Class 12 Maths – Probability Study Guide

1️⃣ Theory in Simple Words with Visuals

1.1 What is Probability?

- **Definition:** Probability measures how likely an event is to happen.
- **Formula:**

$$P(E) = \frac{\text{Number of favorable outcomes}}{\text{Total number of outcomes}}$$

Analogy: Think of a bag of colored balls — probability tells you the chance of picking a red ball.

Visual:
🎱 Bag of balls: 🔴🔴🔵⚪

- Chance of picking 🔴 = 2/4 = 1/2

1.2 Types of Events

Event Type	Meaning	Example	Symbol/Icon
Certain Event	Always happens	Tossing a coin → getting head or tail	✅
Impossible Event	Never happens	Rolling a dice → getting 7	❌
Elementary Event	Single outcome	Rolling 2 on a dice	1️⃣
Compound Event	More than one outcome	Getting even number on dice	2️⃣, 4️⃣, 6️⃣

1.3 Complementary Events

- If E is an event, then its complement E' is: "**E does not happen**"

$$P(E') = 1 - P(E)$$

Example: Probability of not getting head in a coin toss: $1 - 1/2 = 1/2$

1.4 Mutually Exclusive Events

- Two events A and B are **mutually exclusive** if they cannot happen together:

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

Visual: Two circles that **don't overlap** in a Venn diagram.

1.5 Addition Rule

- For **any two events** A and B:

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

- If **mutually exclusive:**

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

Tip: Always subtract the intersection if events are not exclusive.

1.6 Conditional Probability

- Probability of A given B has occurred:

$$P(A|B) = \frac{P(A \cap B)}{P(B)}, \quad P(B) \neq 0$$

Visual Analogy: Pick a card knowing it's red → only red cards are possible outcomes.

1.7 Multiplication Rule

- For **independent events** A and B:

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

- **Dependent events:** Use conditional probability:

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

1.8 Bayes' Theorem (Simple Form)

- If events $A_1, A_2, \ldots, A_n$ partition the sample space:

$$P(A_i|B) = \frac{P(A_i)P(B|A_i)}{\sum_{j=1}^{n} P(A_j)P(B|A_j)}$$

Tip: "Probability of cause given effect."

1.9 Random Variable & Distribution

- Random Variable X: assigns a **number to each outcome**.
- **Discrete Probability Distribution:** Table of X and $P(X)$

Visual: Dice roll → $X = \text{number on dice}$, each 1–6 has probability 1/6

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1. 🔟 Expectation & Variance

- **Expectation (Mean):**

$$E(X) = \sum x_i P(x_i)$$

- **Variance:**

$$Var(X) = \sum (x_i - E(X))^2 P(x_i)$$

Tip: Variance = "average squared deviation from mean."

2️ Key Concepts & Formulas

Concept	Formula	Tip / Mnemonic
Probability of event	$P(E) = \frac{\text{favorable}}{\text{total}}$	🎯 Favorable / Total
Complement	$P(E') = 1 - P(E)$	❌ Not happening
Addition Rule	$P(A \cup B) = P(A) + P(B) - P(A \cap B)$	Avoid double count
Multiplication Rule	Independent: $P(A \cap B) = P(A)P(B)$	🤝 Multiply chances
Conditional Probability	(P(A	B)=P(A\cap B)/P(B))
Bayes' Theorem	(P(A_i	B)=\frac{P(A_i)P(B
Expectation	$E(X) = \sum x_i P(x_i)$	Average outcome
Variance	$Var(X) = \sum (x_i - E(X))^2 P(x_i)$	Spread of outcomes

Mnemonic for addition/multiplication: "Add if union, multiply if together." ✅

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3 Solved Numerical Problems

Example 1: Single Event

Q: A dice is rolled. Probability of getting 4?

$$P(4) = \frac{1}{6}$$

Example 2: Complement

Q: Coin tossed → probability of not getting head?

$$P(\text{not head}) = 1 - \frac{1}{2} = \frac{1}{2}$$

Example 3: Conditional Probability

Q: A card is drawn from a deck. Probability it's king given it is a face card?

$$P(K|F) = \frac{P(K \cap F)}{P(F)} = \frac{4/52}{12/52} = \frac{1}{3}$$

Example 4: Multiplication Rule

Q: Two dice rolled. Probability both show even?

$$P(\text{even, even}) = \frac{3}{6} \cdot \frac{3}{6} = \frac{9}{36} = \frac{1}{4}$$

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4 Previous Years' Board Questions

- Dice, coin, and card-based questions
- Conditional probability problems
- Bayes' theorem in medical testing
- Probability distributions for discrete random variables

High weightage: Conditional probability and combined events (2–3 marks each).

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5 Quick Revision Notes

- **Probability basics:** $P(E) = \frac{\text{fav}}{\text{total}}$
- **Complement:** $1 - P(E)$
- **Addition:** $P(A \cup B) = P(A) + P(B) - P(A \cap B)$
- **Multiplication:** $P(A \cap B) = P(A)P(B)$ (independent)
- **Conditional:** $P(A|B) = P(A \cap B)/P(B)$
- **Bayes' theorem:** reverse probability
- **Expectation & Variance:** $E(X) = \sum x_i P(x_i),\ Var(X) = \sum (x_i - E(X))^2 P(x_i)$

Visual tip: Use dice, cards, and coins as mini diagrams for each formula.

6️⃣ Predicted / Likely Questions

- Probability of single & multiple events (dice/coin/cards)
- Conditional probability
- Bayes' theorem (medical test, bag of balls)
- Random variable expectation and variance
- Addition/multiplication rules with real examples

7️⃣ Exam Tips & Tricks

- **Shortcut for dice/coin:** Count favorable outcomes first.
- **Always check:** Are events independent or dependent?
- **Flowchart for probability problem:**
  1️⃣ Identify event type → 2️⃣ Check if independent → 3️⃣ Apply addition/multiplication → 4️⃣ Solve
- **Common errors:** Forgetting to subtract intersection, mixing up conditional probability.

8️⃣ Visual & Kid-Friendly Learning Style

- Use **red for formulas**, **blue for tips**, **green for examples**.
- **Icons:** ✅ for correct steps, ⚠️ for mistakes, 🎲 for dice problems, 🃏 for cards.
- Use **flowcharts** for conditional probability and Bayes' theorem.
- **Analogies:** Dice = chances, bag of balls = probability space, coin = binary events.