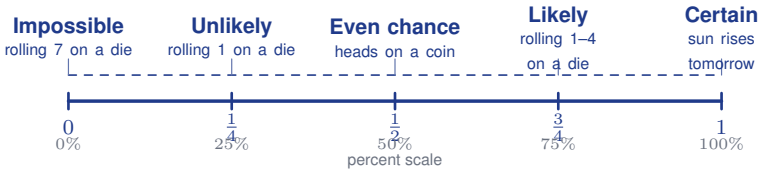
Introduction to Probability

Name: _____	Date: _____	Score: _____ / 17

Probability tells how likely an event is to happen. It ranges from 0 (impossible) to 1 (certain) and can be written as a fraction, decimal, or percent. For fair situations, you simply compare the number of *favorable* outcomes to the *total* number of equally likely outcomes. Learn this idea and you will start reasoning about chance instead of just guessing—that is a game-changer!



Key Concepts & Quick Review

$$P(E) = \frac{\text{favourable outcomes}}{\text{total outcomes}} \qquad 0 \le P(E) \le 1. \qquad P(\text{impossible}) = 0. \qquad P(\text{certain}) = 1.$$

Complement: $P(\text{not } E) = 1 - P(E)$. All probabilities for a complete sample space sum to 1.

Examples

① A bag contains 3 red, 5 blue, and 2 yellow marbles. Find: (a) $P(\text{blue})$ (b) $P(\text{not red})$ (c) $P(\text{green})$

Think It Through: First count the total number of marbles: $3 + 5 + 2 = 10$. For part (a), there are 5 blue marbles out of 10, so $P(\text{blue}) = \frac{5}{10} = \frac{1}{2}$. For part (b), use the complement rule: if red has probability $\frac{3}{10}$, then not red has probability $1 - \frac{3}{10} = \frac{7}{10}$. For part (c), there are no green marbles at all, so the event is impossible and its probability is 0.

Answer: *(a)* $\frac{1}{2}$; *(b)* $\frac{7}{10}$; *(c)* 0

② A fair six-sided die is rolled. Find: (a) $P(\text{even})$ (b) $P(\text{factor of 6})$ (c) $P(\text{greater than 4})$

Think It Through: List the sample space first: $\{1, 2, 3, 4, 5, 6\}$. In part (a), the even outcomes are $2, 4, 6$, so there are 3 favourable outcomes out of 6. In part (b), the factors of 6 on a die are $1, 2, 3, 6$, so the probability is $\frac{4}{6} = \frac{2}{3}$. In part (c), the outcomes greater than 4 are just 5 and 6, so the probability is $\frac{2}{6} = \frac{1}{3}$. Counting favourable outcomes carefully is the key step.

Answer: *(a)* $\frac{1}{2}$; *(b)* $\frac{2}{3}$; *(c)* $\frac{1}{3}$

Practice Problems

Write each probability as a fraction in simplest form.

1. A fair six-sided die is rolled. Find $P(\text{odd})$. _____
2. A fair six-sided die is rolled. Find $P(\text{prime})$. _____
3. A bag has 4 red and 6 blue counters. Find $P(\text{red})$. _____
4. A bag has 4 red and 6 blue counters. Find $P(\text{not blue})$. _____
5. One letter tile is chosen from MATH. Find $P(\text{vowel})$. _____
6. One letter tile is chosen from STATS. Find $P(\text{consonant})$. _____
7. One card is drawn from a standard 52-card deck. Find $P(\text{queen})$. _____
8. One card is drawn from a standard deck. Find $P(\text{heart})$. _____
9. One card is drawn from a standard deck. Find $P(\text{face card})$. _____
10. One card is drawn from a standard deck. Find $P(\text{ace or king})$. _____
11. A bag has 5 white, 3 green, and 2 yellow counters. Find $P(\text{white})$. _____
12. A bag has 5 white, 3 green, and 2 yellow counters. Find $P(\text{not green})$. _____
13. A spinner has 4 equal sectors numbered 1 to 4. Find $P(\text{greater than } 2)$. _____
14. A fair six-sided die is rolled. Find $P(\text{multiple of } 3)$. _____
15. A fair six-sided die is rolled. Find $P(1 \text{ or } 6)$. _____

Study Tips

- Always simplify probability fractions. $P = 4/8$ should be written as $1/2$.
- The **complement rule** $P(\text{not } E) = 1 - P(E)$ is often faster than listing all non-E outcomes directly.
- Probability is **never** negative and **never** greater than 1. If you get a probability outside $[0, 1]$, recheck your count.

Word Problems

16. A prize wheel has 12 equal sectors colored as follows: 4 red, 3 blue, 3 green, 1 gold, and 1 silver. (a) What is the probability of landing on gold? (b) What is the probability of landing on red or blue? (c) If "winning" means landing on gold or silver, what is $P(\text{winning})$? (d) What is $P(\text{losing})$? _____

17. A quality inspector checks light bulbs from a factory. In a box of 50 bulbs, 3 are defective. A bulb is chosen at random. (a) Find $P(\text{defective})$ and $P(\text{not defective})$. (b) Out of $1{,}000$ bulbs produced daily, predict how many will be defective. (c) If the factory improves its process so $P(\text{defective}) = \frac{1}{100}$, how many fewer defective bulbs are expected per day? _____

Answer Keys

1) $\frac{1}{2}$
2) $\frac{1}{2}$
3) $\frac{2}{5}$
4) $\frac{2}{5}$
5) $\frac{1}{4}$
6) $\frac{4}{5}$
7) $\frac{1}{13}$
8) $\frac{1}{4}$
9) $\frac{3}{13}$
10) $\frac{2}{13}$
11) $\frac{1}{2}$
12) $\frac{7}{10}$
13) $\frac{1}{2}$
14) $\frac{1}{3}$
15) $\frac{1}{3}$
16) (a) $\frac{1}{12}$; (b) $\frac{7}{12}$; (c) $\frac{1}{6}$; (d) $\frac{5}{6}$
17) (a) $\frac{3}{50}$; $\frac{47}{50}$; (b) 60; (c) 10; 50 fewer

Step-by-Step Explanations

Strategy: For Populations, Samples, and Sampling Methods, name the whole group, the selected group, and the sampling method before judging bias. The wording usually tells whether the sample represents the population fairly.

Practice 1: A teacher chooses every 5th student from the class list. Identify the sampling method and state whether it is likely unbiased. **Answer:** systematic

For the first worked item, name the population first; then decide whether the chosen students form a fair sample of that group.

Practice 15: A factory tests every 20th item from a production line. Identify the sampling method and one advantage of using it. **Answer:** systematic; efficient

Near the end of this topic, the word “bias” depends on how the sample was chosen, not on whether the topic is interesting.

Word-problem notes:

16. Answer: Population: all $3{,}600$ students; sample: 180 after-school students; yes, biased; better: random from full student list; sample size about 180.

Population: all $3{,}600$ students; sample: 180 after-school students; biased; better method: random from the full district list; reasonable sample size: about 180.

17. Answer: Method A.

Method A is more representative.

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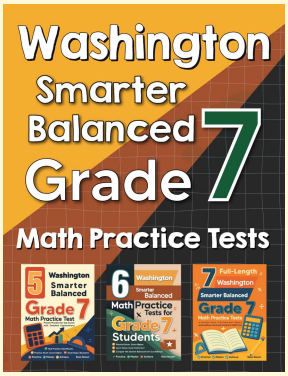

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