CHAPTER 13

Probability

Level - 1 CORE SUBJECTIVE QUESTIONS

MULTIPLE CHOICE QUESTIONS (MCQ) (1 Marks)

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

Explanation: Given:

$$P(A^c)=\frac{1}{2},\ P(B^c)=\frac{2}{3},\ P(A\cap B)=\frac{1}{4}$$

$$P(A^c\cap B^c)=1-P(A\cup B)$$

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

$$P(A)=1-\frac{1}{2}=\frac{1}{2},\ P(B)=1-\frac{2}{3}=\frac{1}{3}$$

$$P(A\cup B)=\frac{1}{2}+\frac{1}{3}-\frac{1}{4}=\frac{6}{12}+\frac{4}{12}-\frac{3}{12}=\frac{7}{12}$$

$$P\left(A^c\cap B^c\right)=1-\frac{7}{12}=\frac{5}{12}$$

Now, $P(A^c|B^c)=\dfrac{P(A^c\cap B^c)}{P(B^c)}=\dfrac{\frac{5}{12}}{\frac{2}{3}}=\dfrac{5}{12}\times\dfrac{3}{2}=\dfrac{5}{8}$

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

Explanation: Given:

$$P(A)=\frac{1}{3},\ P(B)=\frac{1}{5},\ P(C)=\frac{1}{6}$$

The problem is solved if at least one of A, B or C solves it.

(None solve the problem)

$$P(A')=1-\frac{1}{3}=\frac{2}{3},\ P(B')=1-\frac{1}{5}=\frac{4}{5},\ P(C')=1-\frac{1}{6}=\frac{5}{6}$$

$$P\left(A'\cap B'\cap C'\right)=\frac{2}{3}\times\frac{4}{5}\times\frac{5}{6}=\frac{40}{90}=\frac{4}{9}$$

$\therefore$ $P(\text{solved})=1-\dfrac{4}{9}=\dfrac{5}{9}$

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

Explanation: Given:

$$P(A|B)=P(A'|B)$$

Using conditional probability:

$$\frac{P(A\cap B)}{P(B)}=\frac{P(A'\cap B)}{P(B)}$$

Since $P(A'\cap B)=P(B)-P(A\cap B)$, we get:

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

$$2P(A\cap B)=P(B)$$

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

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

Explanation: Given:

$$P(E)=0.1,\ P(F)=0.3,\ P(E\cup F)=0.4$$

Using the formula:

$$P(E\cup F)=P(E)+P(F)-P(E\cap F)$$

$$0.4=0.1+0.3-P(E\cap F)\Rightarrow P(E\cap F)=0$$

Now,

$$P(F|E)=\frac{P(E\cap F)}{P(E)}=\frac{0}{0.1}=0$$

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

Explanation: If $P(A|B)=P(B|A)\neq 0$, then:

We use the conditional probability formula:

$$P(A|B)=\frac{P(A\cap B)}{P(B)},\ P(B|A)=\frac{P(A\cap B)}{P(A)}$$

Given that $P(A|B)=P(B|A)$,

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

Since $P(A\cap B)\neq 0$

$$P(A)=P(B)$$

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

Explanation: By definition, two events A and B are independent if:

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

Expanding $P(A'\cap B')$ using independence:

$$P(A'\cap B')=P(A').P(B')=(1-P(A))(1-P(B))$$

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

Explanation: Given:

$P(A|B) = 0.3, P(A) = 0.4, P(B) = 0.8$

Using the conditional probability formula:

$$P(A|B) = \frac{P(A \cap B)}{P(B)}$$

$$0.3 = \frac{P(A \cap B)}{0.8}$$

$$P(A \cap B) = 0.3 \times 0.8 = 0.24$$

Now,

$$P(B|A) = \frac{P(A \cap B)}{P(A)} = \frac{0.24}{0.4} = 0.6$$

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

Explanation: Given:

$$P(A-B) = \frac{1}{5}, \ P(A) = \frac{3}{5}$$

Since $P(A - B) = P(A) - P(A \cap B)$, we get:

$$\frac{1}{5} = \frac{3}{5} - P(A \cap B)$$

$$P(A \cap B) = \frac{3}{5} - \frac{1}{5} = \frac{2}{5}$$

Now,

$$P(B|A) = \frac{P(A \cap B)}{P(A)} = \frac{\frac{2}{5}}{\frac{3}{5}} = \frac{2}{3}$$

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

Explanation: Possible outcomes that sum to 9 when rolling two dice:

(3, 6), (4, 5), (5, 4), (6, 3)

Total cases: 4

Favorable cases where one die shows 4:

(4, 5), (5, 4)

Favorable cases: 2

Since the total outcomes summing to 9 is 4 , the probability is:

$$\frac{2}{4} = \frac{1}{2}$$

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

Explanation: The probability that A speaks the truth $= \frac{4}{5}$, and B speaks the truth $= \frac{3}{4}$.

They contradict each other if one speaks the truth and the other lies:

$$P(A \text{ speaks truth, } B \text{ lies}) = \frac{4}{5} \times \frac{1}{4} = \frac{4}{20}$$

$$P(A \text{ lies, } B \text{ speaks truth}) = \frac{1}{5} \times \frac{3}{4} = \frac{3}{20}$$

Total probability of contradiction:

$$\frac{4}{20} + \frac{3}{20} = \frac{7}{20}$$

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

Explanation: Using the formula for union of two events:

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

Given:

$$P(A) = 0.4$$
$$P(B) = 0.8$$
$$P(B|A) = 0.6,$$

so $$P(A \cap B) = P(B|A) \times P(A)$$
$$= 0.6 \times 0.4 = 0.24$$
$$P(A \cup B) = 0.4 + 0.8 - 0.24 = 0.96$$

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

Explanation: Total possible outcomes when 5 coins are tossed $= 2^5 = 32$.

Only 1 outcome has all tails.

So, probability of at least one head:

$$1 - P(\text{all tails}) = 1 - \frac{1}{32} = \frac{31}{32}$$

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

Explanation: For independent events,

$$P(B'|A) = 1 - P(B|A) = 1 - P(B)$$

$$[\because P(A \cap B) = P(A).P(B)]$$

Given $P(B) = \frac{1}{4}$,

$$P(B'|A) = 1 - \frac{1}{4} = \frac{3}{4}$$

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

Explanation: Using conditional probability formula:

$$P(B|A) = \frac{P(A \cap B)}{P(A)}$$

Given $P(A) = \frac{4}{5}, P(A \cap B) = \frac{7}{10}$:

$$P(B|A) = \frac{\frac{7}{10}}{\frac{4}{5}} = \frac{7}{8}$$

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

Explanation:

$$S = \{1, 2, 3, 4, 5, 6\}$$
$$E = \{1, 3, 5\}, F = \{2, 3\}$$
$$E \cap F = \{3\}$$

$$P(E|F) = \frac{P(E \cap F)}{P(F)} = \frac{\frac{1}{6}}{\frac{1}{3}} = \frac{1}{2}$$

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

Explanation: Possible cases:

BB, *BG*, *GB*, *GG* (since elder is a girl, *BB*, *BG* are not counted).

$$P(\text{both girls} | \text{elder is girl}) = \frac{1}{2}$$

ASSERTION-REASON QUESTIONS (1 Marks)

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

Explanation: Assertion (A):

If R and S are two events such that

$$P(R \mid S) = 1 \text{ and } P(S) > 0$$

Then:

$$P(R \mid S) = \frac{P(R \cap S)}{P(S)} = 1 \Rightarrow P(R \cap S) = P(S)$$

This means that all outcomes of S are contained in R, i.e., $S \subseteq R$.

The Assertion (A) is true.

Reason (R):

If two events A and B are such that

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

This implies that:

$P(A \cap B) = P(B) \Rightarrow$ All outcomes in B are also in A (since intersection of A and B is just B itself) $\Rightarrow B \subseteq A$

But the reason given states "$A \subset$ B", whereas the correct conclusion is "$B \subset A$".

Reason (R) is false.

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

Explanation: Two coins are tossed simultaneously.

Sample space i.e., possible outcomes are {HT, TH, HH, TT}

E = event of getting two heads

F = event of getting at least one head

$$P(E) = \frac{1}{4}, P(F) = \frac{3}{4}, P(E \cap F) = \frac{1}{4}$$

$$P\left(\frac{E}{F}\right) = \frac{P(E \cap F)}{P(F)}$$

$$= \frac{\left(\frac{1}{4}\right)}{\left(\frac{3}{4}\right)}$$

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

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

Explanation: Given: $P(A) = 0.3$, $P(B) = 0.6$, and A, B are independent.

$$P(B') = 1 - P(B)$$
$$= 1 - 0.6 = 0.4$$
$$P(A \cap B') = P(A) \cdot P(B')$$
$$= 0.3 \times 0.4 = 0.12$$

Assertion (A) is true.

Reason (R) states: $P(A \cap B) = P(A) \cdot P(B)$, which is correct.

Both Assertion and Reason are true, and Reason correctly explains Assertion.

VERY SHORT ANSWER TYPE QUESTIONS (2 Marks)

1. $$P(A|B) = \frac{P(A \cap B)}{P(B)}$$

$$\Rightarrow \quad \frac{3}{4} = \frac{P(A \cap B)}{\frac{1}{2}}$$

$$\Rightarrow \quad P(A \cap B) = \frac{3}{8}$$

$$P(B|A) = \frac{P(B \cap A)}{P(A)} = \frac{\frac{3}{8}}{\frac{5}{8}} = \frac{3}{5}$$

2. $$P(\text{Problem is solved}) = 1 - P(\text{Problem not solved})$$
$$= 1 - P(\bar{A})P(\bar{B})$$
$$= 1 - \frac{1}{3} \cdot \frac{2}{5}$$
$$= \frac{13}{15}$$

3. A: number of appearing on at least one dice is 3

B: sum of numbers appearing on both dice is even

Clearly, $A \cap B$ = {(3, 1), (3, 5), (1, 3), (5, 3), (3, 3)}

$$P\left(\frac{A}{B}\right) = \frac{P(A \cap B)}{P(B)} = \frac{\frac{5}{36}}{\frac{18}{36}} = \frac{5}{18}$$

4. A: Sum is 7

B: 5 has appeared at least on one die

$A \cap B$ = {(2, 5), (5, 2)}

$$P\left(\frac{B}{A}\right) = \frac{P(A \cap B)}{P(A)} = \frac{\frac{2}{36}}{\frac{6}{36}} = \frac{1}{3}$$

5. Total balls = 3 + 4 = 7

After drawing 1 red ball, there are 2 red balls left. The total number of balls remaining is 6.

$$\text{Required Prob.} = \frac{{}^2C_1}{{}^6C_1} \times \frac{{}^1C_1}{{}^5C_1} = \frac{2}{6} \times \frac{1}{5} = \frac{1}{15}$$

6. E_1 : B is standing at centre position

E_2 : A is standing at left corner

$$P(E_1|E_2) = \frac{P(E_1 \cap E_2)}{P(E_2)}$$

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

7. $$P(A) = \frac{1}{2}, P(B) = \frac{7}{12}, P(\bar{A} \cup \bar{B}) = \frac{1}{4}$$

$$P(\bar{A} \cup \bar{B}) = P(\overline{A \cap B}) = 1 - P(A \cap B)$$

$$P(A \cap B) = 1 - \frac{1}{4} = \frac{3}{4}$$

$$P(A) \times P(B) = \frac{1}{2} \times \frac{7}{12} = \frac{7}{24}$$

$$P(A) \times P(B) \neq P(A \cap B)$$

$\therefore$ A and B are not independent.

8. P(both balls drawn are of same colour)

= P(both white) + P(both red)

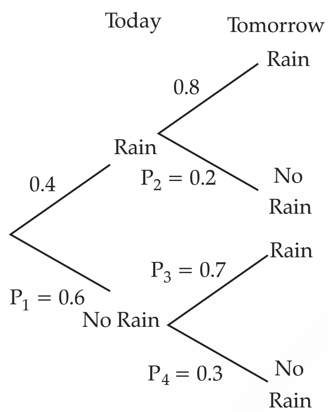
$$= \frac{1}{4} \times \frac{2}{5} + \frac{3}{4} \times \frac{3}{5} = \frac{11}{20}$$

SHORT ANSWER TYPE QUESTIONS (3 Marks)

1. Since the event of raining today and not raining today are complementary events so if the probability that it rains today is 0.4 then the probability that it does not rain today is $1 - 0.4 = 0.6 \Rightarrow P_1 = 0.6$.

If it rains today, the probability that it will rain tomorrow is 0.8 then the probability that it will not rain tomorrow is $1 - 0.8 = 0.2$.

If it does not rain today, the probability that it will rain tomorrow is 0.7 then the probability that it will not rain tomorrow is $1 - 0.7 = 0.3$



(i) $P_1 \times P_4 - P_2 \times P_3 = 0.6 \times 0.3 - 0.2 \times 0.7 = 0.04$.

(ii) Let E_1 and E_2 be the events that it will rain today and it will not rain today respectively.

$P(E_1) = 0.4$ & $P(E_2) = 0.6$

A be the event that it will rain tomorrow

$$P\left(\frac{A}{E_1}\right) = 0.8 \text{ \& } P\left(\frac{A}{E_2}\right) = 0.7.$$

We have, $P(A) = P(E_1)P\left(\frac{A}{E_1}\right) + P(E_2)P\left(\frac{A}{E_2}\right)$

$= 0.4 \times 0.8 + 0.6 \times 0.7 = 0.74.$

The probability of rain tomorrow is 0.74.

2. $P(\bar{E}) = 0.6 \Rightarrow P(E) = 0.4$

$$P(E \cup F) = P(E) + P(F) - P(E \cap F)$$

$$\Rightarrow 0.6 = 0.4 + P(F) - 0.4\,P(F) \Rightarrow P(F) = \frac{1}{3}$$

$$P(\bar{E} \cup \bar{F}) = 1 - P(E \cap F)$$

$$= 1 - 0.4 \times \frac{1}{3} = \frac{13}{15}$$

3. Let E_1: P is appointed as CEO.

E_2 : Q is appointed as CEO.

E_3 : R is appointed as CEO

A : company increase profits from previous year

here, $P(E_1) = \frac{4}{7}, P(E_3) = \frac{1}{7}, P(E_1) = \frac{2}{7}$

$P(A|E_1) = 0.3, P(A|E_2) = 0.8, P(A|E_3) = 0.5$

$P(E_3|A)$

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

$$= \frac{\frac{2}{7} \times 0.5}{\frac{4}{7} \times 0.3 + \frac{1}{7} \times 0.8 + \frac{2}{7} \times 0.5}$$

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

4. E_1: Two Balls transferred from Bag I are Red.

E_2 : Two Balls transferred from Bag I are Black.

E_3 : Two Balls transferred from Bag I are Red and Black.

A : Ball drawn from Bag II is Red

$$P(E_1) = \frac{1}{7}, P(E_2) = \frac{2}{7}, P(E_3) = \frac{4}{7}, P(A|E_1) = \frac{7}{9},$$

$$P(A|E_2) = \frac{5}{9}, P(A|E_3) = \frac{6}{9}$$

$$P(A) = \frac{1}{7} \cdot \frac{7}{9} + \frac{2}{7} \cdot \frac{5}{9} + \frac{4}{7} \cdot \frac{6}{9} = \frac{41}{63}$$

5. Let B : Student getting 'A' grade

E_1 : Student having above 90% attendance

E_2 : Student being irregular

$$P(E_1) = \frac{20}{100}; P(E_2) = \frac{80}{100}\; P(B|E_1) = \frac{80}{100}; P(B|E_2) = \frac{20}{100}$$

$$P(E_2|B) = \frac{P(E_2)P(B|E_2)}{P(E_1)P(B|E_1) + P(E_2)P(B|E_2)}$$

$$= \frac{0.8 \times 0.2}{0.2 \times 0.8 + 0.8 \times 0.2} = \frac{1}{2}$$

6. E_1 : getting both heads

E_2 : Not getting both heads

A : Reporting two heads

Here, $P(E_1) = \frac{1}{4}, P(E_2) = \frac{3}{4}$

$P(A|E_1)=\frac{3}{5}, P(A|E_2)=\frac{2}{5}$

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

$$=\frac{\frac{1}{4}\times\frac{3}{5}}{\frac{1}{4}\times\frac{3}{5}+\frac{3}{4}\times\frac{2}{5}}$$

$$=\frac{3}{9} \text{ or } \frac{1}{3}$$

7. $P(\text{getting a six})=\frac{1}{6}$; $P(\text{not getting a six})=\frac{5}{6}$

$$P(A \text{ wins}) = \frac{1}{6}+\left(\frac{5}{6}\right)^2\cdot\frac{1}{6}+\left(\frac{5}{6}\right)^4\cdot\frac{1}{4}+...=\frac{\frac{1}{6}}{1-\frac{25}{36}}=\frac{6}{11}$$

$$P(B \text{ wins}) = 1-P(A \text{ wins}) = 1-\frac{6}{11}=\frac{5}{11}$$

8. S = Sample paper = {H1, H2, H3, H4, H5, H6, T1, T2, T3, T4, T5, T6}

$$\therefore P(A)=\frac{6}{12}=\frac{1}{2}, P(B)=\frac{2}{12}=\frac{1}{6}, P(A\cap B)=\frac{1}{12}$$

$$\Rightarrow P(A\cap B)=P(A).P(B)=\frac{1}{12}$$

$\therefore$ A & B are independent events.

9. E_1 = Biased coin is selected $\Rightarrow P(E_1)=\frac{1}{2}$

E_2 = Fair coin is selected $\Rightarrow P(E_2)=\frac{1}{2}$

A = Head appeared on tossing a selected coin.

$$P\left(\frac{A}{E_1}\right)=\frac{1}{4}, P\left(\frac{A}{E_2}\right)=\frac{1}{2}$$

By Bayes' Theorem $P\left(\frac{E_1}{A}\right)$

$$=\frac{P(E_1)P\left(\frac{A}{E_1}\right)}{P(E_1)P\left(\frac{A}{E_1}\right)+P(E_2)P\left(\frac{A}{E_2}\right)}$$

$$=\frac{\frac{1}{2}\cdot\frac{1}{4}}{\frac{1}{2}\cdot\frac{1}{4}+\frac{1}{2}\cdot\frac{1}{2}}$$

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

10. Let E_1: event of choosing bag A,

E_2: event of choosing bag B,

A: red ball is found

Here, $P(E_1) = P(E_2)=\frac{1}{2}; P(A|E_1)=\frac{3}{5}, P(A|E_2)=\frac{5}{9}$

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

$$=\frac{\frac{5}{9}\times\frac{1}{2}}{\frac{3}{5}\times\frac{1}{2}+\frac{5}{9}\times\frac{1}{2}}=\frac{25}{52}$$

11. $P(A'\cup B')=\frac{1}{4}$

$$\Rightarrow P(A\cap B)'=\frac{1}{4}$$

$$\Rightarrow 1-P(A\cap B)=\frac{1}{4}\Rightarrow P(A\cap B)=\frac{3}{4}\neq 0$$

$\therefore$ A and B are not mutually exclusive.

$$P(A).P(B)=\frac{1}{2}\cdot\frac{7}{12}=\frac{7}{24}\neq P(A\cap B),$$

$\therefore$ A and B are not independent.

LONG ANSWER TYPE QUESTIONS (5 Marks)

1. Let events A, B and E be defined as:

A : Student knows the answer

B : Student guesses the answer

E : student answered correctly

$$P(A)=\frac{3}{5}, P(B)=\frac{2}{5}$$

Here, $P\left(\frac{E}{A}\right)=1$ and $P\left(\frac{E}{B}\right)=\frac{1}{3}$

By Bayes' theorem

$$P\left(\frac{A}{E}\right)=\frac{P(A).P\left(\frac{E}{A}\right)}{P(A).P\left(\frac{E}{A}\right)+P(B).P\left(\frac{E}{B}\right)}$$

$$=\frac{\frac{3}{5}\times 1}{\left(\frac{3}{5}\times 1\right)+\left(\frac{2}{5}\times\frac{1}{3}\right)}$$

$$=\frac{9}{11}$$

2. E_1 : Lost card is an ace

E_2 : Lost card is not an ace

A : 2 ace cards are drawn

$$P(E_1)=\frac{1}{13} \qquad P(E_2)=\frac{12}{13}$$

$$P(A|E_1)=\frac{{}^3C_2}{{}^{51}C_2} \qquad P(A|E_2)=\frac{{}^4C_2}{{}^{51}C_2}$$

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

$$= \frac{\frac{1}{13}\frac{^3C_2}{^{51}C_2}}{\frac{1}{13}\cdot\frac{^3C_2}{^{51}C_2}+\frac{12}{13}\cdot\frac{^4C_2}{^{51}C_2}}$$

$$= \frac{3}{75} \text{ or } \frac{1}{25}$$

3. E_1 : doublet appeard

E_2 : doublet did not appear

A : He reports doublet

$$P(E_1) = \frac{1}{6} \qquad P(E_2) = \frac{5}{6}$$

$$P(A|E_1) = \frac{7}{10} \qquad P(A|E_2) = \frac{3}{10}$$

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

$$= \frac{\frac{1}{6}\cdot\frac{7}{10}}{\frac{1}{6}\cdot\frac{7}{10}+\frac{5}{6}\cdot\frac{3}{10}}$$

$$= \frac{7}{22}$$

4. E_1 : A is selected

E_2 : B is selected

E_3 : C is selected

F : increase in profit does not take place

$$P(E_1) = \frac{1}{7}, P(E_2) = \frac{2}{7}, P(E_3) = \frac{4}{7}$$

$P(F|E_1) = 0.2$, $P(F|E_2) = 0.5$, $P(F|E_3) = 0.7$

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

$$= \frac{\frac{1}{7}\times\frac{2}{10}}{\frac{1}{7}\times\frac{2}{10}+\frac{2}{7}\times\frac{5}{10}+\frac{4}{7}\times\frac{7}{10}}$$

$$= \frac{2}{40} = \frac{1}{20}$$

5. E_1 = Item was produce by A

E_2 = Item was produce by B

E_3 = Item was produce by C

F : Item was defective

$$P(E_1) = \frac{30}{100}, P(E_2) = \frac{25}{100}, P(E_3) = \frac{45}{100}$$

$$P(F|E_1) = \frac{1}{100}, P(F|E_2) = \frac{1.2}{100}, P(F|E_3) = \frac{2}{100}$$

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

$$= \frac{\frac{25}{100}\times\frac{1.2}{100}}{\frac{30}{100}\times\frac{1}{100}+\frac{25}{100}\times\frac{1.2}{100}+\frac{45}{100}\times\frac{2}{100}}$$

$$= \frac{3}{3+3+9} = \frac{1}{5}$$

6. E_1 : Box I is selected

E_2 : Box II is selected

A : A red ball is drawn from the selected bag

$$P(E_1) = P(E_2) = \frac{1}{2}$$

$$P(A|E_1) = \frac{3}{9} = \frac{1}{3}, P(A|E_2) = \frac{5}{10} = \frac{1}{2}$$

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

$$= \frac{\frac{1}{2}\times\frac{1}{2}}{\frac{1}{2}\times\frac{1}{3}+\frac{1}{2}\times\frac{1}{2}}$$

$$= \frac{\frac{1}{2}}{\frac{1}{3}+\frac{1}{2}} = \frac{3}{5}$$

Level - 2 ADVANCED COMPETENCY FOCUSED QUESTIONS

MULTIPLE CHOICE QUESTIONS (MCQs) (1 Marsk)

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

Explanation: Using formula:

$$P(BT \mid MBA) = \frac{P(BT \cap MBA)}{P(MBA)}$$

Given:

$$P(BT) = \frac{5}{12}$$

$$P(MBA) = \frac{7}{16}$$

$$P(BT \cup MBA) = \frac{11}{24}$$

$$P(BT \cap MBA) = P(BT) + P(MBA) - P(BT \cup MBA)$$

$$= \frac{5}{12} + \frac{7}{16} - \frac{11}{24}$$

$$= \frac{20}{48} + \frac{21}{48} - \frac{22}{48} = \frac{19}{48}$$

$$P(BT \mid MBA) = \frac{\frac{19}{48}}{\frac{7}{16}} = \frac{19}{21}$$

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

   Explanation: Independent events are not necessarily mutually exclusive unless one has probability zero.

   $$P(M \cap N) = P(M)P(N)$$

   For mutually exclusive events, $P(M \cap N) = 0$, which contradicts independence unless one event has probability 0 .

   Also, sum of probabilities is not necessarily 1.

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

   Explanation: P(King or Heart) = P(King) + P(Heart) – P(King $\cap$ Heart)

   $$= \frac{4}{52} + \frac{13}{52} - \frac{1}{52} = \frac{16}{52} = \frac{4}{13}$$

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

   Explanation: P(Passing both tests) = P(Test 1) × P(Test 2) = 0.7 × 0.8 = 0.560

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

   Explanation: Given:Machine A produces 60% of items $\rightarrow P(A)=0.6$

   Machine B produces 40% of items $\rightarrow P(B)=0.4$

   Defective from A: 3% $\rightarrow P\left(\frac{D}{A}\right) = 0.03$

   Defective from B: 5% $\rightarrow P\left(\frac{D}{B}\right) = 0.05$

   To find $P\left(\frac{B}{D}\right)$: Probability that a defective item came from Machine B

   Using Bayes' Theorem:

   $$P\left(\frac{B}{D}\right) = \frac{P(B).P(D \mid B)}{P(A).P(D \mid A) + P(B).P(D \mid B)}$$

   Substitute values:

   $$P(B \mid D) = \frac{0.4 \times 0.05}{0.6 \times 0.03 + 0.4 \times 0.05} = \frac{0.02}{0.018 + 0.02} = \frac{0.02}{0.038}$$

   $$= \frac{20}{38} = \frac{10}{19}$$

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

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

   Substituting the values:

   $P(F \cup C) = 0.40 + 0.30 - 0.10 = 0.60$

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

   Explanation: Since each die has 6 faces, total outcomes when throwing two dice:

   6 × 6 = 36

   Favourable outcomes where the sum is divisible by 3

   The possible sums divisible by 3 are: 3, 6, 9, 12

   Counting the number of combinations that give each of these sums:

   Sum = 3 → (1,2), (2,1) → 2 outcomes

   Sum = 6 → (1,5), (2,4), (3,3), (4,2), (5,1) → 5 outcomes

   Sum = 9 → (3,6), (4,5), (5,4), (6,3) → 4 outcomes

   Sum = 12 → (6, 6) → 1 outcome

   Total favourable outcomes = 2 + 5 + 4 + 1 = 12

   $$\text{Probabitlity} = \frac{\text{favorable outcomes}}{\text{total outcomes}} = \frac{12}{36} = \frac{1}{3}$$

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

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

   $P(A \cup B) = 0.6 + 0.5 - 0.3 = 0.8$

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

   Explanation: Total balls = 4 + 5 + 3 = 12

   Probability first ball is red = $\frac{4}{12}$

   After removing 1 red ball, remaining red = 3, and total = 11

   Probability second ball is red = $\frac{3}{11}$

   So, required probability:

   $$\frac{4}{12} \times \frac{3}{11} = \frac{1}{3} \times \frac{3}{11} = \frac{1}{11}$$

Assertion-Reason Questions (1 Marks)

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

   Explanation: Assertion is true. This is a classic example of conditional probability. If the disease is rare (say, affects only 1% of the population), then a false positive can still be more likely than a true positive, even with 95% test accuracy.

   Reason is also true. Bayes' Theorem is used to update the probability of a hypothesis (e.g., "the person has the disease") based on new evidence (e.g., "the person tested positive").

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

   Explanation: Assertion is true. This is the definition of independent events in probability: the probability of both events happening together (intersection) equals the product of their individual probabilities.

   Reason is also true. If one event has no impact on the other, the chance of both happening is the product of the individual chances.

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

   Explanation: Assertion is true. This is a fundamental axiom of probability. The total probability across all mutually exclusive and exhaustive outcomes in a sample space always equals 1.

   Reason is false. The probability of an impossible event is 0, not greater than 1. In fact, no probability can be greater than 1.

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

Explanation: Assertion is true. If 5% of the items produced are defective, then the probability that a randomly selected item is defective is indeed 0.05.

Reason is also true. This is the basic definition of classical probability:

VERY SHORT ANSWER TYPE QUESTIONS (2 Marks)

1. Writes that $P(X' \cap Y) = P(X'|Y) \times P(Y)$.

Uses the property of conditional probability and simplifies the above equation as:

$P(X' \cap Y) = [1 - P(X|Y)] \times P(Y)$

Substitutes the given values in the above equation to find $P(X' \cap Y)$ as:

$P(X' \cap Y) = 0.8 \times 0.5 = 0.4$

2. Uses the given information and writes the equation for Vidit winning the game that day as:

$$\frac{7}{15} = \left(\frac{1}{3} \times \frac{80}{100}\right) + \left(\frac{1}{3} \times \frac{40}{100}\right) + \left(\frac{1}{3} \times \frac{x}{100}\right)$$

Simplifies the above equation as:

$$\frac{x}{100} = \frac{7}{5} - \frac{120}{100}$$

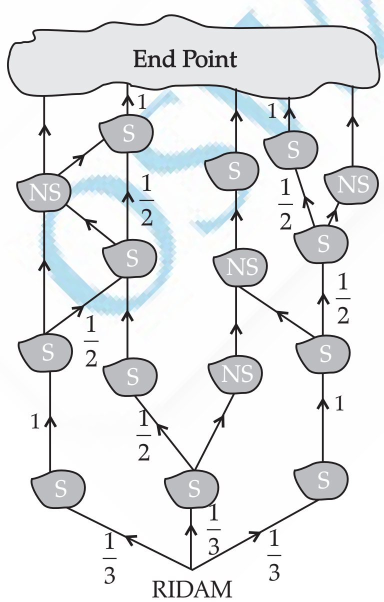
Solves the above equation for x and finds th chances of Vidit winning the game when paired with Opponent 3 as 20%.

3. Finds the probability of a ball being white in the first round as $1 - \frac{4}{16} = \frac{3}{4}$.

Finds the probability of a ball being white in the second round as $1 - \frac{8}{16} = \frac{1}{2}$.

Finds the probability of a ball being white at the end of the second round as $\frac{3}{4} \times \frac{1}{2} = \frac{3}{8}$.

4. Identities that there are three paths which Ridam can take to succeessfully reach the other side of the puddle and draws a tree diagram. The diagram may look as follows:



Finds the probability of Ridam successfully reaching the other side of the puddle as:

$$3 \times \frac{1}{3} \times \frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$$

5. Finds the probability of a student being fluent in economics as:

$$P(E) = 1 - P(M) = 1 - 0.75 = 0.25$$

Represents the mathematics as M and business studies as BS and uses Bayes' theorem to write:

$$P(E|BS) = \frac{P(E)P(BS|E)}{P(E)P(BS|E) + P(M)P(BS|M)}$$

$$= \frac{0.25 \times 0.80}{(0.25 \times 0.80) + (0.75 \times 0.15)}$$

Finds the proability of a student being fluent in economics given that he is fluent in business studies as $\frac{16}{25}$ or 64%.

6. Finds the probability that the train is on-time as $1 - \frac{3}{4} = \frac{1}{4}$.

Finds the probability that the train is on-time, and Vani gets a seat in it as $\frac{1}{4} \times \frac{1}{15} = \frac{1}{60}$.

7. Writes false.

Writes the correct expression. For example, since A and B are mutually exclusive, $A \cap B = \phi$, which means that $P(A \cap B) = 0$. Hence, the probability that at least one of them occurs is $P(A \cup B) = P(A) + P(B)$.

8. Finds the probability that a guitarist selected at random is also a pianist as:

$$= \frac{P(\text{pianist} \cap \text{guitarist})}{P(\text{guitarist})}$$

$$P(\text{pianist}|\text{guitarist}) = \frac{33}{55} = \frac{3}{5}$$

9. Writes that, by using the multiplication theorem of probability, the probability of getting a window seat without paying for a specific seat type can be found as $\frac{1}{6} \times \frac{1}{12} = \frac{1}{72}$.

SHORT ANSWER TYPE QUESTIONS (3 Marks)

1. Writes the probability of Himansh having a misconception as P(M) = 0.6 and of not having a misconception as P(M′) = 1 – 0.6 = 0.4.

   Writes the probability of the test outcome being green given he has a misconception as P(G|M) = 0.2

   Writes the probability of the test outcome being green given he doesn't have a misconception as P(G|M′) = 0.9.

   Uses Bayes' theorem and finds the probability that Himansh has a misconception given his test outcome was green as:

$$P(M|G) = \frac{P(M)P(G|M)}{P(M)P(G|M)+P(M')P(G|M')}$$

$$= \frac{0.6 \times 0.2}{(0.6 \times 0.2)+(0.4 \times 0.9)}$$

   Evaluates the above expression to find the required probability as $\frac{1}{4}$ or 25%.

2. Given: P(Infected) = 0.01

   $P(Healthy) = 1 - 0.01 = 0.99$

$$P\left(\frac{\text{positive}}{\text{Infected}}\right) = 0.95 \rightarrow \text{True positive}$$

$$P\left(\frac{\text{positive}}{\text{Healthy}}\right) = 0.02 \rightarrow \text{False positive}$$

   Using Bayes' Theorem

$$P(\text{Infected} | \text{Positive}) = \frac{P(\text{Positive}|\text{Infected}).P(\text{Infected})}{P(\text{Positive})}$$

$$P(\text{Positive}) = P\left(\frac{\text{positive}}{\text{Infected}}\right).P(\text{Infected}) + P\left(\frac{\text{positive}}{\text{Healthy}}\right)$$

   P(Healthy) = (0.95)(0.01) + (0.02)(0.99) = 0.0095 + 0.0198 = 0.0293

$$P(\text{Infected} | \text{Positive}) = \frac{0.95 \times 0.01}{0.0293} = \frac{0.0095}{0.0293} \approx 0.324$$

3. Given: $P(M_1) = 0.60$, $P(M_2) = 0.40$

$$P\left(\frac{D}{M_1}\right) = 0.03, \quad P\left(\frac{D}{M_2}\right) = 0.05$$

   D: Event that an item is defective.

   Using Bayes' Theorem

$$P(D) = P\left(\frac{D}{M_1}\right).P(M_1) + P\left(\frac{D}{M_2}\right).P(M_2)$$

$$= (0.03)(0.60) + (0.05)(0.40) = 0.018 + 0.020 = 0.038$$

$$P(M_2|D) = \frac{0.05 \times 0.40}{0.038} = \frac{0.020}{0.038} \approx 0.5263$$

$$= 52.6\%$$

4. (i) $P(M \cup S) = P(M) + P(S) - P(M \cap S)$

   $= 0.70 + 0.50 - 0.30 = 0.90$

   (ii) $P(only\ Math) = 0.70 - 0.30 = 0.40$

   (iii) $P(neither) = 1 - P(M \cup S) = 1 - 0.90 = 0.10$

5. (i) $P(A) = \frac{26}{52} = \frac{1}{2}$

   $P(B) = \frac{4}{52} = \frac{1}{13}$

   $P(A \cap B) = \frac{2}{52} = \frac{1}{26}$

   (ii) Two events A and B are independent if:

   $P(A \cap B) = P(A).P(B)$

   $P(A \cap B) = \frac{1}{26}$

   $P(A).P(B) = \frac{1}{2} \times \frac{1}{13} = \frac{1}{26}$

   Since, $P(A \cap B) = P(A).P(B)$

   Therefore, events A and B are independent.

CASE BASED QUESTIONS (4 Marks)

1. Let E_1 be the event that one parrot and one owl flew from cage-I

   E_2 be the event that two parrots flew from Cage-I

   A be the event that the owl is still in cage-I

   (i) Total ways

   From cage I, 1 parrot and 1 owl flew and then from Cage-II, 1 parrot and 1 owl flew back + From cage I, 1 parrot and 1 owl flew and then from Cage-II, 2 parrots flew back + From cage I , 2 parrots flew and then from Cage-II, 2 parrots came back.

   $= ({}^5C_1 \times {}^1C_1)({}^7C_1 \times {}^1C_1) + ({}^5C_1 \times {}^1C_1)({}^7C_2) + ({}^5C_2)({}^8C_2)$

   No. of cases in which owl is still in cage –I

   $= P(E_1 \cap A) + P(E_2 \cap A)$

   $= (5_{C_1} \times 1_{C_1})(7_{C_1} \times 1_{C_1}) + (5_{C_2})(8_{C_2})$

   Probability that the owl is still in cage –I = $P(E_1 \cap A) + P(E_2 \cap A)$

$$\frac{(5_{C_1} \times 1_{C_1})(7_{C_1} \times 1_{C_1}) + (5_{C_2})(8_{C_2})}{(5_{C_1} \times 1_{C_1})(7_{C_1} \times 1_{C_1}) + (5_{C_1} \times 1_{C_1})(7_{C_2}) + (5_{C_2})(8_{C_2})}$$

$$= \frac{35+280}{35+105+280}$$

$$= \frac{315}{420} = \frac{3}{4}$$

(ii) The probability that one parrot and the owl flew from Cage-I to Cage-II given that the owl is still in cage-I is $P\left(\frac{E_1}{A}\right)$

$$P\left(\frac{E_1}{A}\right) = \frac{P(E_1 \cap A)}{P(E_1 \cap A) + P(E_2 \cap A)}$$

(by Baye's Theorem)

$$= \frac{\frac{35}{420}}{\frac{315}{420}} = \frac{1}{9}$$

2. (i) Let A denote the event of airplane reaching its destination late

E_1 = severe tubulence

E_2 = moderate turbulene

E_3 = light turbulence

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

$$= \frac{1}{3} \times \frac{55}{100} + \frac{1}{3} \times \frac{37}{100} + \frac{1}{3} \times \frac{17}{100}$$

$$= \frac{1}{3}\left(\frac{109}{100}\right) = \frac{109}{300}$$

(ii)

$$P(E_2|A) = \frac{P(E_2)P(A/E_2)}{P(A)}$$

$$= \frac{\frac{1}{3} \times \frac{37}{100}}{\frac{109}{300}}$$

$$= \frac{37}{109}$$

3. (i)

$$P(E_2) = 1 - 0.0000001 = 0.9999999$$

(ii) $P\left(\frac{A}{E_1}\right) + P\left(\frac{A}{E_2}\right) = \frac{95}{100} + 1 = \frac{195}{100}$

(iii) (a) $P(A) = P(E_1) \times P(A/E_1) + P(E_2) \times P(A/E_2)$

$$= \frac{1}{10000000} \times \frac{95}{100} + \frac{9999999}{10000000} \times 1$$

$$= \frac{95 + 999999900}{1000000000} = \frac{999999995}{1000000000}$$

OR

(b) $P(E_2/A) = \frac{P(E_2) \times P(A/E_2)}{P(E_1) \times P(A/E_1) + P(E_2) \times P(A/E_2)}$

$$= \frac{\frac{9999999}{10000000}}{\frac{999999995}{1000000000}} = \frac{999999900}{999999995}$$

4. Given P(Rohit) = $\frac{1}{5}$, P(Jaspreet) = $\frac{1}{3}$, P(Alia) = $\frac{1}{4}$

(i) P(atleast one of them is selected)

= 1 – P(no one is selected)

$$= 1 - \left(\frac{4}{5} \times \frac{2}{3} \times \frac{3}{4}\right) = \frac{3}{5}$$

(ii) $P(G|\bar{H}) = \frac{P(G \cap \bar{H})}{P(\bar{H})}$

$$= \frac{P(G) - P(G \cap H)}{P(\bar{H})}$$

$$= \frac{\frac{1}{3} - \frac{1}{3} \times \frac{1}{5}}{\frac{4}{5}} = \frac{\frac{4}{15}}{\frac{4}{5}}$$

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

(iii) P(exactly one of them selected)

$$= P(R) \times P(\bar{J}) \times P(\bar{A}) + P(\bar{R}) \times P(J) \times P(\bar{A}) + P(\bar{R}) \times P(\bar{J}) \times P(A)$$

$$= \left(\frac{1}{5} \times \frac{2}{3} \times \frac{3}{4}\right) + \left(\frac{4}{5} \times \frac{1}{3} \times \frac{3}{4}\right) + \left(\frac{4}{5} \times \frac{2}{3} \times \frac{1}{4}\right)$$

$$= \frac{6}{60} + \frac{12}{60} + \frac{8}{60} = \frac{26}{60} = \frac{13}{30}$$

OR

Exactly two of them is selected

$$= P(R) \times P(J) \times P(\bar{A}) + P(R) \times P(\bar{J}) \times P(A) + P(\vec{R}) + P(J) \times P(A)$$

$$= \frac{1}{5} \times \frac{1}{3} \times \frac{3}{4} + \frac{1}{5} \times \frac{2}{3} \times \frac{1}{4} + \frac{4}{5} \times \frac{1}{3} \times \frac{1}{4}$$

$$= \frac{3}{60} + \frac{2}{60} + \frac{4}{60} = \frac{9}{60} = \frac{3}{20}$$

5. (i) $P(E_1) = \frac{7}{10} = 0.7, P(E_2) = \frac{3}{10} = 0.3$

(ii) $P(A|E_1) = 0.8$, $P(A|E_2) = 0.4$

(iii) $P(A) = P(E_1).P(A|E_1) + P(E_2).P(A|E_2)$

$$= 0.7 \times 0.8 + 0.3 \times 0.4 = 0.68 = \frac{17}{25}$$

OR

$$P\left(\frac{E_1}{A}\right) = \frac{P(E_1).P(A|E_1)}{P(E_1).P(A|E_1) + P(E_2).P(A|E_2)} = \frac{14}{17}$$

6. S = {1, 2, 3, ... 9, 10}

(i) P(getting number > 4)

= P(5 or 6 or 7 or 8 or 9 or 10)

$$= \frac{6}{10} = \frac{3}{5}$$

(ii) A: getting even number = {2, 4, 6, 8, 10}

B: getting number greater than 4 = {5, 6, 7, 8, 9, 10}

$A \cap B$ = {6, 8, 10}

Now $P(A|B) = \dfrac{P(A \cap B)}{P(B)}$

$$= \dfrac{\frac{3}{10}}{\frac{6}{10}} = \dfrac{1}{2}$$

7. (i) $x + 0.21 = 0.44 \Rightarrow x = 0.23$

(ii) $0.41 + y + 0.44 + 0.11 = 1 \Rightarrow y = 0.04$

(iii) (a) $P\left(\dfrac{C}{B}\right) = \dfrac{P(C \cap B)}{P(B)}$

$P(B) = 0.09 + 0.04 + 0.23 = 0.36$

$P\left(\dfrac{C}{B}\right) = \dfrac{0.23}{0.36} = \dfrac{23}{36}$

OR

(b) P(A or B but not C)

$= 0.32 + 0.09 + 0.04$

$= 0.45$

8. (i) $P(L|C) = \dfrac{17}{100}$

(ii) $P(\bar{L}|A) = 1 - P(L|A) = 1 - \dfrac{24}{100} = \dfrac{76}{100}$ or $\dfrac{19}{25}$

(iii) $P(A|L) = \dfrac{\frac{1}{4} \times \frac{24}{100}}{\frac{1}{4} \times \frac{24}{100} + \frac{1}{4} \times \frac{22}{100} + \frac{1}{4} \times \frac{17}{100} + \frac{1}{4} \times \frac{9}{100}}$

$= \dfrac{24}{72} = \dfrac{1}{3}$

OR

Probability that a randomly selected child is left-handed given that exactly one of the parents is left-handed.

$$= P(L|B \cup C) = \frac{22}{100} + \frac{17}{100} = \frac{39}{100}$$

9. (i) $P(E_2) = 1 - P(E_1) = 1 - 0.65 = 0.35$

(ii) $P(E) = P(E_1).P\left(\dfrac{E}{E_1}\right) + P(E_2).P\left(\dfrac{E}{E_2}\right)$

$= 0.65 \times 0.35 + 0.35 \times 0.8$

$= 0.35 \times 1.45$

$= 0.51$

(iii) (a) $P\left(\dfrac{E_1}{E}\right) = \dfrac{P(E_1).P(E|E_1)}{P(E_1).P(E|E_1) + P(E_2).P(E|E_2)}$

$= \dfrac{0.65 \times 0.35}{0.51} = 0.45$

OR

(b) $P\left(\dfrac{E_2}{E}\right) = \dfrac{P(E_2).P(E|E_2)}{P(E_1).P(E|E_1) + P(E_2).P(E|E_2)}$

$= \dfrac{0.35 \times 0.8}{0.51} = 0.55$

10. (i) Probability of randomly chosen seen to germinate

$= \dfrac{4}{10} \times \dfrac{45}{100} + \dfrac{4}{10} \times \dfrac{60}{100} + \dfrac{2}{10} \times \dfrac{35}{100} = 0.49$

(ii) Probability that the randomly selected seed is of type A_1, given that it germinates

$= \dfrac{\frac{4}{10} \times \frac{45}{100}}{\frac{490}{1000}} = \dfrac{180}{490} = \dfrac{18}{49}$

LONG ANSWER TYPE QUESTIONS (5 Marks)

1. Finds the probability of a black ball being in the sealed box as $P(B_1) = \dfrac{1}{2}$ and that of a white ball being in the sealed box as $P(B_1') = \dfrac{1}{2}$.

Finds the probability of picking a black ball, B_2 given that B_1 is black as:

$P(B_2|B_1) = 1$

Finds the probability of picking a black ball given that B_1 is white as:

$P(B_2|B_1') = \dfrac{1}{2}$

Finds the total probability of picking a black ball as:

$P(B_2) = P(B_2|B_1)\, P(B_1) + P(B_2|B_1')\, P(B_1')$

$= \dfrac{1}{2} + \left(\dfrac{1}{2} \times \dfrac{1}{2}\right)$

$= \dfrac{3}{4}$

Finds the probability that the original ball in the box is black given that he picked a black ball as:

$$P(B_1|B_2) = \frac{P(B_1)P(B_2|B_1)}{P(B_2)} = \frac{\frac{1}{2}}{\frac{3}{4}} = \frac{2}{3}$$

2. (i) Takes A to be the event of picking an apple and finds $P(A) = \dfrac{4}{10} = \dfrac{2}{5}$.

Finds the probability of getting an apple in the second pick with the condition that one apple has already been picked as $P(A|A) = \dfrac{3}{9} = \dfrac{1}{3}$.

Finds the probability of getting an apple in the third pick with the condition that two apples have already been picked as $P(A|AA) = \dfrac{2}{8} = \dfrac{1}{4}$.

Uses the multiplication theorem of probability and finds P(all three fruits picked are apples) as:

$$P(AAA) = \frac{2}{5} \times \frac{1}{3} \times \frac{1}{4} = \frac{1}{30}$$

(ii) Takes G to be the event of picking a guava and finds $P(G) = \frac{6}{10} = \frac{3}{5}$.

Finds the probability of getting an apple in the second pick with the condition that one guava has already been picked as $P(A \mid G) = \frac{4}{9}$.

Finds the probability of getting an apple in the third pick with the condition that one guava and one apple have already been picked as $P(A \mid GA) = \frac{3}{8}$.

Uses the multiplication theorem of probability and finds P(the first fruit is guava and the next two are apples) as:

$$P(GAA) = \frac{3}{5} \times \frac{4}{9} \times \frac{3}{8} = \frac{1}{10}$$

(iii) Uses step 4 and finds P(at least one of the fruits picked is a guava) as:

1 – P(all three fruits picked are apples)

$$= 1 - \frac{1}{30}$$

$$= \frac{29}{30}$$