EXERCISE 12.2

1. If A and B are two events such that $P(A)=\frac{1}{4}$, $P(B)=\frac{1}{2}$ and $P(A\cap B)=\frac{1}{8}$, find $P(A\cup B)$.
2. In an apartment, selecting a house from door numbers 1 to 50 randomly, find the probability of getting the door number of the house to be an even number or a perfect square number.
3. The probability of a team winning any match is $\frac{3}{10}$ and the probability of losing any match is $\frac{2}{10}$. What is the probability that
   (i) the team wins or loses a particular match.
   (ii) the team neither wins nor loses a match.
4. In a single throw of two dice, find the probability of having sum of 7 or 11.
5. Find the probability of getting a sum of 5 or 7 in a throw of two dice.
6. A card is taken out at random from a standard pack of 52 cards. Find the probability of taking out.
   (i) A king or a Jack. (ii) Neither a king nor a Jack.
7. A dice is thrown twice. What is the probability that at least one of the two throws comes up with number 3.
8. There are 15 cards in a bag marked as 1, 2, 3, …., 15. Find the probability of picking a card at random, the number written on which is a multiple of 5 or of 7.
9. Two fair coins are tossed once. What is the probability of getting at least one head or two heads.
10. At a busy intersection, 50% of vehicles turn right, 30% turn left and 20% go straight. What is the probability that a randomly selected vehicle turn left or right?
11. Two fair coins are tossed. What is the probability of getting either two heads or two tails?
12. If A and B are two mutually exclusive events of a random experiment and $P(\text{not } A) = 0.45$, $P(A\cup B) = 0.65$, then find $P(B)$.
13. If $P(A)=\frac{2}{3}$, $P(B)=\frac{2}{5}$, $P(A\cup B)=\frac{1}{3}$ then find $P(A\cap B)$.
14. A and B are two events such that, $P(A) = 0.42$, $P(B) = 0.48$, and $P(A\cap B) = 0.16$.
    Find: (i) $P(\overline{A})$ (ii) $P(\overline{B})$ (iii) $P(A\cup B)$

EXERCISE 12.2 - Addition Rule of Probability

Question 1

Given:

$$P(A)=\frac{1}{4}, P(B)=\frac{1}{2}, P(A\cap B)=\frac{1}{8}$$

Find: $P(A\cup B)$

Solution:

Step 1: Use the addition rule of probability:

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

Step 2: Substitute the given values:

$$P(A \cup B) = \frac{1}{4} + \frac{1}{2} - \frac{1}{8}$$

Step 3: Find common denominator (8):

$$P(A \cup B) = \frac{2}{8} + \frac{4}{8} - \frac{1}{8} P(A \cup B) = \frac{2+4-1}{8} = \frac{5}{8}$$

Answer: $P(A \cup B) = \frac{5}{8}$

Question 2

Given: Door numbers 1 to 50
Find: Probability of getting an even number or a perfect square number

Solution:

Step 1: Define events.

- Let A = event of getting an even number
- Let B = event of getting a perfect square number

Step 2: Find $n(A)$ - Even numbers from 1 to 50.

$$\text{Even numbers} = \{2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 50\} n(A) = 25$$

Step 3: Find $n(B)$ - Perfect squares from 1 to 50.

$$\text{Perfect squares} = \{1, 4, 9, 16, 25, 36, 49\} n(B) = 7$$

Step 4: Find $n(A \cap B)$ - Numbers that are both even and perfect squares.

$$A \cap B = \{4, 16, 36\} n(A \cap B) = 3$$

Step 5: Total outcomes:

$$n(S) = 50$$

Step 6: Apply addition rule:

$$P(A \cup B) = P(A) + P(B) - P(A \cap B) P(A \cup B) = \frac{25}{50} + \frac{7}{50} - \frac{3}{50} P(A \cup B) = \frac{25+7-3}{50} = \frac{29}{50}$$

Answer: $\frac{29}{50}$

Question 3

Given:

$$P(\text{win}) = \frac{3}{10}, P(\text{lose}) = \frac{2}{10}$$

Find: Probability that the team wins or loses a particular match.

Solution:

Step 1: Define events.

- Let W = event of winning
- Let L = event of losing

Step 2: These events are mutually exclusive (the team cannot win and lose at the same time).

$$P(W \cap L) = 0$$

Step 3: Apply addition rule for mutually exclusive events:

$$P(W \cup L) = P(W) + P(L) - P(W \cap L) P(W \cup L) = \frac{3}{10} + \frac{2}{10} - 0 P(W \cup L) = \frac{5}{10} = \frac{1}{2}$$

Answer: $\frac{1}{2}$

Summary Table

1	$\frac{5}{8}$
2	$\frac{29}{50}$
3	$\frac{1}{2}$

Key Formulas

Addition Rule of Probability:

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

Mutually Exclusive Events:

If two events cannot occur at the same time:

$$P(A \cap B) = 0$$

Then:

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

Key Concepts

1. $P(A \cup B)$ = Probability of A **or** B occurring
2. $P(A \cap B)$ = Probability of A **and** B occurring together
3. **Mutually Exclusive Events:** Events that cannot happen at the same time (no common outcomes)

4. **Addition Rule:** When finding probability of "or", add probabilities and subtract the overlap

Visual Representation:

text

A B

+---------+---------+

| | |

| A B | |

| | |

+---------+---------+

- $P(A \cup B)$ = Area of A + Area of B - Area of overlap

EXERCISE 12.2 (Continued) - Addition Rule of Probability

Question 3(ii)

Given: $P(\text{win}) = \frac{3}{10}$, $P(\text{lose}) = \frac{2}{10}$
Find: Probability that the team neither wins nor loses.

Solution:

Step 1: The team neither wins nor loses means it draws (or no result).

Step 2: Total probability = 1:

$$P(\text{win}) + P(\text{lose}) + P(\text{neither}) = 1$$

Step 3: Substitute values:

$$\frac{3}{10} + \frac{2}{10} + P(\text{neither}) = 1 \frac{5}{10} + P(\text{neither}) = 1 P(\text{neither}) = 1 - \frac{1}{2} = \frac{1}{2}$$

Answer: $\frac{1}{2}$

Question 4

Find: Probability of getting sum of 7 or 11 in a single throw of two dice.

Solution:

Step 1: Total outcomes = 36.

Step 2: Favorable outcomes for sum = 7:

$$(1,6), (2,5), (3,4), (4,3), (5,2), (6,1) \rightarrow 6 \text{ outcomes}$$

Step 3: Favorable outcomes for sum = 11:

$$(5,6), (6,5) \rightarrow 2 \text{ outcomes}$$

Step 4: These events are mutually exclusive (sum cannot be both 7 and 11):

$$P(\text{sum 7 or 11}) = \frac{6}{36} + \frac{2}{36} = \frac{8}{36} = \frac{2}{9}$$

Answer: $\frac{2}{9}$

Question 5

Find: Probability of getting a sum of 5 or 7 in a throw of two dice.

Solution:

Step 1: Total outcomes = 36.

Step 2: Favorable outcomes for sum = 5:

$$(1,4),(2,3),(3,2),(4,1) \rightarrow 4 \text{ outcomes}$$

Step 3: Favorable outcomes for sum = 7:

$$(1,6),(2,5),(3,4),(4,3),(5,2),(6,1) \rightarrow 6 \text{ outcomes}$$

Step 4: Events are mutually exclusive:

$$P(\text{sum 5 or 7}) = \frac{4}{36} + \frac{6}{36} = \frac{10}{36} = \frac{5}{18}$$

Answer: $\frac{5}{18}$

Question 6

Given: Standard pack of 52 cards
Find: Probability of taking out (i) A king or a Jack (ii) Neither a king nor a Jack.

Solution:

6(i) King or Jack

Step 1: Number of Kings = 4, Number of Jacks = 4.

Step 2: Events are mutually exclusive:

$$P(\text{King or Jack}) = \frac{4}{52} + \frac{4}{52} = \frac{8}{52} = \frac{2}{13}$$

Answer: $\frac{2}{13}$

6(ii) Neither King nor Jack

Step 1: Total cards = 52. Cards that are Kings or Jacks = 8.

Step 2: Neither King nor Jack:

$$P(\text{neither}) = 1 - P(\text{King or Jack}) = 1 - \frac{2}{13} = \frac{11}{13}$$

Answer: $\frac{11}{13}$

Question 7

Find: Probability that at least one of the two throws comes up with number 3.

Solution:

Step 1: Total outcomes = 36.

Step 2: Number of outcomes with no 3:

- First die: 5 options (1,2,4,5,6)
- Second die: 5 options (1,2,4,5,6)

$$n(\text{no 3}) = 5 \times 5 = 25$$

Step 3: At least one 3:

$$P(\text{at least one 3}) = 1 - P(\text{no 3}) = 1 - \frac{25}{36} = \frac{11}{36}$$

Answer: $\frac{11}{36}$

Question 8

Given: Cards numbered 1 to 15
Find: Probability of picking a number that is a multiple of 5 or 7.

Solution:

Step 1: Multiples of 5: {5, 10, 15} → 3 numbers

Step 2: Multiples of 7: {7, 14} → 2 numbers

Step 3: No overlap (multiples of both 5 and 7 would be multiples of 35, none in 1–15)

Step 4: Total outcomes = 15:

$$P(\text{multiple of 5 or 7}) = \frac{3}{15} + \frac{2}{15} = \frac{5}{15} = \frac{1}{3}$$

Answer: $\frac{1}{3}$

Question 9

Find: Probability of getting at least one head or two heads when two coins are tossed.

Solution:

Step 1: Sample space: {HH, HT, TH, TT}

Step 2: Events:

- At least one head: {HH, HT, TH}
- Two heads: {HH}

Step 3: At least one head already includes two heads:

$$P(\text{at least one head or two heads}) = P(\text{at least one head}) = \frac{3}{4}$$

Answer: $\frac{3}{4}$

Question 10

Given: 50% turn right, 30% turn left, 20% go straight.
Find: Probability that a vehicle turns left or right.

Solution:

Step 1: $P(\text{left}) = 0.30$, $P(\text{right}) = 0.50$

Step 2: These are mutually exclusive:

$$P(\text{left or right}) = 0.30 + 0.50 = 0.80 = \frac{4}{5}$$

Answer: $\frac{4}{5}$

Question 11

Find: Probability of getting either two heads or two tails when two coins are tossed.

Solution:

Step 1: Sample space: {HH, HT, TH, TT}

Step 2: Favorable: {HH, TT} $\rightarrow$ 2 outcomes

$$P(\text{two heads or two tails}) = \frac{2}{4} = \frac{1}{2}$$

Answer: $\frac{1}{2}$

Question 12

Given: A and B are mutually exclusive, $P(\text{not } A) = 0.45$, $P(A \cup B) = 0.65$.
Find: $P(B)$.

Solution:

Step 1: $P(\text{not } A) = 0.45 \Rightarrow P(A) = 1 - 0.45 = 0.55$

Step 2: Since A and B are mutually exclusive:

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

Step 3: Substitute:

$$0.65 = 0.55 + P(B) P(B) = 0.65 - 0.55 = 0.10$$

Answer: $P(B) = 0.10$

Question 13

Given: $P(A) = \frac{2}{3}$, $P(B) = \frac{2}{5}$, $P(A \cup B) = \frac{1}{3}$
Find: $P(A \cap B)$.

Solution:

Step 1: Use addition rule:

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

Step 2: Substitute:

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

Step 3: Solve:

$$P(A \cap B) = \frac{2}{3} + \frac{2}{5} - \frac{1}{3} P(A \cap B) = \frac{1}{3} + \frac{2}{5} = \frac{5}{15} + \frac{6}{15} = \frac{11}{15}$$

Answer: $P(A \cap B) = \frac{11}{15}$

Question 14

Given: $P(A) = 0.42$, $P(B) = 0.48$, $P(A \cap B) = 0.16$
Find: (i) $P(\bar{A})$ (ii) $P(\bar{B})$ (iii) $P(A \cup B)$

Solution:

14(i) P($\bar{A}$)

$$P(\bar{A}) = 1 - P(A) = 1 - 0.42 = 0.58$$

Answer: 0.58

14(ii) P($\bar{B}$)

$$P(\bar{B}) = 1 - P(B) = 1 - 0.48 = 0.52$$

Answer: 0.52

14(iii) P(A ∪ B)

$$P(A \cup B) = P(A) + P(B) - P(A \cap B) P(A \cup B) = 0.42 + 0.48 - 0.16 = 0.74$$

Answer: 0.74

Summary Table

3(ii)	$\frac{1}{2}$
4	$\frac{2}{9}$
5	$\frac{5}{18}$
6(i)	$\frac{2}{13}$
6(ii)	$\frac{11}{13}$
7	$\frac{11}{36}$
8	$\frac{1}{3}$
9	$\frac{3}{4}$
10	$\frac{4}{5}$
11	$\frac{1}{2}$
12	0.10
13	$\frac{11}{15}$
14(i)	0.58
14(ii)	0.52
14(iii)	0.74

Key Formulas

Formula	Application
$P(A \cup B) = P(A) + P(B) - P(A \cap B)$	General addition rule
$P(A \cup B) = P(A) + P(B)$	For mutually exclusive events
$P(\bar{A}) = 1 - P(A)$	Complement rule
$P(\text{at least one}) = 1 - P(\text{none})$	At least one probability