible event, Sure event, Good chance, Poor chance, Outcomes, Impossible chance, Sure changes, Probabilistic, Favourable, Coin, Die, Cards

### INTRODUCTION

In everyday life, we come across statements such as

- (1) It will probably rain today.
- (2) Chances are high that the prices of diesel will go up.
- (3) There is 50-50 chance of India winning a toss in today's match.

The words 'probably', 'chance' etc. used in the above statements involve an elements of uncertainty.

The uncertainty of "probably" can be measured numerically by means of "probability" in many cases.

Though probability started with gambling, it has been used extensively in various fields such as biological sciences, weather forecasting commerce etc.

## 18.1 PROBABILITY

### (a) Definitions

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 out comes of a random experiment is called a **sample space** associated with it and is generally denoted by **S**. For example, When a die is rolled 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 rolling a die getting an even number is an event.

**Favourable Event :** Let **S** be a sample space associated with a random experiment and **A** be an 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 favourable out comes : (2, 6), (3, 5), (4, 4), (5, 3), (6, 2). So, there are 5 elementary events favourable to event A.

**(b) Probability**

If there are **n** elementary events associated with a random experiment and **m** of them are favourable to an event **A**, then the probability of happening or occurrence of event **A** is denoted by **P(A)**.

$$\text{Thus, } P(A) = \frac{\text{Total number of favourable outcomes}}{\text{Total number of possible outcomes}} = \frac{m}{n}$$

And  $0 \leq P(A) \leq 1$

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.

**The chances of happening of an event are classified as :**

**(i) Even chance :** If the chances of happening and not happening of an event are same, we say that the event has **even chances** of happening. For example, the chance of a newly born baby to be a girl is even.

**(ii) Sure (Certain) chance :** If we throw a dice, there is a sure chance of getting one of the numbers 1, 2, 3, 4, 5 or 6. Such events are called **sure events**.

**(iii) Impossible (No) chance :** There is no chance that it will rain everyday in Delhi in one year. Such events are called **impossible events**.

**(iv) Good chance :** If an event is more likely to happen than not to happen, it is said to have **good chance** of happening.

**(v) Poor chance :** If an event is less likely to happen than not to happen, it is said to have **poor chance** of happening.

**Illustration 18.1**

When a die is thrown, list the outcomes of getting :

- |                                      |                                  |
|--------------------------------------|----------------------------------|
| <b>(i)</b> a prime number            | <b>(ii)</b> an even number       |
| <b>(iii)</b> a number greater than 5 | <b>(iv)</b> a number less than 3 |

- Sol.** Possible outcomes : 1, 2, 3, 4, 5, 6
- (i)** Outcomes (a prime number) = 2, 3, 5
  - (ii)** Outcomes (an even number) = 2, 4, 6
  - (iii)** Outcomes (a number greater than 5) = 6
  - (iv)** Outcomes (a number less than 3) = 1, 2

**Illustration 18.2**

A coin is tossed. What is the probability (chance ) that head will come up ?

- Sol.** Possible outcome: Head, Tail  
So, getting a head has 1 chance out of 2.

$$\text{Probability of getting a head} = \frac{1}{2} .$$

**Illustration 18.3**

A die is thrown. What is the probability that the number 4 will appear on the upper face?

**Sol.** Possible outcomes: 1, 2, 3, 4, 5, 6  
 But 4 has only one chance out of 6.  
 $\therefore$  Probability of getting 4 =  $\frac{1}{6}$ .

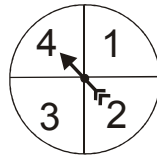
**Illustration 18.4**

A die is thrown. What is the probability that the number comes up is even ?

**Sol.** Possible outcomes: 1, 2, 3, 4, 5, 6  
 Even numbers = 2, 4, 6  
 $\therefore$  Probability of getting even number =  $\frac{\text{No. of even numbers}}{\text{No. of possible outcomes}} = \frac{3}{6} = \frac{1}{2}$ .

**Illustration 18.5**

A spinner as shown is spun 120 times. How many times do you expect the number 2 ?



**Sol.** When this spinner is spun one time, the possible outcomes are 1, 2, 3, 4.  
 Probability of 2 to come =  $\frac{1}{4}$   
 In 120 times, one can expect 4 to come =  $\frac{1}{4} \times 120 = 30$  times.

**Illustration 18.6**

From a well shuffled pack of 52 cards, find the probability of getting :

- (i) a king      (ii) a red card      (iii) a diamond      (iv) face card

**Sol.** Number of possible outcomes 52.

(i) No. of King card = 4  
 Probability of getting king =  $\frac{4}{52} = \frac{1}{13}$ .

(ii) No. of red card = 26  
 Probability of getting red card =  $\frac{26}{52} = \frac{1}{2}$ .

(iii) No. of diamond card = 13  
 Probability of getting diamond card =  $\frac{13}{52} = \frac{1}{4}$ .

(iv) King, Queen and Jack are called face cards.  
 No. of face cards = 12  
 Probability of getting face cards =  $\frac{12}{52} = \frac{3}{13}$ .

## Ask yourself

- A coin is tossed 1000 times with the following frequencies :  
Head : 455, Tail : 545  
Compute the probability for each event.
- The record of a weather station shows that out of the past 250 consecutive days, its weather forecasts were correct 175 times.
  - What is the probability that on a given day it was correct ?
  - What is the probability that it was not correct on a given day ?
- 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.
- The letter of the word 'HAPPY' are written on similar cardboard. These cardboard are then mixed and put upside down so that no one can see the letters. Ram takes one of the cardboards. What is the probability that it has the letter 'P' on it.
- Numbers 1 to 10 are written on 10 separate slips (one number on one slip), kept in a box and mixed up well . One slip is chosen from the box without looking into it. What is the probability of :
  - getting a number 7
  - not getting a number 6
  - getting a 1 digit number
  - getting a square number
  - getting a number at least 7
  - getting a number at most 3

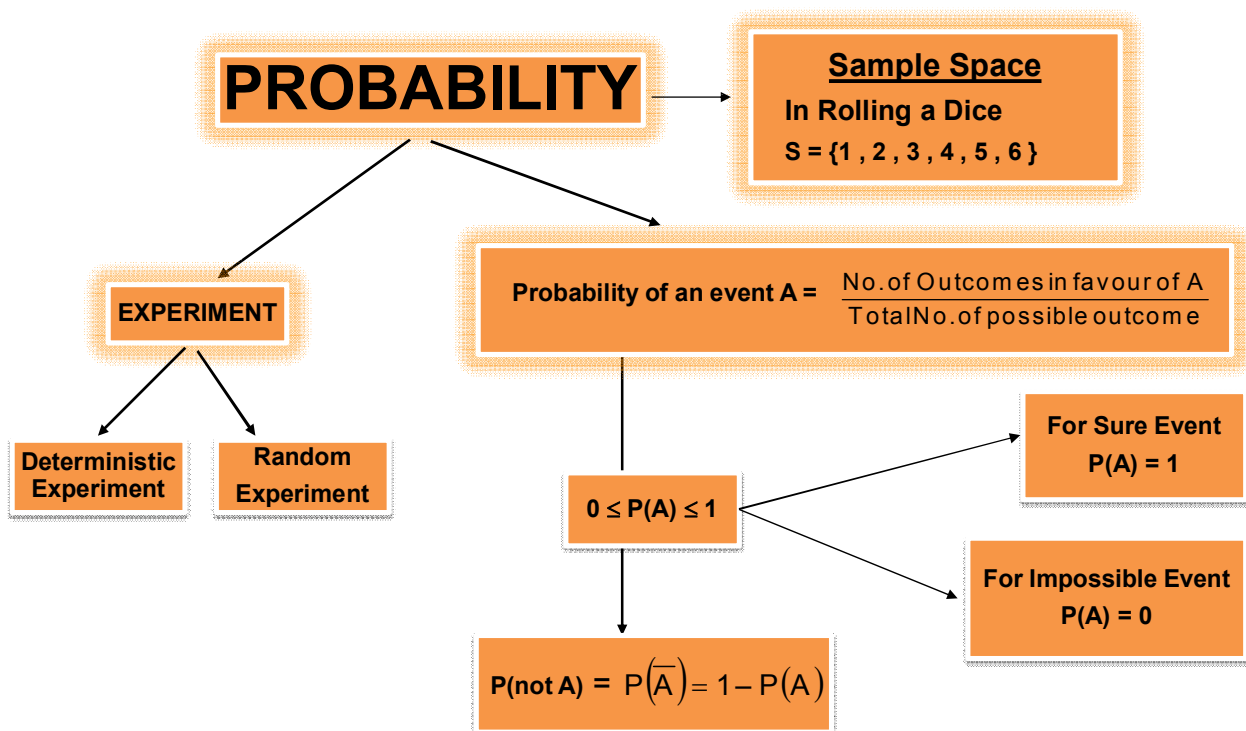
## Answers

- $P(\text{head}) = \frac{91}{200}$  ,  $P(\text{tail}) = \frac{109}{200}$
- $\frac{7}{10}$
  - $\frac{3}{10}$
- $\frac{4}{5}$
- $\frac{2}{5}$
- $\frac{1}{10}$
  - $\frac{9}{10}$
  - $\frac{9}{10}$
  - $\frac{3}{10}$
  - $\frac{2}{5}$
  - $\frac{3}{10}$

## Add to Your Knowledge

1. When 'n' coins are tossed, then total number outcomes is equal to  $2^n$ .
2. When 'n' non-zero digits are given, then total number of n-digit numbers can be formed (repetition is allowed) =  $n^n$ .
3. When 'n' non-zero digits are given, then the total number of n-digit numbers can be formed (repetition is not allowed).  
=  $1 \times 2 \times 3 \times 4 \dots n$ .

## Concept Map



## Summary

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1. An event for an experiment is the collection of some outcomes of the experiment.
2. The empirical (or experimental) probability  $P(E)$  of an even  $E$  is given by
$$P(E) = \frac{\text{Number of trials in which } E \text{ has happened}}{\text{Total number of trials}}$$
3. The probability of an event lies between 0 and 1 (0 and 1 inclusive).



## Exercise-1

### SECTION -A (FIXED RESPONSE TYPE)

#### MULTIPLE CHOICE QUESTIONS

1. Which of the following is an experiment ?  
 (A) Tossing a coin (B) Rolling a single 6-sided die.  
 (C) Choosing a marble from a jar. (D) All of the above.
  
2. Which of the following is an outcome?  
 (A) Rolling a pair of dice. (B) Landing on red.  
 (C) Choosing 2 marbles from a jar. (D) None of the above
  
3. Which of the following experiments does not have equally likely outcomes ?  
 (A) Choose a number at random from 1 to 7  
 (B) Toss a coin  
 (C) Choose a letter at random from the word SCHOOL.  
 (D) None of the above
  
4. What is the probability of choosing a vowel from the alphabet ?  
 (A)  $\frac{21}{26}$  (B)  $\frac{5}{26}$  (C)  $\frac{1}{21}$  (D) None of the above
  
5. A number from 1 to 11 is chosen at random. What is the probability of choosing an odd number ?  
 (A)  $\frac{1}{11}$  (B)  $\frac{5}{11}$  (C)  $\frac{6}{11}$  (D) None of the above
  
6. 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)  $\frac{2}{9}$
  
7. In a cricket match, a bats woman 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
  
8. 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)  $\frac{7}{9}$
  
9. If  $P(E) = 0.05$ , then  $P(\text{not } E) =$   
 (A)  $-0.05$  (B) 0.5 (C) 0.9 (D) 0.95
  
10. 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

**FILL IN THE BLANKS**

1. The probability of getting two heads when two coins are tossed simultaneously is \_\_\_\_\_
2. The probability of drawing a red card from a well shuffled deck of 52 playing cards is \_\_\_\_\_
3. For an unbiased coin, probability of getting a tail is \_\_\_\_\_
4. If a die is rolled, the probability of getting an even prime numbers is \_\_\_\_\_
5. The maximum value of probability of an event is \_\_\_\_\_
6. Probability of getting a prime number when a die is rolled is \_\_\_\_\_
7. Probability that a light will glow when its switch is turned on is \_\_\_\_\_

**TRUE / FALSE**

1. Probability of an event can never be negative.
2. The probability of getting an even number when a die is rolled is  $\frac{1}{2}$ .
3. Drawing a card from a well shuffled deck of 52 cards is an event.
4. Probability is always greater than 1.
5. Probability of getting a natural number when a die is rolled is  $\frac{5}{6}$ .

**MATCH THE COLUMN**

- | 1. Column – I  | Column–II          |
|--|--------------------|
| (A) Getting a head when a coin is tossed                         | (p) $\frac{1}{3}$  |
| (B) Getting a natural number when a die is thrown                | (q) $\frac{1}{2}$  |
| (C) Getting a king from a well shuffled deck of 52 playing cards | (r) 1              |
| (D) Getting a number greater than 6 when a die is thrown.        | (s) $\frac{1}{13}$ |
| (E) Getting a composit number when a die is thrown               | (t) 0              |

2. When a pair of coins is tossed the probability of getting:

**Column – I**

- (A) different faces on the coins  
 (B) at most 1 head  
 (C) a head or a tail on at least one coin  
 (D) no heads

**Column – II**

- (p)  $1/4$   
 (q) 1  
 (r)  $1/2$   
 (s)  $3/4$

### SECTION -B (FREE RESPONSE TYPE)

#### VERY SHORT ANSWER TYPE

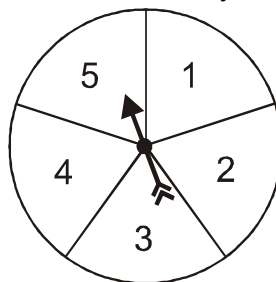
1. Find the probability of :  
 (i) Coming of january after december.    (ii) Your birthday falling on tuesday.  
 (iii) 2017 to be a leap year.                    (iv) a red rose having red colour
2. If a fair coin is tossed , what is the probability of getting a head ?
3. A die is thrown. Find the probability of  
 (i) prime number                    (ii) multiple of 2 or 3                    (iii) a number greater than 3

#### SHORT ANSWER TYPE

4. A bag contains 5 black, 4 white, 7 red and 2 green balls. If a single ball is chosen at random from the bag, what is the probability of choosing  
 (i) a black ball                    (ii) not a white ball                    (iii) a red or green ball
5. From a well shuffled pack of 52 cards, find the probability of getting :  
 (i) Queen of red colour    (ii) Jack    (iii) King or Queen                    (iv) Not king
6. A die is thrown. What is the probability that the number 6 will appear on the upper face ?
7. The probability that a vowel selected at random in english language is an 'i' is
8. Two coins are tossed simultaneously. Find the probability of getting  
 (i) two heads                    (ii) at least one head                    (iii) no head

#### LONG ANSWER TYPE

9. A spinner as shown is spun 60 times. How many times do you expect the number 3 ?



10. The letter of the word 'MATHEMATICS' are written on similar cardboard. These cardboard are then mixed and put upside down so that no one can see the letters. Ram takes one of the cardboards. What is the probability that it is a vowel.
11. A jar contains 72 marbles each of which is red, black or yellow. The probability of selecting a yellow marble is  $\frac{1}{6}$  and the probability of selecting a black marble is  $\frac{1}{2}$ . How many red marble does the jar contains. Also find the probability of selecting a red marble.

## Exercise-2

### SECTION -A (COMPETITIVE EXAMINATION QUESTION)

#### MULTIPLE CHOICE QUESTIONS

- 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
- 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)  $\frac{1}{a-b}$
- A card is drawn from a deck of 52 cards. The event E is that card is not an ace of hearts. The number of outcomes favourable to E is :  
 (A) 4                      (B) 13                      (C) 48                      (D) 51
- Some one is asked to choose a number from 1 to 100. The probability of its being a prime number is :  
 (A)  $\frac{1}{5}$                       (B)  $\frac{6}{25}$                       (C)  $\frac{1}{4}$                       (D)  $\frac{13}{50}$
- If a card is drawn from a pack of cards. The probability of getting black ace is :  
 (A)  $\frac{1}{52}$                       (B)  $\frac{1}{26}$                       (C)  $\frac{1}{13}$                       (D)  $\frac{1}{4}$
- A letter of English alphabet is chosen at random. The probability that it is a letter of the word 'RANDOM' is :  
 (A)  $\frac{11}{26}$                       (B)  $\frac{3}{13}$                       (C)  $\frac{9}{26}$                       (D)  $\frac{4}{13}$
- The probability that a non-leap year has 53 sundays is  
 (A)  $\frac{2}{7}$                       (B)  $\frac{5}{7}$                       (C)  $\frac{6}{7}$                       (D)  $\frac{1}{7}$
- In a single throw of a dice, the probability of getting a multiple of 2.  
 (A)  $\frac{1}{2}$                       (B)  $\frac{1}{3}$                       (C)  $\frac{1}{6}$                       (D)  $\frac{2}{3}$

9. A bag contains 50 coins and each coin is marked from 51 to 100. One coin is picked at random. The probability that the number on the coin is not a prime number is  
 (A)  $\frac{1}{5}$  (B)  $\frac{3}{5}$  (C)  $\frac{2}{5}$  (D)  $\frac{4}{5}$
10. A coin is tossed 1000 times, if the probability of getting a tail is  $\frac{3}{8}$ , how many times head is obtained  
 (A) 525 (B) 375 (C) 625 (D) 725

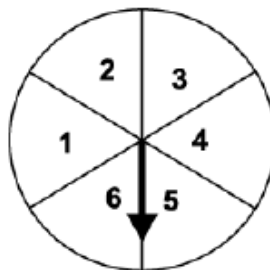
### SECTION -B (TECHIE STUFF)

11. 2 coins are tossed simultaneously. Find the probability of getting atleast 1 head ?  
 (A)  $\frac{3}{4}$  (B)  $\frac{1}{4}$  (C)  $\frac{1}{2}$  (D) 1
12. Using '1', '2', '3', '4' four digit numbers are formed, find out the probability that the number formed is even? (Repitition is not allowed)  
 (A)  $\frac{1}{4}$  (B)  $\frac{1}{2}$  (C)  $\frac{1}{8}$  (D) None of these
13. Using digits '1', '3', '5', 3 digit numbers are formed, find the probability that the number so formed is divisible by 5 ? (Repitition is not allowed)  
 (A)  $\frac{1}{6}$  (B)  $\frac{1}{3}$  (C)  $\frac{1}{2}$  (D) None of these

## Exercise-3

### (PREVIOUS YEAR EXAMINATION QUESTIONS)

1. In a simultaneous throw of two dice, what is the probability of getting a total of 7?  
 (IMO-2011)  
 (A)  $\frac{1}{6}$  (B)  $\frac{1}{4}$  (C)  $\frac{2}{3}$  (D)  $\frac{3}{4}$
2. A spinner consists of six equal regions as shown. If Mohit spins the spinner once, what is the probability that the arrow will land on a region numbered less than or equal to 2?  
 (IMO-2012)



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

3. A bag contains 4 red, 3 pink and 8 white balls. One ball is drawn at random. Find the probability that the ball drawn is not red. **(IMO-2012)**  
 (A)  $\frac{1}{5}$  (B)  $\frac{8}{11}$  (C)  $\frac{11}{15}$  (D)  $\frac{3}{11}$
4. Numbers 1 to 10 are each written on ten separate slips (one number on each slip), kept in a box and mixed well. One slip is randomly chosen from the box. What is the probability of the number chosen being less than 6? **[NSTSE - 2013]**  
 (A)  $\frac{1}{3}$  (B)  $\frac{1}{2}$  (C)  $\frac{2}{3}$  (D)  $\frac{4}{3}$
5. A bag contain a number of marbles of which 80 are red, 24 are white and the rest are blue. If the probability of randomly selecting blue marble from this bag is  $\frac{1}{5}$ , how many blue marbles are there in the bag? **[NSTSE - 2009]**  
 (A) 25 (B) 26 (C) 27 (D) 28
6. In a world cup final match against Srilanka, for six times Sachin Tendulkar hits a six out of 30 balls he plays. What is the probability that in a given throw, the ball does not hit a six? **[NSTSE - 2012]**  
 (A)  $\frac{1}{4}$  (B)  $\frac{5}{4}$  (C)  $\frac{4}{5}$  (D)  $\frac{3}{4}$
7. The value of  $\pi$  upto 35 decimal places is given 3.14159265358979323846264338327950288. Find the probability of occurring 8 in it.  
 (A)  $\frac{1}{3}$  (B)  $\frac{1}{5}$  (C)  $\frac{5}{36}$  (D)  $\frac{1}{7}$
8. A number is chosen at random from 1 to 120. The probability of the number chosen being a multiple of 3 and 15 both is **[IMO - 2014]**  
 (A)  $\frac{1}{15}$  (B)  $\frac{1}{16}$  (C)  $\frac{1}{17}$  (D)  $\frac{1}{19}$

**Direction - (Q. 9 to Q. 11)**

A dice is rolled once. What is the probability that

9. The number will be a factor of 36. **[IMO - 2014]**  
 (A)  $\frac{5}{6}$  (B)  $\frac{1}{6}$  (C)  $\frac{2}{3}$  (D) 1
10. The number will be odd  
 (A)  $\frac{1}{4}$  (B)  $\frac{1}{2}$  (C)  $\frac{1}{3}$  (D) None of these
11. The number will be less than 1  
 (A)  $\frac{1}{6}$  (B)  $\frac{2}{3}$  (C) 0 (D) None of these

## Answer Key

### Exercise-1

#### SECTION -A (FIXED RESPONSE TYPE)

##### MULTIPLE CHOICE QUESTIONS

Ques.	1	2	3	4	5	6	7	8	9	10
Ans.	D	B	C	B	C	C	A	D	D	B

#### FILL IN THE BLANKS

- |                  |                  |                  |                  |
|------------------|------------------|------------------|------------------|
| 1. $\frac{1}{4}$ | 2. $\frac{1}{2}$ | 3. $\frac{1}{2}$ | 4. $\frac{1}{6}$ |
| 5. 1             | 6. $\frac{1}{2}$ | 7. 1             |                  |

#### TRUE / FALSE

- |          |         |          |          |
|----------|---------|----------|----------|
| 1. True  | 2. True | 3. False | 4. False |
| 5. False |         |          |          |

#### MATCH THE COLUMN

- |  |                                       |
|--|---------------------------------------|
| 1. (A) – q, (B) – r, (C) – s, (D) – t, (E) – p | 2. (A) – r, (B) – s, (C) – q, (D) – p |
|--|---------------------------------------|

#### SECTION -B (FREE RESPONSE TYPE)

##### VERY SHORT ANSWER TYPE

- |                  |                      |                    |                     |
|------------------|----------------------|--------------------|---------------------|
| 1. (i) 1         | (ii)                 | (iii) 0            | (iv) 1              |
| 2. $\frac{1}{2}$ | 3. (i) $\frac{1}{2}$ | (ii) $\frac{2}{3}$ | (iii) $\frac{1}{2}$ |

##### SHORT ANSWER TYPE

- |                       |                     |                      |  |
|-----------------------|---------------------|----------------------|--|
| 4. (i) $\frac{5}{18}$ | (ii) $\frac{7}{9}$  | (iii) $\frac{1}{2}$  |  |
| 5. (i) $\frac{1}{26}$ | (ii) $\frac{1}{13}$ | (iii) $\frac{2}{13}$ | (iv) $\frac{12}{13}$                   |
| 6. $\frac{1}{6}$      | 7. $\frac{1}{5}$    | 8. (i) $\frac{1}{4}$ | (ii) $\frac{3}{4}$ (iii) $\frac{1}{4}$ |

##### LONG ANSWER TYPE

- |             |                    |                       |
|-------------|--------------------|-----------------------|
| 9. 12 times | 10. $\frac{4}{11}$ | 11. 24, $\frac{1}{3}$ |
|-------------|--------------------|-----------------------|

## Exercise-2

### SECTION -A (COMPETITIVE EXAMINATION QUESTION)

#### MULTIPLE CHOICE QUESTIONS

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13
Ans.	B	D	D	C	B	B	D	A	D	C	A	B	B

## Exercise-3

### PREVIOUS YEAR EXAMINATION QUESTIONS

Ques.	1	2	3	4	5	6	7	8	9	10	11
Ans.	A	B	C	B	B	C	C	A	A	B	C