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CLASS 12

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# CASE STUDY Questions

## 550+ CHAPTERWISE Practice Questions FOR CBSE BOARD 2021

- Case Study / Passage Based

# MATHEMATICS

Over 550 Questions & Solutions
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# QUESTION PAPER DESIGN 2020-21#

| S. No. | Chapter | VSA / Case based (1 mark) | SA-I (2 marks) | SA-II (3 marks) | LA (5 marks) | Total |
|---|---|---|---|---|---|---|
| 1. | Relations and Functions | 3(3)* | – | 1(3) | – | **4(6)** |
| 2. | Inverse Trigonometric Functions | – | 1(2) | – | – | **1(2)** |
| 3. | Matrices | 2(2)* | – | – | – | **2(2)** |
| 4. | Determinants | 1(1) | 1(2)* | – | 1(5)* | **3(8)** |
| 5. | Continuity and Differentiability | – | 1(2) | 2(6)* | – | **3(8)** |
| 6. | Application of Derivatives | 1(4) | 1(2) | 1(3) | – | **3(9)** |
| 7. | Integrals | 1(1)* | 1(2)* | 1(3) | – | **3(6)** |
| 8. | Application of Integrals | 1(1) | 1(2) | 1(3)* | – | **3(6)** |
| 9. | Differential Equations | 1(1)* | 1(2) | 1(3) | – | **3(6)** |
| 10. | Vector Algebra | 3(3) | 1(2) | – | – | **4(5)** |
| 11. | Three Dimensional Geometry | 2(2) | 1(2) | – | 1(5)* | **4(9)** |
| 12. | Linear Programming | – | – | – | 1(5)* | **1(5)** |
| 13. | Probability | 2(2) + 1(4) | 1(2)* | – | – | **4(8)** |
| | **Total** | **18(24)** | **10(20)** | **7(21)** | **3(15)** | **38(80)** |

*It is a choice based question.



*⋆ Case study is not possible in the chapter*

*#For latest information please refer to www.cbse.nic.in*

CHAPTER

# 13 Probability

Syllabus

Conditional probability, multiplication theorem on probability, independent events, total probability, Bayes' theorem, Random variable and its probability distribution.

## CASE STUDY / PASSAGE BASED QUESTIONS

### 1

Three friends $A$, $B$ and $C$ are playing a dice game. The numbers rolled up by them in their first three chances were noted and given by $A = \{1, 5\}$, $B = \{2, 4, 5\}$ and $C = \{1, 2, 5\}$ as $A$ reaches the cell 'SKIP YOUR NEXT TURN' in second throw.

Based on the above information, answer the following questions.

**(i)** $P(A \mid B) =$

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

**(ii)** $P(B \mid C) =$

(a) $\frac{2}{3}$ (b) $\frac{1}{12}$ (c) $\frac{1}{9}$ (d) 0

**(iii)** $P(A \cap B \mid C) =$

(a) $\frac{1}{6}$ (b) $\frac{1}{2}$ (c) $\frac{1}{12}$ (d) $\frac{1}{3}$

**(iv)** $P(A \mid C) =$

(a) $\frac{1}{4}$ (b) 1 (c) $\frac{2}{3}$ (d) None of these

**(v)** $P(A \cup B \mid C) =$

(a) 0 (b) $\frac{1}{2}$ (c) $\frac{2}{3}$ (d) 1

**(i)** $P(A \cap B) =$

(a) 0.2 (b) 0.9 (c) 0.48 (d) 0.6

**(ii)** $P(A \cup B) =$

(a) 0.92 (b) 0.08 (c) 0.48 (d) 0.64

**(iii)** $P(B \mid A) =$

(a) 0.14 (b) 0.2 (c) 0.6 (d) 0.8

**(iv)** $P(A \mid B) =$

(a) 0.6 (b) 0.9 (c) 0.19 (d) 0.11

**(v)** $P$ (not $A$ and not $B$) =

(a) 0.01 (b) 0.48 (c) 0.08 (d) 0.91

## 4

A doctor is to visit a patient. From the past experience, it is known that the probabilities that he will come by cab, metro, bike or by other means of transport are respectively 0.3, 0.2, 0.1 and 0.4. The probabilities that he will be late are 0.25, 0.3, 0.35 and 0.1 if he comes by cab, metro, bike and other means of transport respectively.

Based on the above information, answer the following questions.

**(i)** When the doctor arrives late, what is the probability that he comes by metro?

(a) $\frac{5}{14}$ (b) $\frac{2}{7}$ (c) $\frac{5}{21}$ (d) $\frac{1}{6}$

**(ii)** When the doctor arrives late, what is the probability that he comes by cab?

(a) $\frac{4}{21}$ (b) $\frac{1}{7}$ (c) $\frac{5}{14}$ (d) $\frac{2}{21}$

**(iii)** When the doctor arrives late, what is the probability that he comes by bike?

(a) $\frac{5}{21}$ (b) $\frac{4}{7}$ (c) $\frac{5}{6}$ (d) $\frac{1}{6}$

**(iv)** When the doctor arrives late, what is the probability that he comes by other means of transport?

(a) $\frac{6}{7}$ (b) $\frac{5}{14}$ (c) $\frac{4}{21}$ (d) $\frac{2}{7}$

**(v)** What is the probability that the doctor is late by any means?

(a) 1 (b) 0 (c) $\frac{1}{2}$ (d) $\frac{1}{4}$

## 5

Suman was doing a project on a school survey, on the average number of hours spent on study by students selected at random. At the end of survey, Suman prepared the following report related to the data.
Let $X$ denotes the average number of hours spent on study by students. The probability that $X$ can take the values $x$, has the following form, where $k$ is some unknown constant.

$$P(X=x)=\begin{cases}0.2, \text{ if } x=0\\ kx, \text{ if } x=1 \text{ or } 2\\ k(6-x), \text{ if } x=3 \text{ or } 4\\ 0, \text{ otherwise}\end{cases}$$

Based on the above information, answer the following questions.

**(i)** Find the value of $k$.
(a) 0.1 (b) 0.2 (c) 0.3 (d) 0.05

**(ii)** What is the probability that the average study time of students is not more than 1 hour?
(a) 0.4 (b) 0.3 (c) 0.5 (d) 0.1

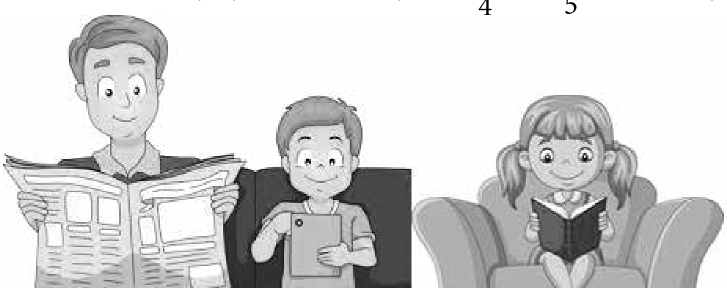
**(iii)** What is the probability that the average study time of students is at least 3 hours?
(a) 0.5 (b) 0.9 (c) 0.8 (d) 0.1

**(iv)** What is the probability that the average study time of students is exactly 2 hours?
(a) 0.4 (b) 0.5 (c) 0.7 (d) 0.2

**(v)** What is the probability that the average study time of students is at least 1 hour?
(a) 0.2 (b) 0.4 (c) 0.8 (d) 0.6

## 6

On a holiday, a father gave a puzzle from a newspaper to his son Ravi and his daughter Priya. The probability of solving this specific puzzle independently by Ravi and Priya are $\frac{1}{4}$ and $\frac{1}{5}$ respectively.



Based on the above information, answer the following questions.

**(i)** The value of $a + b + c - ab - bc - ca + abc$ is
(a) 0.3 (b) 0.5 (c) 0.7 (d) 0.6

**(ii)** The value of $ab + bc + ac - 2abc$ is
(a) 0.5 (b) 0.3 (c) 0.4 (d) 0.6

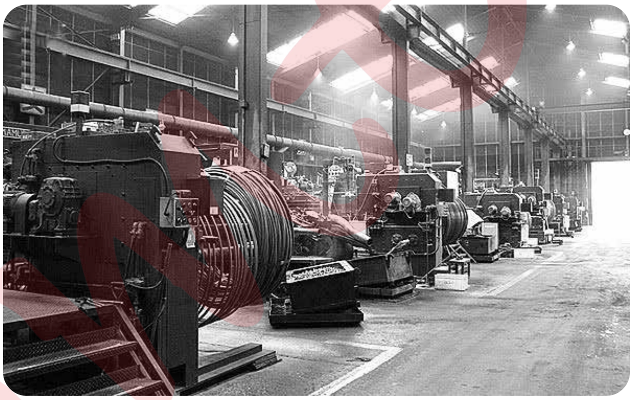
**(iii)** The value of $abc$ is
(a) 0.1 (b) 0.5 (c) 0.7 (d) 0.3

**(iv)** The value of $ab + bc + ac$ is
(a) 0.1 (b) 0.6 (c) 0.5 (d) 0.3

**(v)** The value of $a + b + c$ is
(a) 1 (b) 1.5 (c) 1.6 (d) 1.4

## 14

A factory has three machines $A$, $B$ and $C$ to manufacture bolts. Machine $A$ manufacture 30%, machine $B$ manufacture 20% and machine $C$ manufacture 50% of the bolts respectively. Out of their respective outputs 5%, 2% and 4% are defective. A bolt is drawn at random from total production and it is found to be defective.



Based on the above information, answer the following questions.

**(i)** Probability that defective bolt drawn is manufactured by machine $A$, is
(a) $\frac{4}{13}$ (b) $\frac{5}{13}$ (c) $\frac{6}{13}$ (d) $\frac{9}{13}$

**(ii)** Probability that defective bolt drawn is manufactured by machine $B$, is
(a) 0.3 (b) 0.1 (c) 0.2 (d) 0.4

**(iii)** Probability that defective bolt drawn is manufactured by machine $C$, is
(a) $\frac{16}{39}$ (b) $\frac{17}{39}$ (c) $\frac{20}{39}$ (d) $\frac{15}{39}$

**(iv)** Probability that defective bolt is not manufactured by machine $B$, is
(a) $\frac{35}{39}$ (b) $\frac{61}{39}$ (c) $\frac{41}{39}$ (d) none of these

**(v)** Probability that defective bolt is not manufactured by machine $C$, is
(a) 0.03 (b) 0.09 (c) 0.5 (d) 0.9

## 19

In a wedding ceremony, consists of father, mother, daughter and son line up at random for a family photograph, as shown in figure.

Based on the above information, answer the following questions.

**(i)** Find the probability that daughter is at one end, given that father and mother are in the middle.

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

**(ii)** Find the probability that mother is at right end, given that son and daughter are together.

(a) $\frac{1}{2}$ (b) $\frac{1}{3}$ (c) $\frac{1}{4}$ (d) 0

**(iii)** Find the probability that father and mother are in the middle, given that son is at right end.

(a) $\frac{1}{4}$ (b) $\frac{1}{2}$ (c) $\frac{1}{3}$ (d) $\frac{2}{3}$

**(iv)** Find the probability that father and son are standing together, given that mother and daughter are standing together.

(a) 0 (b) 1 (c) $\frac{1}{2}$ (d) $\frac{2}{3}$

**(v)** Find the probability that father and mother are on either of the ends, given that son is at second position from the right end.

(a) $\frac{1}{3}$ (b) $\frac{2}{3}$ (c) $\frac{1}{4}$ (d) $\frac{2}{5}$

## 20

Between students of class XII of two schools A and B basketball match is organised. For which, a team from each school is chosen, say $T_1$ be the team of school A and $T_2$ be the team of school B. These teams have to play two games against each other. It is assumed that the outcomes of the two games are independent. The probability of $T_1$ winning, drawing and losing a game against $T_2$ are $\frac{1}{2}, \frac{3}{10}$ and $\frac{1}{5}$ respectively.

Each team gets 2 points for a win, 1 point for a draw and 0 point for a loss in a game.

Let $X$ and $Y$ denote the total points scored by team A and B respectively, after two games.

**(iii)** The total probability of committing an error in processing the form is

(a) 0 (b) 0.047 (c) 0.234 (d) 1

**(iv)** The manager of the company wants to do a quality check. During inspection he selects a form at random from the days output of processed forms. If the form selected at random has an error, the probability that the form is NOT processed by Vinay is

(a) 1 (b) $\frac{30}{47}$ (c) $\frac{20}{47}$ (d) $\frac{17}{47}$

**(v)** Let $A$ be the event of committing an error in processing the form and let $E_1$, $E_2$ and $E_3$ be the events that Vinay, Sonia and Iqbal processed the form. The value of $\sum_{i=1}^{3} P(E_i \mid A)$ is

(a) 0 (b) 0.03 (c) 0.06 (d) 1

## HINTS & EXPLANATIONS

**1.** Here, sample space = {1, 2, 3, 4, 5, 6}, $A \cap B = \{5\}$, $B \cap C = \{2, 5\}$, $A \cap C = \{1, 5\}$, $A \cap B \cap C = \{5\}$ and $\{A \cup B\} \cap C = \{1, 2, 5\}$

Also, $P(A) = \frac{2}{6}$, $P(B) = \frac{3}{6}$, $P(C) = \frac{3}{6}$

$P(A \cap B) = \frac{1}{6}$, $P(B \cap C) = \frac{2}{6}$, $P(A \cap C) = \frac{2}{6}$,

$P(A \cap B \cap C) = \frac{1}{6}$ and $P((A \cup B) \cap C) = \frac{3}{6}$

**(i) (b):** $P(A|B) = \frac{P(A \cap B)}{P(B)} = \frac{1/6}{3/6} = \frac{1}{3}$

**(ii) (a):** $P(B|C) = \frac{P(B \cap C)}{P(C)} = \frac{2/6}{3/6} = \frac{2}{3}$

**(iii) (d):** $P(A \cap B | C) = \frac{P(A \cap B \cap C)}{P(C)} = \frac{1/6}{3/6} = \frac{1}{3}$

**(iv) (c):** $P(A|C) = \frac{P(A \cap C)}{P(C)} = \frac{2/6}{3/6} = \frac{2}{3}$

**(v) (d):** $P(A \cup B | C) = \frac{P((A \cup B) \cap C)}{P(C)} = \frac{3/6}{3/6} = 1$

**2.** Let $B$, $R$, $Y$ and $G$ denote the events that ball drawn is blue, red, yellow and green respectively.

$\therefore$ $P(B) = \frac{12}{35}$, $P(R) = \frac{8}{35}$, $P(Y) = \frac{10}{35}$ and $P(G) = \frac{5}{35}$

**(i) (c):** $P(G \cap B) = P(B) \cdot P(G \mid B) = \frac{12}{35} \cdot \frac{5}{34} = \frac{6}{119}$

**(ii) (b):** $P(R \cap Y) = P(Y) \cdot P(R \mid Y) = \frac{10}{35} \cdot \frac{8}{34} = \frac{8}{119}$

**(iii) (a):** Let $E$ = event of drawing a first red ball and $F$ = event of drawing a second red ball

Here, $P(E) = \frac{8}{35}$ and $P(E) = \frac{7}{34}$

$\therefore$ $P(F \cap E) = P(E) \cdot P(F \mid E) = \frac{8}{35} \cdot \frac{7}{34} = \frac{4}{85}$

**(iv) (c):** $P(Y' \cap G) = P(G) \cdot (Y' \mid G) = \frac{5}{35} \cdot \frac{24}{34} = \frac{12}{119}$

**(v) (d):** Let $E$ = event of drawing a first non-blue ball and $F$ = event of drawing a second non-blue ball

Here, $P(E) = \frac{23}{35}$ and $P(F) = \frac{22}{34}$

$\therefore$ $P(F \cap E) = P(E) \cdot P(F \mid E) = \frac{23}{35} \cdot \frac{22}{34} = \frac{253}{595}$

**3.** Here, $P(A) = 0.6$ and $P(B) = 0.8$

**(i) (c):** $P(A \cap B) = P(A) \cdot P(B) = (0.6)(0.8) = 0.48$

**(ii) (a):** $P(A \cup B) = P(A) + P(B) - P(A \cap B)$
$= 0.6 + 0.8 - 0.48 = 0.92$

**(iii) (d):** $P(B \mid A) = P(B)$ ($\because$ $A$ and $B$ are independent) $= 0.8$

**(iv) (a):** $P(A \mid B) = P(A)$ ($\because$ $A$ and $B$ are independent) $= 0.6$

**(v) (c) :** $P(\text{not } A \text{ and not } B) = P(A' \cap B') = P(A \cup B)'$ $= 1 - P(A \cup B) = 1 - 0.92 = 0.08$

**4.** Let $E$ be the event that the doctor visit the patient late and let $A_1$, $A_2$, $A_3$, $A_4$ be the events that the doctor comes by cab, metro, bike and other means of transport respectively.

$P(A_1) = 0.3$, $P(A_2) = 0.2$, $P(A_3) = 0.1$, $P(A_4) = 0.4$

$P(E|A_1)$ = Probability that the doctor arriving late when he comes by cab = 0.25

Similarly, $P(E \mid A_2) = 0.3$, $P(E \mid A_3) = 0.35$ and $P(E \mid A_4) = 0.1$

Also, $n(A \cap B) = 4$

$\therefore \quad P(A|B) = \dfrac{P(A \cap B)}{P(B)} = \dfrac{4/24}{4/24} = 1$

**(ii) (b):** Let $A$ denotes the event that mother is at right end.

$\therefore \quad n(A) = 6$

and $B$ denotes the event that son and daughter are together.

$\therefore \quad n(B) = 12$

Also, $n(A \cap B) = 4$

$\therefore \quad P(A|B) = \dfrac{P(A \cap B)}{P(B)} = \dfrac{4/24}{12/24} = \dfrac{1}{3}$

**(iii) (c):** Let $A$ denotes the event that father and mother are in the middle.

$\therefore \quad n(A) = 4$

and $B$ denotes the event that son is at right end.

$\therefore \quad n(B) = 6$

Also, $n(A \cap B) = 2$

$\therefore \quad P(A|B) = \dfrac{P(A \cap B)}{P(B)} = \dfrac{2/24}{6/24} = \dfrac{1}{3}$

**(iv) (d):** Let $A$ denotes the event that father and son are standing together.

$\therefore \quad n(A) = 12$

and $B$ denotes the event that mother and daughter are standing together.

$\therefore \quad n(B) = 12$

Also, $n(A \cap B) = 8$

$\therefore \quad P(A|B) = \dfrac{P(A \cap B)}{P(B)} = \dfrac{8/24}{12/24} = \dfrac{2}{3}$

**(v) (a):** Let $A$ denotes the event that father and mother are on either of the ends.

$\therefore \quad n(A) = 4$

and $B$ denotes the event that son is at second position from the right end.

$\therefore \quad n(B) = 6$

Also, $n(A \cap B) = 2$

$\therefore \quad P(A|B) = \dfrac{P(A \cap B)}{P(B)} = \dfrac{2/24}{6/24} = \dfrac{1}{3}$

**20. (i) (a):** Clearly, $P(\text{T}_2$ winning a match against $\text{T}_1)$

$= P(\text{T}_1 \text{ losing}) = \dfrac{1}{5}$

**(ii) (d):** Clearly, $P(\text{T}_2$ drawing a match against $\text{T}_1)$

$= P(\text{T}_1 \text{ drawing}) = \dfrac{3}{10}$

**(iii) (d):** According to given information, we have the following possibilities for the values of $X$ and $Y$.

| $X$ | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|
| $Y$ | 0 | 1 | 2 | 3 | 4 |

Now, $P(X > Y) = P(X = 4, Y = 0) + P(X = 3, Y = 1)$

$= P(\text{T}_1 \text{ win})\, P(\text{T}_1 \text{ win}) + P(\text{T}_1 \text{ win})\, P(\text{match draw})$
$+ P(\text{match draw})\, P(\text{T}_1 \text{ win})$

$= \dfrac{1}{2}\cdot\dfrac{1}{2} + \dfrac{1}{2}\cdot\dfrac{3}{10} + \dfrac{3}{10}\cdot\dfrac{1}{2} = \dfrac{5+3+3}{20} = \dfrac{11}{20}$

**(iv) (c):** $P(X = Y) = P(X = 2, Y = 2)$

$= P(\text{T}_1 \text{ win})\, P(\text{T}_2 \text{ win}) + P(\text{T}_2 \text{ win})\, P(\text{T}_1 \text{ win})$
$+ P(\text{match draw})\, P(\text{match draw})$

$= \dfrac{1}{2}\cdot\dfrac{1}{5} + \dfrac{1}{5}\cdot\dfrac{1}{2} + \dfrac{3}{10}\cdot\dfrac{3}{10} = \dfrac{1}{10} + \dfrac{1}{10} + \dfrac{9}{100} = \dfrac{29}{100}$

**(v) (a):** From the given information, it is clear that maximum sum of $X$ and $Y$ can be 4, therefore $P(X + Y = 8) = 0$

**21.** Let $A$ be the event of commiting an error and $E_1$, $E_2$ and $E_3$ be the events that Vinay, Sonia and Iqbal processed the form.

**(i) (b) :** Required probability $= P(A|E_2)$

$$= \frac{P(A \cap E_2)}{P(E_2)} = \frac{\left(0.04 \times \dfrac{20}{100}\right)}{\left(\dfrac{20}{100}\right)} = 0.04$$

**(ii) (c) :** Required probability $= P(A \cap E_2)$

$= 0.04 \times \dfrac{20}{100} = 0.008$

**(iii) (b):** Total probability is given by

$P(A) = P(E_1)\cdot P(A|E_1) + P(E_2)\cdot P(A|E_2) + P(E_3)\cdot P(A|E_3)$

$= \dfrac{50}{100} \times 0.06 + \dfrac{20}{100} \times 0.04 + \dfrac{30}{100} \times 0.03 = 0.047$

**(iv) (d):** Using Bayes' theorem, we have

$$P(E_1|A) = \frac{P(E_1)\cdot P(A|E_1)}{P(E_1)\cdot P(A|E_1) + P(E_2)\cdot P(A|E_2) + P(E_3)\cdot P(A|E_3)}$$

$$= \frac{0.5 \times 0.06}{0.5 \times 0.06 + 0.2 \times 0.04 + 0.3 \times 0.03} = \frac{30}{47}$$

$\therefore \quad$ Required probability $= P(\bar{E}_1|A)$

$= 1 - P(E_1|A) = 1 - \dfrac{30}{47} = \dfrac{17}{47}$

**(v) (d):** $\displaystyle\sum_{i=1}^{3} P(E_i|A) = P(E_1|A) + P(E_2|A) + P(E_3|A)$

$= 1 \qquad [\because$ Sum of posterior probabilities is 1]

☺☺☺