ANSWER KEY & MARKING SCHEME · CBSE CLASS 11

# Probability

Applied Mathematics · Chapter 5 · Use this with the Board Paper · Companion to Quick Drill

**HOW TO USE**

Attempt the Board Paper first (closed-book, full time). Then come here. For 2-mark+ questions, compare your answer to the model. For 3-4 mark questions, also consult the **Topper Templates** below — these show the exact step-by-step structure that scores full marks per CBSE marking-scheme conventions.

## MODEL ANSWERS · BOARD PAPER

### Section A — MCQs (1 mark each)

**Q1.** If P(A) = 0.7, then P(A') equals: (a) 0.3 (b) 0.7 (c) 1 (d) 0 [1 mark]

**Ans:** (a) 0.3. P(A') = 1 − 0.7 = 0.3.

**Q2.** Two dice are thrown. P(sum = 7) is: (a) 1/12 (b) 1/9 (c) 1/6 (d) 5/36 [1 mark]

**Ans:** (c) 1/6. Six favourable pairs out of 36.

**Q3.** A card is drawn from 52. P(ace) is: (a) 1/52 (b) 1/13 (c) 4/13 (d) 1/4 [1 mark]

**Ans:** (b) 1/13. 4/52 = 1/13.

**Q4.** If A, B independent, P(A) = 1/3, P(B) = 1/4, then P(A∩B) = (a) 7/12 (b) 1/7 (c) 1/12 (d) 1/2 [1 mark]

**Ans:** (c) 1/12. P(A∩B) = (1/3)(1/4) = 1/12.

**Q5.** P(impossible event) = (a) 1 (b) 1/2 (c) 0 (d) undefined [1 mark]

**Ans:** (c) 0. By axiom P(∅) = 0.

### Section B — Short Answer (2 marks each)

**Q6.** From a well-shuffled pack of 52 cards, one card is drawn. Find the probability that it is a king OR a heart. [2 marks]

**Ans:** P(K) = 4/52, P(H) = 13/52, P(K∩H) = 1/52 (king of hearts). P(K∪H) = 4/52 + 13/52 − 1/52 = 16/52 = 4/13.

**Q7.** If P(A) = 0.4, P(B) = 0.5 and A, B are mutually exclusive, find P(A∪B) and P(A∩B). [2 marks]

**Ans:** Mutually exclusive ⇒ P(A∩B) = 0. P(A∪B) = P(A) + P(B) − P(A∩B) = 0.4 + 0.5 − 0 = 0.9.

**Q8.** Two coins are tossed. Find the probability of getting at least one tail. [2 marks]

**Ans:** S = {HH, HT, TH, TT}, |S| = 4. Complement of 'at least one T' is 'no T' = {HH}, so P = 1 − 1/4 = 3/4.

### Section C — Long Answer (3 marks each)

**Q9.** A bag contains 5 red, 4 blue and 3 green balls. Two balls are drawn one after the other without replacement. Find the probability that both balls are red. [3 marks]

**Ans:** Total balls = 12. P(R1) = 5/12. After one red is removed, 4 red remain out of 11. P(R2|R1) = 4/11. Multiplication rule: P(R1 ∩ R2) = (5/12)·(4/11) = 20/132 = 5/33.

**Q10.** Given P(A) = 1/2, P(B) = 1/3 and P(A∩B) = 1/6. Verify whether A and B are independent. Also find P(A|B) and P(B|A). [3 marks]

**Ans:** Independence check: P(A)·P(B) = (1/2)(1/3) = 1/6 = P(A∩B), so A and B ARE independent. P(A|B) = P(A∩B)/P(B) = (1/6)/(1/3) = 1/2 = P(A). P(B|A) = P(A∩B)/P(A) = (1/6)/(1/2) = 1/3 = P(B). The conditional probabilities equal the marginals — confirming independence.

**Q11.** In a class of 60 students, 25 like cricket, 20 like football and 10 like both. A student is chosen at random. Find the probability the student likes cricket or football. Also find P(likes cricket | likes football). [3 marks]

**Ans:** P(C) = 25/60 = 5/12. P(F) = 20/60 = 1/3. P(C∩F) = 10/60 = 1/6. P(C∪F) = 5/12 + 1/3 − 1/6 = 5/12 + 4/12 − 2/12 = 7/12. P(C|F) = P(C∩F)/P(F) = (1/6)/(1/3) = 1/2.

## Section D — Case / Bayes Long Answer (5 marks each)

**Q12.** **Urn I contains 4 white and 6 black balls. Urn II contains 7 white and 3 black balls. An urn is chosen at random and one ball is drawn from it. The ball is found to be white. Find the probability that it was drawn from Urn II.** **[5 marks]**

> **Ans:** Step 1 — Let A1 = 'chose Urn I', A2 = 'chose Urn II', E = 'white ball'. Priors: P(A1) = P(A2) = 1/2. Conditionals: P(E|A1) = 4/10 = 2/5, P(E|A2) = 7/10. Step 2 — Total probability: P(E) = P(E|A1)P(A1) + P(E|A2)P(A2) = (2/5)(1/2) + (7/10)(1/2) = 2/10 + 7/20 = 4/20 + 7/20 = 11/20. Step 3 — Apply Bayes: P(A2|E) = [P(E|A2)P(A2)] / P(E) = (7/20) / (11/20) = 7/11. Step 4 — Interpretation: given the ball drawn is white, the probability it came from Urn II is 7/11 (≈ 0.636).

**Q13.** **In a factory, machine A produces 60% of items (3% defective) and machine B produces 40% of items (5% defective). An item is picked at random and found defective. Find the probability that it was produced by machine A. Also state which machine is more 'responsible' for the defects.** **[5 marks]**

> **Ans:** Step 1 — Let A = 'machine A', B = 'machine B', E = 'item defective'. P(A) = 0.6, P(B) = 0.4. P(E|A) = 0.03, P(E|B) = 0.05. Step 2 — Total probability: P(E) = (0.03)(0.6) + (0.05)(0.4) = 0.018 + 0.020 = 0.038. Step 3 — Bayes for machine A: P(A|E) = (0.018) / (0.038) = 18/38 = 9/19. Step 4 — For machine B: P(B|E) = (0.020)/(0.038) = 10/19. Step 5 — Interpretation: although machine A produces more items overall, machine B is slightly more likely to be the source GIVEN a defect (10/19 > 9/19), because its defect rate is higher. This is the classic Bayes inversion — frequency in the population vs likelihood given the evidence.

## ★ TOPPER ANSWER TEMPLATES

2 TEMPLATES · MEMORISE THE FORMAT

**★ TOPPER TEMPLATE — Topper template 1**
Common

**COMMON LOSS OF MARKS:**
- Skipping definitions or terminology mid-answer
- No clear paragraph/point structure
- Conclusion absent or one-line

**★ TOPPER TEMPLATE — Topper template 2**
Common

**COMMON LOSS OF MARKS:**
- Skipping definitions or terminology mid-answer
- No clear paragraph/point structure
- Conclusion absent or one-line

**MARKING SCHEME — GENERAL NOTES**

- MCQs — full mark only for the correct option. No partial credit.
- In addition-rule questions, award 1 method mark for writing P(A∪B) = P(A) + P(B) − P(A∩B) explicitly even if the arithmetic later slips.
- In multiplication-rule (without-replacement) questions, award 1 mark for correctly updating the sample space for the second draw.
- In Bayes problems: 1 mark for defining events + priors; 1 for the total probability line; 2 for the Bayes ratio; 1 for the final simplified fraction with interpretation.
- Accept equivalent forms: 5/14, 0.357, 35.7% — but the final boxed answer should be the simplest fraction.
- Deduct 1 mark for any answer outside [0, 1] without self-correction — signals a conceptual error.