MATHEMATICS
WORKSHEET_150426
CHAPTER 14 – PROBABILITY (ANSWERS)

SUBJECT: MATHEMATICS **MAX. MARKS : 40**

CLASS : XI **DURATION : 1½ hrs**

General Instructions:

(i). **All** questions are compulsory.

(ii). This question paper contains 2**0** questions divided into five Sections A, B, C, D and E.

(iii). **Section A** comprises of **10 MCQs** of **1 mark** each. **Section B** comprises of 4 questions of **2 marks** each. **Section C** comprises of 3 questions of **3 marks** each. **Section D** comprises of 1 question of **5 marks** each and **Section E** comprises of 2 Case Study Based Questions of **4 marks** each.

(iv). There is no overall choice.

(v). Use of Calculators is not permitted

SECTION – A

Questions 1 to 10 carry 1 mark each.

1. In a non-leap year, the probability of having 53 tuesday or 53 wednesday is

(a) 1/7 (b) 2/7 (c) 3/7 (d) none of these

Ans. (a) 1/7

2. While shuffling a pack of 52 playing cards, 2 are accidentally dropped. The probability that the missing cards are to be of different colours is

(a) 29/52 (b) 1/2 (c) 26/51 (d) 27/51

Ans. (c) 26/51

3. 6 boys and 6 girls sit in a row at random. The probability that all the girls sit together is

(a) 1/432 (b) 12/431 (c) 1/132 (d) none of these

Ans. (c) 1/132

4. A single letter is selected at random from the word 'PROBABILITY'. The probability that it is a vowel is

(a) 1/3 (b) 4/11 (c) 2/11 (d) 3/11

Ans. (b) 4/11

5. The probability that in a random arrangements of the letters of the word 'FAVOURABLE', 'A' do not come together is

(a) 1/5 (b) 1/10 (c) 9/10 (d) 4/5

Ans. (d) 4/5

6. 3 mangoes and 3 apples are in a box. If 2 fruits are choosen at random. The probability that one is a mango and other is an apple is

(a) 2/5 (b) 5/6 (c) 3/36 (d) 3/5

Ans. (d) 3/5

7. A fair coin with 1 marked on one face and 6 on the other and a fair die are both tossed. Find the probability that the sum of numbers that turn up is 3.

(a) 1/6 (b) 1/12 (c) 2/3 (d) 1/4

Ans. (b) 1/12

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

Total events in sample space is 12

Now probability to come sum as 3 is (1,2) = 1/12

8. A coin is tossed repeatedly until a head comes up for the first time. Then, the sample space for this experiment is:
(a) {H, TH, TTH}
(b) {HH, HHH, TTH, HTT}
(c) {H, TH, TTH, TTTH, TTTTH, ...}
(d) None of these
Ans. (c) {H, TH, TTH, TTTH, TTTTH, ...}
The sample space is
S = {H, TH, TTH, TTTH, TTTTH, ...}

For Q9 and Q10, a statement of assertion (A) is followed by a statement of reason (R). Choose the correct answer out of the following choices.
(a) Both (A) and (R) are true and (R) is the correct explanation of (A).
(b) Both (A) and (R) are true but (R) is not the correct explanation of (A).
(c) (A) is true but (R) is false.
(d) (A) is false but (R) is true.

9. **Assertion (A):** The probability of drawing either an ace or a king from a pack of cards in a single draw is 2/13.
Reason (R): For two events A and B which are not mutually exclusive,
$P(A \cup B) = P(A) + P(B) - P(A \cap B)$.
Ans. (b) Both (A) and (R) are true but (R) is not the correct explanation of (A).
P (Drawing either an ace or a king) = 4/52 + 4/52 = 8/52 = 2/13 (∵ Both events are mutually exclusive)
If two events A and B are not mutually exclusive, then $P(A \cup B) = P(A) + P(B) - P(A \cap B)$.

10. Consider the experiment of rolling a die. Then, sample space is S = {1, 2, 3, 4, 5, 6}.
Assertion (A): The event E :″ the number appears on the die is a multiple of 7″, is an impossible event.
Reason (R): The event F :″ the number turns up is odd or even", is a sure event.
Ans. (b) Both (A) and (R) are true but (R) is not the correct explanation of (A).
Given, E be the event "the number appears on the die is a multiple of 7". It is impossible to have a multiple of 7 on the upper face of the die. Thus, the event E = f is an impossible event.
Another event F is "the number turns up is odd or even". Clearly, F = {1,2,3,4,5,6} = S, i.e., all possible outcomes of the experiment ensure the occurrence of the event F. Thus, the event F is a sure event.

SECTION – B

Questions 11 to 14 carry 2 marks each.

11. In an entrance test that is graded on the basis of two examination, the probability of a randomly chosen student passing the first examination is 0.8 and the probability of passing the second examination is 0.7. The probability of passing at least one of them is 0.95. What is the probability of passing both?
Ans. Let A be the event that the student passes the first examination and B be the event that the student passes the second examination.
Then P(A) = 0.8, P(B) = 0.7 and $P(A \cup B) = 0.95$
We know that $P(A \cup B) = P(A) + P(B) - P(A \cap B)$
$\Rightarrow 0.95 = 0.8 + 0.7 - P(A \cap B) \Rightarrow 0.95 = 1.5 - P(A \cap B)$
$\therefore P(A \cap B) = 1.5 - 0.95 = 0.55$

12. A fair coin with 1 marked on one face and 6 on the other and a fair die are both tossed. Find the probability that the sum of numbers that turn up is (i) 3 (ii) 12

Ans. The coin with 1 marked on one face and 6 on the other face and die are tossed together.
$\therefore$ S = {(1, 1), (1, 2), (1, 3), (1, 4), (1, 5), (1, 6), (6, 1), (6, 2), (6, 3), (6, 4), (6, 5), (6, 6)}
$\Rightarrow$ n(S) = 12
(i) Let A be the event having sum of numbers is 3.
A = {(1, 2)} $\Rightarrow$ n(A) = 1
Thus P(A) = 1/12
(ii) Let B be the event having sum of numbers is 12.
$\therefore$ B = {(6, 6)} $\Rightarrow$ n(B) = 1
Thus P(B) = 1/12.

13. A letter is chosen at random from the word ASSASSINATION. Find the probability that letter is (i) a vowel (ii) a consonant.
Ans. There are 13 letters in the word ASSASSINATION which contains 6 vowels and 7 consonants.
One letter is selected out of 13 letters in $^{13}C_1 = 13$ ways
(i) One vowel is selected out of 6 vowels in $^{6}C_1 = 6$ ways.
Thus, probability of a vowel = 6/13
(ii) One consonant is selected out of 7 consonants in $^{7}C_1 = 7$ ways.
Thus, probability of a consonant = 7/13.

14. In class XI of a school 40% of the students study Mathematics and 30% study Biology, 10% of the class study both Mathematics and Biology. If a student is selected at random from the class, find the probability that he will be studying Mathematics or Biology.
Ans. Let A be the event that the student is studying mathematics and B be the event that the student is studying biology.

$$\text{Then} \quad P(A) = \frac{40}{100} = \frac{2}{5} \text{ and } P(B) = \frac{30}{100} = \frac{3}{10}$$

$$P(A \cap B) = \frac{10}{100} = \frac{1}{10}$$

$$\text{We know that } P(A \cup B) = P(A) + P(B) - P(A \cap B)$$

$$= \frac{2}{5} + \frac{3}{10} - \frac{1}{10} = \frac{4+3-1}{10} = \frac{6}{10} = \frac{3}{5}$$

OR

Three balls are drawn from a bag containing 5 red, 4 white, and 3 black balls. Find the number of ways in which this can be done if atleast 2 balls are red.
Ans. Number of red balls = 5
Number of white balls = 4
Number of black balls = 3
Number of ball drawn = 3
Note, at least 2 red balls can be drawn in following ways:
$\Rightarrow$ 2 red and 1 non red.
$\Rightarrow$ all 3 reds balls.
$\therefore$ Number of ways of drawing at least two red balls is all red $^{5}C_3 + {}^{5}C_2 \times {}^{7}C_1$

$$= \frac{4\times5}{2} + \frac{4\times5}{2} \times 7 = 10 + 35 \times 2 = 80$$

SECTION – C

Questions 15 to 17 carry 3 marks each.

15. Three coins are tossed once. Find the probability of getting (i) 3 heads (ii) no head (iii) at most two tails
Ans. Here three coins are tossed once. The sample space S is
S = {HHH, HHT, HTH, THH, TTH, THT, HTT, TTT} i.e., n(S) = 8
(i) Let A be the event of getting 3 heads.

A = {HHH} ⇒ n(A) = 1
Thus, P(A) = n(A)/n(S) = 1/8
(ii) Let E be the event of getting no head.
E = {TTT} ⇒ n(E) = 1
Thus, P(E) = n(E)/n(S) = 1/8
(iii) Let L be the event of getting atmost two tails.
L = {HHH, TTH, THT, HTT, HHT, HTH, THH} ⇒ n(L) = 7
Thus, P(L) = n(L)/n(S) = 7/8

16. A bag contains 8 red and 5 white balls. Three balls are drawn at random. Find the probability that (a) all the three balls are white. (b) all the three balls are red. (c) one ball is red and two balls are white.
Ans. Total number of balls = 8 + 5 = 13
Total number of events for drawing 3 balls = $^{13}C_3$
(a) Total number of events for getting white balls = $^5C_3$

P(all 3 balls white) = $\frac{^5C_3}{^{13}C_3} = \frac{5!}{3! \times 2!} \times \frac{3! \times 10!}{13!}$

⇒ P(all 3 balls white) = 5/143
(b) Favourable number of events for getting red balls = $^8C_3$

P(all 3 balls red) = $\frac{^8C_3}{^{13}C_3} = \frac{8!}{3! \times 2!} \times \frac{3! \times 10!}{13!}$

⇒ P(all 3 balls red) = 28/143
(c) Favourable number of events for getting 1 red ball = $^8C_1$
Favourable number of events for getting 2 white balls = $^5C_2$

P(1 red and 2 white balls) = $\frac{^8C_1 \times ^5C_2}{^{13}C_3} = \frac{8!}{1! \times 7!} \times \frac{5!}{2! \times 3!} \times \frac{3! \times 10!}{13!}$

⇒ P(all 3 balls red) = 40/143

17. Three dice are thrown together. Find the probability of getting a total of at least 6.
Ans. Since one die can be thrown in six ways to obtain any one of the six numbers marked on its six faces. Therefore, if three dice are thrown, the total number of elementary events = 6 × 6 × 6 = 216.
Let A be the event of getting a total of at least 6. Then, $\overline{A}$ denotes the event of getting a total of less than 6 i.e., 3, 4, 5.
∴ $\overline{A}$ = {(1, 1, 1), (1, 1, 2), (1, 2, 1), (2, 1, 1), (1, 1, 3), (1, 3, 1), (3, 1, 1), (1, 2, 2), (2, 1, 2), (2, 2, 1)}
So, favourable number of elementary events = 10

∴ $P(\overline{A}) = \frac{10}{216} \Rightarrow 1 - P(A) = \frac{10}{216} \Rightarrow P(A) = 1 - \frac{10}{216} = \frac{103}{108}$

SECTION – D

Questions 18 carry 5 marks.

18. If 4 digit numbers greater than 5000 are randomly formed from the digits 0, 1, 3, 5 and 7 then what is the probability of forming a number divisible by 5 when
(i) the digits are repeated?
(ii) the repetition of digits is not allowed?
Ans. (i) When digits are repeated:
In a 4 digit number greater than 5000, thousands place can be filled up by either 5 or 7.
So thousands place can be filled in 2 ways.
∵ Digits can be repeated therefore the remaining three places can be filled in 53 = 125 ways.
∴ Total number of exhaustive cases = 2 × 125 = 250.
A number is divisible by 5 if the digit at unit place is either 0 or 5.

For a 4-digit number greater than 5000 and divisible by 5 the unit and thousands places are filled in 4 ways.
The hundreds and tens places are to be filled in $5^2 = 25$ ways.
$\therefore$ Number of favourable cases = $4 \times 25 = 100$
Thus, required probability = 100/250 = 2/5
(ii) When digits are not repeated :
In a 4-digit number greater than 5000, thousands place can be filled up by either 5 or 7.
If the thousands place is filled by 5 then the hundreds, tens and unit places may be filled in $4 \times 3 \times 2 = 24$ ways.
Similarly when the thousands place is filled by 7 then the hundreds, tenth and unit places may be filled in $4 \times 3 \times 2 = 24$ ways.
A number greater than 5000 and divisible by 5 when unit place is either 0 or 5 and thousands place is either 5 or 7.
The tens and hundreds places can be filled in $3 \times 2 = 6$ ways.
Number of favourable cases = $3 \times 6 = 18$.
Thus, required probability = 18/48 = 3/8.

OR

In a class of 60 students, 30 opted for NCC, 32 opted for NSS and 24 opted for both NCC and NSS. If one of these students is selected at random, find the probability that
(i) the student opted for NCC or NSS.
(ii) the student has opted neither NCC nor NSS.
(iii) the student has opted NSS but not NCC.
Ans. Here total number of students n(S) = 60.
Let A be the event that student opted for NCC and B be the event that the student opted for NSS.
Then $n(A) = 30$, $n(B) = 32$ and $n(A \cap B) = 24$

Thus $P(A) = \frac{n(A)}{n(S)} = \frac{30}{60} = \frac{1}{2}$ and $P(B) = \frac{n(B)}{n(S)} = \frac{32}{60} = \frac{8}{15}$

$$P(A \cap B) = \frac{n(A \cap B)}{n(S)} = \frac{24}{60} = \frac{2}{5}$$

(*i*) P (student opted for NCC or NSS) = $P(A \cup B)$

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

$$= \frac{1}{2} + \frac{8}{15} - \frac{2}{5} = \frac{15 + 16 - 12}{30} = \frac{19}{30}$$

(*ii*) P (student has opted neither NCC nor NSS) = $P(\overline{A} \cap \overline{B})$

$$P(\overline{A \cap B}) = 1 - P(A \cup B) = 1 - \frac{19}{30} = \frac{11}{30}$$

(*iii*) P (student has opted NSS but not NCC) = $P(A' \cap B)$

$$= P(B) - P(A \cap B) = \frac{8}{15} - \frac{2}{5} = \frac{8 - 6}{15} = \frac{2}{15}$$

SECTION – E (Case Study Based Questions)

Questions 19 to 20 carry 4 marks each.

19. Two students, Anil and Vijay, appeared in a highly competitive examination. Anil has been preparing part-time while managing a job, which has left him with limited preparation time. On the other hand, Vijay, though dedicated, has struggled with certain key concepts. Based on their preparation and past performance, the probability that Anil will qualify the examination is estimated to be 0.05, and the probability that Vijay will qualify is estimated at 0.10. Additionally, the probability that both students will qualify together, due to their independent preparation and individual strengths, is calculated as 0.02.

(a) Find the probability that at least one of them will qualify the exam.
(b) Find the probability that at least one of them will not qualify the exam.
(c) Find the probability that both Anil and Vijay will not qualify the exam.
(d) Find the probability that only one of them will qualify the exam.
Ans. (a) $P(A \cup B) = P(A) + P(B) - P(A \cap B)$
$= 0.05 + 0.10 - 0.02 = 0.13$
(b) Probability of at least one of them does not qualify
$= P(A' \cup B') = P((A \cap B)') = 1 - P(A \cap B) = 1 - 0.02 = 0.98$
(c) Probability that both Anil and Vijay will not qualify the exam
$= P(A' \cap B') = P((A \cup B)') = 1 - P(A \cup B) = 1 - 0.13 = 0.87$
(d) Probability that only one of them will qualify the exam
$= P((A - B) \cup (B - A)) = P(A - B) + P(B - A) = P(A \cup B) - P(A \cap B) = 0.13 - 0.02 = 0.11$

20. One of the four persons John, Rita, Aslam or Gurpreet will be promoted next month. Consequently, the sample space consists of four elementary outcomes S = {John promoted, Rita promoted, Aslam promoted, Gurpreet promoted}. You are told that the chances of John's promotion is same as that of Gurpreet, Rita's chances of promotion are twice as likely as Johns. Aslam's chances are four times that of John.

(a) What is the probability that John got promotion?
(b) What is the probability that Rita got promotion?
(c) What is the probability that Aslam got promotion?
(d) What is the probability that Gurpreet got promotion?
Ans. Let Event:
J = John promoted
R = Rita promoted
A = Aslam promoted
G = Gurpreet promoted
Given sample space, *S* = {John promoted, Rita promoted, Aslam promoted, Gurpreet promoted}
i.e., *S* = {J, *R*, *A*, *G*)

It is given that, chances of John's promotion is same as that of Gurpreet.

$$P(T) = P(G)$$

Rita's chances of promotion are twice as likely as John.

$$P(R) = 2P(T)$$

and Aslam's chances of promotion are four times that of John.

$$P(A) = 4P(D)$$

(a) Now, $P(C) + P(R) + P(A) + P(C) = 1$

$\Rightarrow P(J) + 2P(J) + 4P(J) + P(J) = 1$

$\Rightarrow 8P(J) = 1$

$\Rightarrow P(T) = P(\text{John Promoted}) = 1/8$

(b) $P(\text{Rita promoted}) = P(R)$

$= 2P(J) = 2 \times 1/8 = 1/4$

(c) $P(\text{Aslam promoted})$

$= 4P(J)$

$= 4 \times 1/8 = 1/2$

(d) $P(\text{Gurpreet promoted})$

$= P(G) = P(J) = 1/8$