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DETAILED SOLUTIONS: PROBABILITY (HOTS)

Mathematics | Class IX | (2026/PROB-HOTS/09/001)

Section A: Multiple Choice Questions

1. **Answer: (b)** $P(E) + P(\bar{E}) = 1$

Reasoning: This is the fundamental property of complementary events. The sum of the probability of an event and its negation is always unity.

2. **Answer: (d) Cannot be determined exactly without frequency of '1'**

Reasoning: A die has outcomes $\{1, 2, 3, 4, 5, 6\}$. Primes are $\{2, 3, 5\}$. Composites are $\{4, 6\}$. The number '1' is neither prime nor composite. To find the frequency of $\{4, 6\}$, we need the frequency of '1' to subtract from the total ($250 - 125 - f_1$).

3. **Answer: (a)** $\frac{1}{7}$

Reasoning: A non-leap year has 365 days = 52 weeks + 1 extra day. 53 Tuesdays occur if the extra day is a Tuesday. Since the extra day can be any of the 7 days of the week, $P = \frac{1}{7}$.

4. **Answer: (b)** 0.64

Reasoning: $P(\text{at least 2 heads}) = \frac{72}{200} = 0.36$. 'Less than 2 heads' is the complement of 'at least 2 heads'. $P(< 2) = 1 - 0.36 = 0.64$.

5. **Answer: (b)** 1

Reasoning: Probability of an impossible event $x = 0$. Probability of a certain event $y = 1$. $x^2 + y^2 = 0^2 + 1^2 = 1$.

6. **Answer: (a)** $\frac{15}{11}$

Reasoning: $P(E) + P(\text{not } E) = 1 \implies \frac{x}{3} + \frac{2x}{5} = 1$. Taking LCM (15): $\frac{5x+6x}{15} = 1 \implies 11x = 15 \implies x = \frac{15}{11}$.

Section B: Short Answer Questions

7. Total trials = 400. Freq(Sum 10) = 45. Freq(Sum not 10) = $400 - 45 = 355$. $P(\text{not 10}) = \frac{355}{400} = \frac{71}{80} = 0.8875$.

8. Total = 800. Defective = 56. Good = $800 - 56 = 744$. (i) $P(\text{good}) = \frac{744}{800} = 0.93$. (ii) $P(\text{defective}) = \frac{56}{800} = 0.07$.

9. Sample Space = $\{1, 2, \dots, 50\}$. Total = 50. Perfect squares = $\{1, 4, 9, 16, 25, 36, 49\}$. Total favorable = 7. $P(\text{Perfect square}) = \frac{7}{50} = 0.14$.

10. Total students = 45. Boys = 25. Girls = $45 - 25 = 20$. $P(\text{Girl}) = \frac{20}{45} = \frac{4}{9}$.

11. Word: P, R, O, B, A, B, I, L, I, T, Y. Total letters = 11. Vowels: O, A, I, I. Total vowels = 4. $P(\text{Vowel}) = \frac{4}{11}$.

Section C: Long Answer Questions

12. Total families = 500. (i) At least 1 girl = families with 1, 2, or 3 girls = $200 + 190 + 60 = 450$. $P = \frac{450}{500} = 0.9$. (ii) At most 1 girl = families with 0 or 1 girl = $50 + 200 = 250$. $P = \frac{250}{500} = 0.5$.

13. Total = 100. Defective (D) = 10. Non-defective (ND) = 90. (i) $P(D) = \frac{10}{100} = 0.1$. (ii) $P(ND) = \frac{90}{100} = 0.9$. (iii) If 1st is D and not replaced, remaining Total = 99, remaining D = 9. $P(2\text{nd is D}) = \frac{9}{99} = \frac{1}{11}$.
14. Total students = 30. (i) At least 40 kg: sum of students in 40–45 and 45–50 = 6 + 4 = 10. $P = \frac{10}{30} = \frac{1}{3}$. (ii) Less than 40 kg: sum of students in 30–35 and 35–40 = 8 + 12 = 20. $P = \frac{20}{30} = \frac{2}{3}$.

Section D: Case Study Questions

15. **Weather Forecasting Solution:** (i) $P(\text{Correct}) = \frac{210}{300} = \frac{7}{10} = 0.7$. (ii) $P(\text{Incorrect}) = 1 - 0.7 = 0.3$. (iii) Expected correct days = $10 \times 90\% = 10 \times 0.9 = 9$ days. (iv) Proof: Let E be correct forecast and \bar{E} be incorrect. $P(E) + P(\bar{E}) = \frac{210}{300} + \frac{90}{300} = \frac{300}{300} = 1$. Hence proved.
16. **Coin Toss Analysis:** (i) $P(H) = \frac{455}{1000} = 0.455$; $P(T) = \frac{545}{1000} = 0.545$. (ii) **No**, it is not guaranteed.

Experimental probability is based on actual trials and fluctuates. Theoretical probability (which would be 0.5 for a fair coin) is what we expect in the long run. As the number of trials increases (Law of Large Numbers), experimental probability approaches theoretical probability, but individual results remain random.