

8C2: Combinatorics

Name Answer Key

Date _____

Worksheet B2: Permutations

1. A lock contains 3 dials, each with ten digits. How many possible sequences of numbers exist?

$$\begin{array}{ccc} 10 & \cdot & 10 & \cdot & 10 \\ \hline 1^{\text{st}} & & 2^{\text{nd}} & & 3^{\text{rd}} \end{array} = \boxed{1000}$$

(or 720
if I say
you can't
repeat)

2. Four students are to be chosen from a group of 10 to fill the positions of president, vice-president, treasurer and secretary. In how many ways can this be accomplished?

$$10 P 4 = \boxed{5040}$$

3. How many ways can the letters MATH be arranged?

$$4 P 4 = 4! = \boxed{24}$$

4. A shelf can hold 7 trophies. How many ways can the trophies be arranged if there are 10 trophies available?

$$10 P 7 = \boxed{604800}$$

5. Bill has three pairs of pants, 5 shirts and 2 pairs of shoes. How many outfits can he make?

$$\begin{array}{ccc} 3 C 1 & \cdot & 5 C 1 & \cdot & 2 C 1 \\ \hline \text{pants} & & \text{shirts} & & \text{shoes} \end{array} = \boxed{30}$$

or

$$\begin{array}{ccc} 3 & \cdot & 5 & \cdot & 2 \\ \hline P & & Sh & & S \end{array}$$

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Worksheet C2 : All Types of Permutations

1. How many 5-number license plates can be made using the digits 0, 1, 2, 3, 4, 5, if not numbers so zero can be 1st

a. repetitions ARE allowed $6 \cdot 6 \cdot 6 \cdot 6 \cdot 6 = 7,776$

b. repetitions are NOT allowed $6P6 = 720$

2. A teacher wants to write an ordered 4-question test from a pool of 12 questions. How many different forms of the test can the teacher write?

$12P4 = 11,880$

3. How many 5-number license plates can be made using the digits 1, 2, 3, 4, 5, 6, 7, if an odd digit must come first and

a. repetitions ARE allowed $4 \cdot 7 \cdot 7 \cdot 7 \cdot 7 = 9,604$

b. repetitions are NOT allowed $4 \cdot 6 \cdot 5 \cdot 4 \cdot 3 = 1,140$

4. Assume the same situation as #3, but tell me how many EVEN license plates can be made if repetitions ARE allowed.

$4 \cdot 7 \cdot 7 \cdot 7 \cdot 3 = 4,116$ (even)

5. In how many ways can 4 blue, 3 red, and 2 green flags be arranged on a pole?

$\frac{9!}{4!3!2!} = 1260$
4 blue, 3 red, 2 green

6. Find the number of permutations of the letters of these words:

a. DEED $\frac{4!}{2!2!} = 6$

b. COMMITTEE $\frac{9!}{2!2!2!} = 145,360$

c. CINCINNATI $\frac{10!}{2!3!3!} = 50,400$

7. A player in a word game has the letters E, E, B, D, G, G, G. In how many ways can these letters be arranged?

$\frac{7!}{2!3!} = 420$

8. Find the number of permutations of six colors on a spinner.

$6! = 720$

9. Find the number of ways 10 cheerleaders and make a circular formation.

$10! = 3,628,800$

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Worksheet E2 : Combinations

Use the combinations formula to simplify each problem.

1. ${}^9C_4 = 126$

2. ${}^4C_4 = 1$

3. ${}^9C_0 = 1$

4. ${}^{40}C_3 = 9880$

5. ${}^{12}C_4 = 495$

6. ${}^{12}C_8 = 495$

7. How many different 12-member juries be chosen from a pool of 32 people?

$${}^{32}C_{12} = 225,792,840$$

8. A test consists of 20 questions, but you are told to answer only 15. In how many different ways can you choose the 15 questions?

$${}^{20}C_{15} = 15,504$$

9. How many ways can nine starting players be chosen from a softball team of 15?

$${}^{15}C_9 = 5005$$

10. Four seniors will speak at graduation. If 30 students audition to speak, how many different groups of 4 speakers can be selected?

$${}^{30}C_4 = 27,405$$

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Worksheet F2 : More Combinations

Use the combinations formula to simplify each problem.

$$1. \binom{9}{5} = 9C_5 = \boxed{126}$$

$$2. \binom{50}{2} = 50C_2 = \boxed{1,225}$$

$$3. \binom{12}{8} = \boxed{495}$$

$$4. \binom{n}{n} = \boxed{1}$$

$$5. \binom{n}{n-1} = \boxed{n}$$

$$* 6. \binom{n+1}{n-1} = \frac{(n+1)(n)}{2!}$$

$4C2 = \frac{4 \cdot 3}{2 \cdot 1}$
 $6C4 = \frac{6 \cdot 5 \cdot 4 \cdot 3}{4 \cdot 3 \cdot 2 \cdot 1}$
 $7C5 = \frac{7 \cdot 6 \cdot 5 \cdot 4 \cdot 3}{5 \cdot 4 \cdot 3 \cdot 2 \cdot 1}$

7. How many basketball games are played in a 10-team league if each team plays all other teams TWICE?

$$\binom{10}{2} \times 2 = \boxed{90}$$

↑
twice

8. Of the first 8 questions on a test, a student must answer 6. Of the next 7 questions, 4 must be answered. In how many ways can this be done?

$$\binom{8}{2} \cdot \binom{7}{4} = \boxed{980}$$

28 35

9. Irene's Ice Cream serves 10 flavors of ice cream, 4 kinds of syrup, and 6 varieties of toppings. How many different Sundaes can you make if each has 2 flavors of ice cream, 2 kinds of syrup, and 3 toppings?

$$\binom{10}{2} \cdot \binom{4}{2} \cdot \binom{6}{3} = \boxed{5,400}$$

45 6 20

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Worksheet G2: Mixed Combinatorics

Decide if the problem is an example of a permutation or combination. Then evaluate each one. Show proper notation, and your work.

1. How many teams of 4 horses would be made if there were 9 horses in the stable?

$${}^9C_4 = 126$$

2. A lock manufacturer uses the numbers 1 - 30 in its combinations. How many different combinations for the lock are there if it uses 3-number combinations?

$$\text{Repeats ok: } 27,000 \quad \text{No repeats: } 24,360$$

3. Mike has nine baseball trophies to arrange on the shelf. How many different ways can they be arranged?

$${}^9P_9 = 362,880$$

4. In math class, there are 24 students. The teacher picks 4 students to help do a demonstration. How many different groups of 4 could she have chosen?

$${}^{24}C_4 = 10,626$$

5. In how many ways can 10 people wait in line for concert tickets?

$${}^{10}P_{10} = 3,628,800$$

6. The teacher has listed 30 books as book report options. You must read 5. How many different sets of 5 books could you have chosen to read?

not asking about order

$${}^{30}C_5 = 142,506$$

7. How many different ways are there to purchase 2 CD's, 3 DVD's and 1 set of headphones if there are 7 CD titles, 5 DVD titles, and 3 types of headphones available?

$$\frac{{}^7C_2}{} \cdot \frac{{}^5C_3}{} \cdot \frac{{}^3C_1}{} = 21 \cdot 10 \cdot 3 = 630$$

MORE COMBINATION AND PERMUTATION PRACTICE PROBLEMS:

1. Suppose that 7 people enter a swim meet. Assuming that there are no ties, in how many ways could the gold, silver, and bronze medals be awarded?

$$7P_3 = 210$$

2. How many different committees of 3 people can be chosen to work on a special project from a group of 9 people?

$$9C_3 = 84$$

3. A coach must choose how to line up his five starters from a team of 12 players. How many different ways can the coach choose the starters?

$$12P_5 = 95,040$$

4. John bought a machine to make fresh juice. He has five different fruits: strawberries, oranges, apples, pineapples, and lemons. If he only uses two fruits, how many different juice drinks can John make?

$$5C_2 = 10$$

5. How many different four-letter passwords can be created for a software access if no letter can be used more than once?

$$26P_4 = 358,800$$

6. How many different ways you can elect a Chairman and Co-Chairman of a committee if you have 10 people to choose from.

$$10P_2 = 90$$

7. There are 25 people who work in an office together. Five of these people are selected to go together to the same conference in Orlando, Florida. How many ways can they choose this team of five people to go to the conference?

$$25C_5 = 53,130$$

8. There are 25 people who work in an office together. Five of these people are selected to attend five different conferences. The first person selected will go to a conference in Hawaii, the second will go to New York, the third will go to San Diego, the fourth will go to Atlanta, and the fifth will go to Nashville. How many such selections are possible?

$$25P_5 = 6,375,600$$

9. John couldn't recall the Serial number on his expensive bicycle. He remembered that there were 6 different digits, none used more than once, but couldn't remember what digits were used. He decided to write down all of the possible 6 digit numbers. How many different possibilities will he have to create?

$$10P_6 = 151,200$$

10. How many different 7-card hands can be chosen from a standard 52-card deck?

$$52C_7 =$$

11. One hundred twelve people bought raffle tickets to enter a random drawing for three prizes. How many ways can three names be drawn for first prize, second prize, and third prize?

$$112P_3 = 1,367,520$$

$$133,784,560$$

12. A disc jockey has to choose three songs for the last few minutes of his evening show. If there are nine songs that he feels are appropriate for that time slot, then how many ways can he choose and arrange to play three of those nine songs?

$$9P_3 = 504$$