

Probability of Compound Events

Name: _____ Date: _____ Score: _____ / 24

Q Quick Review

A **compound event** combines two or more simple events. To find its probability, first decide how the events relate. For **independent** events (one outcome does not affect the other, like separate coin flips), *multiply*: $P(A \text{ and } B) = P(A) \cdot P(B)$. For **dependent** events (the first outcome changes the second, like drawing without replacing), use the *updated* probability for the second event. You can also list the **sample space** — all possible outcomes — and count the favorable ones. A useful shortcut: $P(\text{at least one}) = 1 - P(\text{none})$.

◊ **Example:** A bag has 3 red and 5 blue marbles. Find the probability of drawing red, replacing it, then drawing red again.
 ⇒ Because we *replace* the first marble, the bag is exactly the same for the second draw — the two draws are **independent**. On each draw, $P(\text{red}) = \frac{3}{8}$ (3 red out of 8 marbles). Since the events are independent, we multiply: $P(\text{red then red}) = \frac{3}{8} \cdot \frac{3}{8} = \frac{9}{64}$. If we had *not* replaced the first marble, the second probability would change to $\frac{2}{7}$ — so always check whether there is replacement!

Answer: $P(\text{red, then red}) = \frac{9}{64}$

PRACTICE

Find each compound probability. Write answers as reduced fractions.

- | | |
|--|---|
| 1. $P(\text{heads and heads on two coin flips})$ _____ | 12. $P(\text{drawing red then blue WITH replacement: 3 red, 5 blue})$ _____ |
| 2. $P(\text{tails and a 3 on a die})$ _____ | _____ |
| 3. $P(\text{a 6 and then a 6 on two die rolls})$ _____ | 13. $P(\text{red then red WITHOUT replacement: 2 red, 3 blue})$ _____ |
| 4. $P(\text{heads, heads, heads on three flips})$ _____ | _____ |
| 5. $P(\text{even on a die and heads on a coin})$ _____ | 14. $P(\text{two dice both show 6})$ _____ |
| 6. $P(\text{a 1 then a 2 on two die rolls})$ _____ | 15. $P(\text{rolling two dice with a sum of 2})$ _____ |
| 7. $P(\text{spinner 1-4 lands on 3 twice})$ _____ | 16. $P(\text{rolling two dice with a sum of 7})$ _____ |
| 8. $P(\text{odd on a die and tails on a coin})$ _____ | 17. $P(\text{at least one head on two coin flips})$ _____ |
| 9. $P(\text{two dice both show even})$ _____ | 18. $P(\text{coin heads and spinner 1-4 on 2})$ _____ |
| 10. $P(\text{drawing red twice WITH replacement: 3 red, 5 blue})$ _____ | 19. $P(\text{drawing green twice WITHOUT replacement: 3 green, 2 red})$ _____ |
| 11. $P(\text{drawing blue twice WITH replacement: 3 red, 5 blue})$ _____ | 20. $P(\text{a 5 on a die, then heads, then a 5 again})$ _____ |

◆ Word Problems

21. A spinner has 4 equal sections and a coin is flipped. What is the probability of landing on section 1 *and* getting heads?

22. A drawer has 4 black socks and 6 white socks. You grab two socks without looking and without replacing the first. What is the probability both are black?

23. You roll two fair dice. What is the probability that the sum is 7?

24. A quiz has 3 true/false questions and you guess each one. What is the probability of guessing all 3 correctly?



Answer Keys

1. $\frac{1}{4}$

2. $\frac{1}{12}$

3. $\frac{1}{36}$

4. $\frac{1}{8}$

5. $\frac{1}{4}$

6. $\frac{1}{36}$

7. $\frac{1}{16}$

8. $\frac{1}{4}$

9. $\frac{1}{4}$

10. $\frac{9}{64}$

11. $\frac{25}{64}$

12. $\frac{15}{64}$

13. $\frac{1}{10}$

14. $\frac{1}{36}$

15. $\frac{1}{36}$

16. $\frac{1}{6}$

17. $\frac{3}{4}$

18. $\frac{1}{8}$

19. $\frac{3}{10}$

20. $\frac{1}{72}$

21. $\frac{1}{4} \cdot \frac{1}{2} = \frac{1}{8}$

22. $\frac{4}{10} \cdot \frac{3}{9} = \frac{2}{15}$

23. $\frac{6}{36} = \frac{1}{6}$

24. $\left(\frac{1}{2}\right)^3 = \frac{1}{8}$

Step-by-Step Explanations

1. Independent flips: $\frac{1}{2} \cdot \frac{1}{2} = \frac{1}{4}$.2. Independent: $\frac{1}{2} \cdot \frac{1}{6} = \frac{1}{12}$.3. Independent rolls: $\frac{1}{6} \cdot \frac{1}{6} = \frac{1}{36}$.4. Three independent flips: $\frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} = \frac{1}{8}$.5. Independent: $\frac{3}{6} \cdot \frac{1}{2} = \frac{1}{2} \cdot \frac{1}{2} = \frac{1}{4}$.6. Independent rolls: $\frac{1}{6} \cdot \frac{1}{6} = \frac{1}{36}$.7. Independent spins: $\frac{1}{4} \cdot \frac{1}{4} = \frac{1}{16}$.8. Independent: $\frac{3}{6} \cdot \frac{1}{2} = \frac{1}{2} \cdot \frac{1}{2} = \frac{1}{4}$.9. Each die: $P(\text{even}) = \frac{1}{2}$, so $\frac{1}{2} \cdot \frac{1}{2} = \frac{1}{4}$.10. With replacement the draws are independent: $\frac{3}{8} \cdot \frac{3}{8} = \frac{9}{64}$.11. Independent draws: $\frac{5}{8} \cdot \frac{5}{8} = \frac{25}{64}$.12. Independent: $\frac{3}{8} \cdot \frac{5}{8} = \frac{15}{64}$.13. First: $\frac{2}{5}$. After removing a red, $\frac{1}{4}$. Multiply: $\frac{2}{5} \cdot \frac{1}{4} = \frac{1}{10}$.14. Independent: $\frac{1}{6} \cdot \frac{1}{6} = \frac{1}{36}$.

15. Only 1 outcome out of 36 gives a sum of 2: (1, 1).

16. There are 6 ways to make 7 out of 36 outcomes: $\frac{6}{36} = \frac{1}{6}$.17. Use the shortcut: $1 - P(\text{no heads}) = 1 - \frac{1}{4} = \frac{3}{4}$.18. Independent: $\frac{1}{2} \cdot \frac{1}{4} = \frac{1}{8}$.19. First: $\frac{3}{5}$. After removing a green, $\frac{2}{4} = \frac{1}{2}$. Multiply: $\frac{3}{5} \cdot \frac{1}{2} = \frac{3}{10}$.20. All independent: $\frac{1}{6} \cdot \frac{1}{2} \cdot \frac{1}{6} = \frac{1}{72}$.21. The spin and flip are independent. $P(\text{section 1}) = \frac{1}{4}$ and $P(\text{heads}) = \frac{1}{2}$, so multiply: $\frac{1}{4} \cdot \frac{1}{2} = \frac{1}{8}$.22. First sock black: $\frac{4}{10}$. Now 3 black of 9 remain, so the second is $\frac{3}{9}$. Multiply: $\frac{4}{10} \cdot \frac{3}{9} = \frac{12}{90} = \frac{2}{15}$.23. There are 36 equally likely outcomes. The pairs that sum to 7 are (1, 6), (2, 5), (3, 4), (4, 3), (5, 2), (6, 1) — 6 of them — so $\frac{6}{36} = \frac{1}{6}$.24. Each guess is independent with probability $\frac{1}{2}$ of being right, so all three correct is $\frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} = \frac{1}{8}$.

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