# What Is Probability?

Explore ideas and representations

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

**QUICK REVIEW**

Probability describes chance from $0$ (impossible) to $1$ (certain). In bag questions, assume one counter is drawn uniformly at random. For equally likely outcomes, divide the favorable count by the total count. The chance an event does not occur is $1$ minus its chance.

**Worked example**

An equally likely spinner has six sections: one silver and five green. Find the silver and not-silver probabilities.

1. The spinner has $6$ equal sections and exactly $1$ silver section.
2. Divide favorable by total: $P(\text{silver}) = 1/6$.
3. The complement is $1 - 1/6 = 5/6$; together the probabilities make $1$.

**Answer:** Silver $1/6$; not silver $5/6$.

## Practice Problems

Show your thinking.

**1.** A fair six-sided die is rolled. Find the probability of an outcome above $6$ and classify the event.

**2.** A fair die is rolled. Find the probability of an outcome below $7$ and classify the event.

**3.** A bag contains $3$ red and $7$ blue counters. Find red probability and decide whether red is more or less likely than blue.

**4.** A fair coin has heads and tails. Find heads probability and locate it between impossible and certain.

**5.** An event has probability $1/5$. Find the probability it does not happen and compare the two.

**6.** A student reports probability $6/5$ for one event. Explain why it is invalid and how far it exceeds the largest valid probability.

**7.** A bag has $5$ winning and $15$ other counters. Find winning and nonwinning probabilities.

**8.** An event has probability $3/8$. Find its complement and check the total.

**9.** Design a $12$-counter bag with red probability $2/3$. Find red and other counts.

**10.** Can a single event have probability $7/4$? Find the excess over the largest allowed probability.

# Answer Key

1. $0$; impossible.
2. $1$; certain.
3. $3/10$; red is less likely.
4. $1/2$; equally likely to happen or not happen.
5. $4/5$; not happening is more likely.
6. Invalid; exceeds $1$ by $1/5$.
7. Win $1/4$; no win $3/4$.
8. Complement $5/8$.
9. $8$ red and $4$ other.
10. Invalid; distance outside $[0, 1]$ is $\frac{3}{4}$.

## Step-by-Step Solutions

Follow each calculation, then check your own work.

### Problem 1

1. The possible outcomes are $1, 2, 3, 4, 5, 6$.
2. None are above $6$, so favorable count is $0$.
3. $P = 0/6 = 0$, an impossible event.

### Problem 2

1. All six outcomes $1$ through $6$ are below $7$.
2. Favorable/total $= 6/6 = 1$.
3. A probability of $1$ means the event is certain.

### Problem 3

1. Total counters $= 3 + 7 = 10$.
2. $P(R) = 3/10$ and $P(B) = 7/10$.
3. $3/10 < 7/10$, so red is less likely.

### Problem 4

1. Two equally likely outcomes are H and T.
2. One is heads, so $P(H) = 1/2$.
3. $0 < 1/2 < 1$, halfway from impossible to certain.

### Problem 5

1. Total probability is $1 = 5/5$.
2. Complement $= 5/5 - 1/5 = 4/5$.
3. $4/5 > 1/5$, so the event is less likely than its complement.

### Problem 6

1. Probabilities lie between $0$ and $1$.
2. $6/5 = 1 + 1/5 > 1$.
3. The excess over certainty is $6/5 - 1 = 1/5$.

### Problem 7

1. Choose one counter at random, so all $5 + 15 = 20$ counters belong in the denominator.
2. Five favorable counters give $5/20 = 1/4$.
3. Fifteen nonwinning counters give $15/20 = 3/4$. Check $1/4 + 3/4 = 1$.

### Problem 8

1. Write the whole probability as $1 = 8/8$.
2. Subtract: $8/8 - 3/8 = 5/8$.
3. Check that $3/8 + 5/8 = 1$.

### Problem 9

1. Two thirds of the $12$ counters must be red: $12(2/3) = 8$.
2. The other count is $12 - 8 = 4$.
3. Check: $8/(8 + 4) = 2/3$. The denominator counts all counters.

### Problem 10

1. Valid single-event probabilities satisfy $0 \le P \le 1$.
2. The claim is $\frac{7}{4}$.
3. Excess $\frac{7}{4} - 1 = \frac{3}{4}$.

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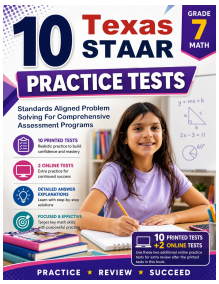


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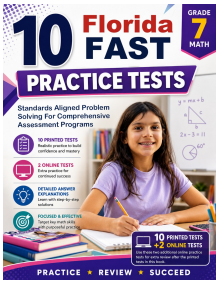


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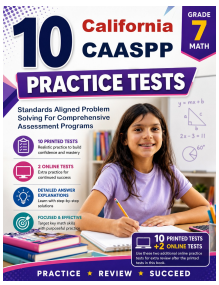


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