Theoretical Probability

Explore ideas and representations

Name _____ **Date** _____ **Score** _____ / 10

QUICK REVIEW

For equally likely elementary outcomes, count favorable outcomes once and divide by all possible outcomes. A wheel with 5 equal sections, of which 2 are blue, has blue probability $2/5$. Complements total 1; count outcomes, not the size of their labels.

Worked example

Find probability of a multiple of 3 on a fair die.

1. Favorable labels are $3, 6$: two outcomes.
2. There are six equally likely labels.
3. $P = 2/6 = 1/3$; complement $4/6 = 2/3$.
Answer: $1/3$.

Practice Problems

Show your thinking.

1. A fair device has equally likely labels 1 through 6. List outcomes for an even label, then find its theoretical probability and complement.

2. A fair device has equally likely labels 1 through 8. List outcomes for a label above 5, then find its theoretical probability and complement.

3. A fair device has equally likely labels 1 through 10. List outcomes for a multiple of 3, then find its theoretical probability and complement.

4. A fair device has equally likely labels 1 through 12. List outcomes for a label at most 4, then find its theoretical probability and complement. Explain why favorable count is not the denominator.

5. A fair device has equally likely labels 1 through 8. List outcomes for an odd label, then find its theoretical probability and complement.

6. A fair device has equally likely labels 1 through 10. List outcomes for any label except 5, then find its theoretical probability and complement.

7. A fair wheel has labels 1–12. List favorable labels for a prime label and find the exact probability.

8. A fair wheel has labels 1–12. List favorable labels for a label from 4 through 8, inclusive and find the exact probability.

9. A fair wheel has labels 1–12. List favorable labels for a label not divisible by 3 and find the exact probability.

10. A fair wheel has labels 1–12. List favorable labels for a label divisible by 2 or 3 and find the exact probability.

Answer Key

1. $\frac{1}{2}$; complement $\frac{1}{2}$.
2. $\frac{3}{8}$; complement $\frac{5}{8}$.
3. $\frac{3}{10}$; complement $\frac{7}{10}$.
4. $\frac{1}{3}$; complement $\frac{2}{3}$.
5. $\frac{1}{2}$; complement $\frac{1}{2}$.
6. $\frac{9}{10}$; complement $\frac{1}{10}$.
7. $\frac{5}{12}$.
8. $\frac{5}{12}$.
9. $\frac{2}{3}$.
10. $\frac{2}{3}$.

Step-by-Step Solutions

Follow each calculation, then check your own work.

Problem 1

1. Favorable labels: $2, 4, 6$, count 3.
2. $P = 3/6 = \frac{1}{2}$.
3. Complement $= 1 - \frac{1}{2} = \frac{1}{2}$; the probabilities total 1.

Problem 2

1. Favorable labels: $6, 7, 8$, count 3.
2. $P = 3/8 = \frac{3}{8}$.
3. Complement $= 1 - \frac{3}{8} = \frac{5}{8}$; the probabilities total 1.

Problem 3

1. Favorable labels: $3, 6, 9$, count 3.
2. $P = 3/10 = \frac{3}{10}$.
3. Complement $= 1 - \frac{3}{10} = \frac{7}{10}$; the probabilities total 1.

Problem 4

1. Favorable labels: $1, 2, 3, 4$, count 4.
2. The denominator is all 12 equally likely labels, not only the 4 that win. The numerator is the favorable count.
3. $P = 4/12 = \frac{1}{3}$.
4. Complement $= 1 - \frac{1}{3} = \frac{2}{3}$; the probabilities total 1.

Problem 5

1. Favorable labels: $1, 3, 5, 7$, count 4.
2. $P = 4/8 = \frac{1}{2}$.
3. Complement $= 1 - \frac{1}{2} = \frac{1}{2}$; the probabilities total 1.

Problem 6

1. Favorable labels: $1, 2, 3, 4, 6, 7, 8, 9, 10$, count 9.
2. $P = 9/10 = \frac{9}{10}$.
3. Complement $= 1 - \frac{9}{10} = \frac{1}{10}$; the probabilities total 1.

Problem 7

1. Favorable labels $2, 3, 5, 7, 11$; count 5.
2. Probability $5/12 = \frac{5}{12}$.
3. Complement $1 - \frac{5}{12} = \frac{7}{12}$.

Problem 8

1. Favorable labels $4, 5, 6, 7, 8$; count 5.
2. Probability $5/12 = \frac{5}{12}$.
3. Complement $1 - \frac{5}{12} = \frac{7}{12}$.

Problem 9

1. Favorable labels $1, 2, 4, 5, 7, 8, 10, 11$; count 8.
2. Probability $8/12 = \frac{2}{3}$.
3. Complement $1 - \frac{2}{3} = \frac{1}{3}$.

Problem 10

1. Favorable labels $2, 3, 4, 6, 8, 9, 10, 12$; count 8.
2. Probability $8/12 = \frac{2}{3}$.
3. Complement $1 - \frac{2}{3} = \frac{1}{3}$.

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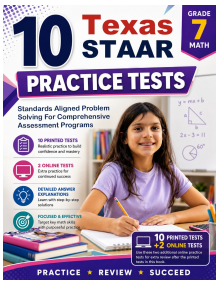

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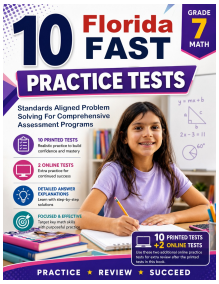

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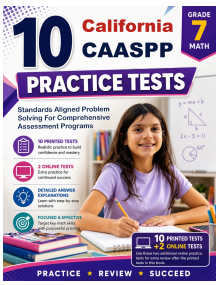

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