

# Multiplication Rules for Probability

NAME \_\_\_\_\_

**Definition:** Two events, A and B, are **independent** if the fact that A occurs does not affect the probability of B occurring. Some examples of independent events are:

- Landing on heads after tossing a coin **AND** rolling a 5 on a single 6-sided die.
- Choosing a marble from a jar **AND** landing on heads after tossing a coin.
- Choosing a 3 from a deck of cards, replacing it, **AND** then choosing an ace as the second card.
- Rolling a 4 on a single 6-sided die, **AND** then rolling a 1 on a second roll of the die.

To find the probability of two independent events that occur in sequence, find the probability of each event occurring separately, and then multiply the probabilities. This multiplication rule is defined symbolically below. Note that multiplication is represented by **AND**.

**Multiplication Rule 1:** When two events, A and B, are independent, the probability of both occurring is:

$$P(A \text{ and } B) = P(A) \cdot P(B) \text{ or } P(A \cup B) = P(A) \cdot P(B)$$

*note: this symbol "U" is "union" or same as "and"*



1. A dresser drawer contains one pair of socks with each of the following colors: blue, brown, red, white and black. Each pair is folded together in a matching set.

You reach into the sock drawer and choose a pair of socks without looking.

- A. What is the probability of picking red socks first time? \_\_\_\_\_
- B. If you replace the socks, what is the chance of picking red socks the second time? \_\_\_\_\_
- C. Overall what the chance of picking red socks BOTH times?  
P(red and red) = \_\_\_\_\_



2. A coin is tossed and a single 6-sided die is rolled.

- A. What is the probability of head side on the coin? \_\_\_\_\_
- B. What is the probability of rolling a 3 on the die? \_\_\_\_\_
- C. Find the probability of landing on the head side of the coin and rolling a 3 on the die.  
P(head and rolling a 3) = \_\_\_\_\_

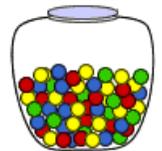


3. A card is chosen at random from a deck of 52 cards. It is then replaced and a second card is chosen.

What is the probability of choosing a jack and then an eight?

P(jack and eight) = \_\_\_\_\_

4. A jar contains 3 red, 5 green, 2 blue and 6 yellow marbles. A marble is chosen at random from the jar. After replacing it, a second marble is chosen.



What is the probability of choosing a green and then a yellow marble?

P(green and yellow) = \_\_\_\_\_



5. A school survey found that 9 out of 10 students like pizza. If three students are chosen at random with replacement.

- A. What is the probability the first student likes pizza? \_\_\_\_\_
- B. What is the probability second student likes pizza? \_\_\_\_\_
- C. What is the probability third student likes pizza? \_\_\_\_\_
- D. What is the probability that all 3 students like pizza?  
P(1<sup>st</sup> likes and 2<sup>nd</sup> likes and 3<sup>rd</sup> likes) = \_\_\_\_\_

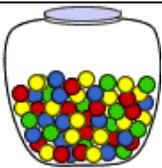
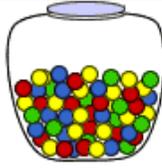


6. A nationwide survey found that 72% of people in the United States like pizza.

(Please convert the 72% to a decimal for the probability.)

Please show your work and express your answer as a decimal.

If 3 people are selected at random, what is the probability that all three like pizza?

 <p>7. Spin a spinner numbered 1 to 7, and toss a coin. What is the probability of getting an odd number on the spinner and a tail on the coin? (show your work)</p>	 <p>8. A jar contains 6 red balls, 3 green balls, 5 white balls and 7 yellow balls. Two balls are chosen from the jar, with replacement. What is the probability that both balls chosen are green? (show your work)</p>
 <p>9. Look back at the jar of colored balls in #8. What is the probability that a green one and then a yellow one is chosen? (show your work)</p>	<p>10. Look once again at the jar of colored balls from #8 and #9. What is the probability that a red ball and then a white ball is chosen? (show your work)</p>
<p>11. You pick 2 days of the week at random. Each day has an equal chance of being picked for both of the days in question. What is the probability that the first day picked is a Monday and then the second day is a Tuesday? (show your work)</p>	 <p>12. Four cards are chosen at random from a regular deck of 52 playing card WITH REPLACEMENT. What is the probability of choosing 4 hearts in a row? (show your work)</p>

**Definition:** Two events are **dependent** if the outcome or occurrence of the first affects the outcome or occurrence of the second so that the probability is changed

Now consider this: **A card is chosen at random from a standard deck of 52 playing cards. Without replacing it, a second card is chosen. What is the probability that the first card chosen is a queen and the second card chosen is a jack?**

Because you are NOT replacing the card, then the outcome of the second card is somewhat dependent on what is chosen as the first card.

The probability that the first card is a queen is 4 out of 52. However, if the first card is not replaced, then the second card is chosen from only 51 cards. Accordingly, the probability that the second card is a jack given that the first card is a queen is 4 out of 51

SOLUTION: Probabilities:

$$P(\text{queen on first pick}) = \frac{4}{52}$$

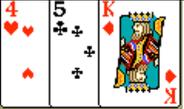
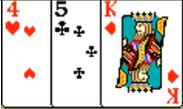
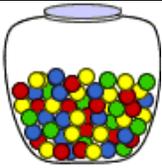
$$P(\text{jack on 2nd pick given queen on 1st pick}) = \frac{4}{51}$$

$$P(\text{queen and jack}) = \frac{4}{52} \cdot \frac{4}{51} = \frac{16}{2652} = \frac{4}{663}$$

**Definition:** The **conditional probability** of an event B in relationship to an event A is the probability that event B occurs given that event A has already occurred. The notation for conditional probability is  $P(B|A)$  [pronounced as *The probability of event B given A*].

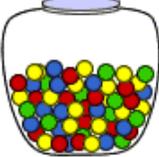
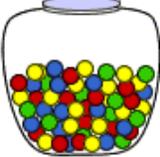
**Multiplication Rule 2:** When two events, A and B, are dependent, the probability of both occurring is:

$$P(A \text{ and } B) = P(A) \cdot P(B|A) \text{ or } P(A \cup B) = P(A) \cdot P(B \text{ given } A \text{ has happened})$$

 <p>13. Mr. Parietti needs two students to help him with a science demonstration for his class of 18 girls and 12 boys. He randomly chooses one student who comes to the front of the room. He then chooses a second student from those still seated. What is the probability that both students chosen are girls? (show your work)</p>	 <p>14. In a shipment of 20 computers, 3 are defective. Three computers are randomly selected and tested. What is the probability that all three are defective if the first and second ones are not replaced after being tested?</p>
 <p>15. Four cards are chosen at random from a deck of 52 cards without replacement. What is the probability of choosing a ten, a nine, an eight and a seven in order? (show your work)</p>	 <p>16. Three cards are chosen at random from a deck of 52 cards without replacement. What is the probability of choosing 3 aces? (show your work)</p>
<p>17. Two cards are chosen at random from a deck of 52 cards without replacement. What is the probability of choosing two kings?</p>	<p>18. Two cards are chosen at random from a deck of 52 cards without replacement. What is the probability that the first card is a jack and the second card is a ten?</p>
<p>19. On a math test, 5 out of 20 students got an A. If three students are chosen at random without replacement, what is the probability that all three got an A on the test?</p>	<p>20. Three cards are chosen at random from a deck of 52 cards without replacement. What is the probability of choosing an ace, a king, and a queen in order?</p>
<p>21. A school survey found that 7 out of 30 students walk to school. If four students are selected at random without replacement, what is the probability that all four walk to school?</p>	 <p>22. A jar contains 6 red balls, 3 green balls, 5 white balls and 7 yellow balls. Two balls are chosen from the jar, <u>without</u> replacement. What is the probability that both balls chosen are green? (show your work)</p>

**MIXED PRACTICE: Basic Probability**  
**Multiplication Rule #1 (with replacement)**

**Addition Rule (for "or")**  
**Multiplication Rule #2 (without replacement)**

<p>1. What is the probability of drawing a 5 from a deck of 52 playing cards?</p>	<p>2. What is the probability of drawing a 5 and then a queen from a deck of 52 playing cards if they are drawn with replacement?</p>
<p>3. What is the probability of drawing a 5 or a 6 from a deck of 52 playing cards?</p>	<p>4. What is the probability of drawing a spade or a 10 from a deck of 52 playing cards?</p>
<p>5. What is the probability of drawing an ace and then a queen from a deck of 52 playing cards if they are drawn without replacement?</p>	<p>6. What is the probability of drawing a red card or a black 10 from a deck of 52 playing cards?</p>
 <p>7. A jar contains 3 red, 5 green, 2 blue and 6 yellow marbles. A marble is chosen at random from the jar. After replacing it, a second marble is chosen. What is the probability of choosing a green and then a red marble?</p>	 <p>8. A jar contains 3 red, 5 green, 2 blue and 6 yellow marbles. A marble is chosen at random from the jar. Without replacing it, a second marble is chosen. What is the probability of choosing a green and then a red marble?</p>
<p>9. What is the probability of drawing a day of the week at random and having those days be a Monday or a Tuesday?</p>	<p>10. If you are rolling a regular 6 sided dice, what is the probability of rolling a number greater than 3 or an odd number?</p>
 <p>11. If a sock drawer containing 10 pairs of socks had the following: 2 white, 4 black, 3 brown and 1 red pair of socks.          What is the probability of drawing out at random a brown pair of socks?</p>	 <p>12. If a sock drawer containing 10 pairs of socks had the following: 2 white, 4 black, 3 brown and 1 red pair of socks.          What is the probability of getting a black pair or a red pair?</p>
 <p>13. If a sock drawer containing 10 pairs of socks had the following: 2 white, 4 black, 3 brown and 1 red pair of socks.          What is the probability of picking 2 pair of socks with replacement that were white and then black?</p>	 <p>14. If a sock drawer containing 10 pairs of socks had the following: 2 white, 4 black, 3 brown and 1 red pair of socks.          What is the probability of picking 2 pair of socks without replacement that were white and then black?</p>

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