Class 11 Mathematics · Chapter 14: Probability

Answer key and marking scheme · 20 marks · about 40 minutes · based on NCERT

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1. For a sample space $S = \{\omega_1, \omega_2, \omega_3\}$, $P(\omega_1) = 0.3$ and $P(\omega_2) = 0.45$. Then $P(\omega_3)$ is [1]

(a) 0.75 (b) 0.15
(c) 0.55 (d) 0.25

Answer: (d) The probabilities of all the outcomes add to 1: $P(\omega_3) = 1 - 0.3 - 0.45 = 0.25$.

2. A spinner has eight equal sectors numbered 1 to 8 and is spun once. The number of simple events of its sample space is [1]

(a) 8 (b) 1
(c) 7 (d) 256

Answer: (a) S = {1, 2, ..., 8} has 8 sample points, and each singleton is a simple event, so there are exactly 8 simple events.

3. In a lucky draw at a Diwali mela, the probability that a ticket wins a pressure cooker is 0.05 and that it wins a mixer is 0.12; no ticket wins both. The probability that a ticket wins a cooker or a mixer is [1]

(a) 0.006 (b) 0.17
(c) 0.07 (d) 0.83

Answer: (b) The two events are mutually exclusive, so P(cooker or mixer) = 0.05 + 0.12 = 0.17.

4. A bag holds only green and white balls, and one ball is drawn from it. Which of the following is an impossible event? [1]

(a) the ball is green (b) the ball is green or white
(c) the ball is neither green nor white (d) the ball is not white

Answer: (c) No outcome is neither green nor white, so that event is the empty set ϕ. 'Green or white' is the whole sample space, the sure event.

5. For $S = \{\omega_1, \omega_2, \omega_3, \omega_4\}$, the assignment $P(\omega_1) = k$, $P(\omega_2) = 2k$, $P(\omega_3) = 3k$, $P(\omega_4) = 4k$ is valid. The probability of the event $\{\omega_2, \omega_4\}$ is [1]

(a) $\frac{1}{10}$ (b) $\frac{2}{5}$
(c) $\frac{3}{5}$ (d) $\frac{1}{2}$

Answer: (c) $k + 2k + 3k + 4k = 1$ gives $k = 1/10$. $P(\{\omega_2, \omega_4\}) = 2k + 4k = 6/10 = 3/5$.

6. Five friends, among them Ravi and Sana, sit in a row of five chairs at random. Find the probability that Ravi and Sana occupy the two end chairs. [2]

$n(S) = 5! = 120$. Ravi and Sana take the two ends in 2 ways and the other three fill the middle in $3! = 6$ ways: 12 arrangements. $P = 12/120 = 1/10$.

- $n(S) = 120$ and favourable $2 \times 3! = 12$ (1)
- $P = 1/10$ (1)

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7. A number x is chosen from S = {1, 2, ..., 10}. Let A: 'x is a factor of 12' and B: 'x is odd'. Write the events A ∪ B and A′ ∩ B. [2]

A = {1, 2, 3, 4, 6}, B = {1, 3, 5, 7, 9}. A ∪ B = {1, 2, 3, 4, 5, 6, 7, 9}. A′ = {5, 7, 8, 9, 10}, so A′ ∩ B = {5, 7, 9}.

- A ∪ B = {1, 2, 3, 4, 5, 6, 7, 9} (1)
- A′ ∩ B = {5, 7, 9} (1)

8. A two-digit number is chosen at random. Find the probability that its two digits are equal. [2]

There are 90 two-digit numbers (10 to 99), all equally likely. Equal digits: 11, 22, ..., 99, that is 9 numbers. P = 9/90 = 1/10.

- n(S) = 90 and 9 favourable numbers (1)
- P = 1/10 (1)

9. In a school in Jaipur, a student is chosen at random. The probabilities that the student reads a Hindi, an English and a regional-language newspaper are 0.5, 0.4 and 0.2; for Hindi and English 0.15, for English and regional 0.05, for Hindi and regional 0.1, and for all three 0.03. Find the probability that the student reads (i) at least one of the three, (ii) none of them. [3]

With H, E, R the three events, P(H ∪ E ∪ R) = P(H) + P(E) + P(R) − P(H ∩ E) − P(E ∩ R) − P(H ∩ R) + P(H ∩ E ∩ R) = 1.1 − 0.3 + 0.03 = 0.83. (ii) P(none) = 1 − 0.83 = 0.17.

- writes the formula for P(H ∪ E ∪ R) (1)
- P(at least one) = 0.83 (1)
- P(none) = 0.17 (1)

10. For events A and B, show that P(A ∩ B′) = P(A) − P(A ∩ B). Hence find the probability that exactly one of A and B occurs when P(A) = 0.5, P(B) = 0.35 and P(A ∩ B) = 0.1. [3]

A = (A ∩ B′) ∪ (A ∩ B), and these two are mutually exclusive, so P(A) = P(A ∩ B′) + P(A ∩ B), giving P(A ∩ B′) = P(A) − P(A ∩ B). Likewise P(A′ ∩ B) = P(B) − P(A ∩ B). 'Exactly one' is (A ∩ B′) ∪ (A′ ∩ B), mutually exclusive, so P = P(A) + P(B) − 2P(A ∩ B) = 0.5 + 0.35 − 0.2 = 0.65.

- splits A into the disjoint A ∩ B′ and A ∩ B and applies axiom (iii) (1)
- P(exactly one) = P(A) + P(B) − 2P(A ∩ B) (1)
- value 0.65 (1)

11. Two cards are drawn at random from a well shuffled deck of 52 cards. Find the probability that they are of the same rank (for example, two sevens). [3]

n(S) = $^{52}C_2$ = 1326. Choose the rank in 13 ways and two of its four cards in $^{4}C_2$ = 6 ways: 78 favourable pairs. P = 78/1326 = 1/17.

- n(S) = $^{52}C_2$ = 1326 (1)
- favourable 13 × $^{4}C_2$ = 78 (1)
- P = 1/17 (1)

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