

*\*create own problem @ end if time permits*



**Flipping a Coin**

Mary decides to flip a coin and record the outcomes. Every 3 flips she records what happened. In the table below this is what she has recorded so far.

	Flip 1	Flip 2	Flip 3
Outcome 1	Heads	Tails	Heads
Outcome 2	Tails	Heads	Heads
Outcome 3	Heads	Heads	Tails

1. How are the three outcomes similar?

*two heads 1 tails*

2. How are the three outcomes different?

*different order*

Which outcome describes a coin flip that resulted in heads the first flip, heads the second flip and tails the third flip?

*outcome 3*

4. Did the order matter when determining the answer to question 3? Why or why not?

*yes*

5. Which outcome might describe a coin flip that resulted in heads twice and tails once?

*all*

6. Did the order matter when determining the answer to question 5? Why or why not?

*no*

7. Can the three outcomes be considered the same if the order of the elements matters? Justify your answer.

*no*

Can the three outcomes be considered the same if the order of the elements doesn't matter? Justify your answer.

*yes*

# Permutations & Combinations

Name \_\_\_\_\_

## Explain

Date \_\_\_\_\_ Period \_\_\_\_\_

An ordered arrangement of items is called a permutation. Consider the "Flipping a Coin" example. When we specified what the first, second, and third flip should be, the order of the elements mattered.

1. The student body is electing a president, a vice president, and a treasurer.

How many different ways can the officers be chosen from the 10 members who are running for office?

$$\underline{10} \quad \underline{9} \quad \underline{8} = 720$$

$${}_{10}P_3 = 720$$

Student Body Officers Ballot	
President	_____
Vice President	_____
Treasurer	_____

~~10-9-8-7-6-5-4-3-2-1~~  
7-6-5-4-3-2-1

### Calculating Permutations:

math → PRB →  $nPr$

The notation for a permutation:

$${}_n P_r$$

$n$  is the **total** number of objects

$r$  is the number of objects chosen (want)

The formula for a permutation:

$${}_n P_r = \frac{n!}{(n-r)!} \quad \frac{10!}{(10-3)!}$$

2. Twelve students are competing in a spelling bee. The top 3 finishers are awarded gold, silver, and bronze medals.

a) In how many ways can the medals be won?

$${}_{12}P_3 = 1320$$



b) Why is this a permutation?

order matters → gold, silver, bronze

An unordered collection of items is called a Combination. Consider the "Flipping a Coin" example. When we did not specify the order of the elements, the outcomes always contained the same elements; two Heads and one Tails.

1. Your English class requires you to choose 2 books to read over Summer Break from a list of 4. Your book choices are Harry Potter (HP), Divergent (D), Twilight (TW), or To Kill A Mocking Bird (M).

How many different ways are there in which you can choose the books?  
List all possible options.

HP D T M

HP D ① DT ②  
HP T ③ DM ④  
HP M ⑤ TM ⑥

⑥



$$4C_2 = 6$$

2. Your English class requires you to choose 4 books to read over Summer Break from a list of 12. How many different ways are there in which you can choose the books?

$$12C_4 = 495$$

Calculating Combinations: math  $\rightarrow$  PRB  $\rightarrow nCr$

The notation for a combination:

$$n C_r$$

$n$  is the **total** number of objects  
 $r$  is the number of objects chosen (want)

The formula for a combination:

$$n C_r = \frac{n!}{r!(n-r)!} \quad \frac{12!}{4!(12-4)!}$$

3. A service club has 15 freshmen. 7 of the freshmen are to be chosen to be on a clean-up crew for the town's annual picnic.

a) How many different ways are there to make the crew?

$$15 C_7 = 6,435$$

b) Why is this a combination and not a permutation?

order doesn't matter in group

c) The club also has 18 Sophomores. If 7 Sophomores are chosen to join the 7 Freshmen in the cleaning crew, how many ways can the crew be made now?

$$18 C_7 \cdot 15 C_7$$

$$31,824 \cdot 6,435 = 204,787,440$$



## Permutations & Combinations

### In Class Practice

With a partner, determine which situations below are permutations and combinations.

Then, calculate the answer.

1. A professional basketball team has 12 members, but only five can play at one time. How many different groups of players can be on the court at one time?

C

$$12C_5 = 792$$

2. Megan has 4 different skirts and 8 different blouses to choose from. How many outfits are possible if she chooses 1 skirt and 1 blouse?

C

$$4 \cdot 8 = 32$$

$$4C_1 \cdot 8C_1 = 32$$

3. How many different ways can 5 students stand in a line in the cafeteria?

P

$$5P_5 = 120$$

$$5 \cdot 4 \cdot 3 \cdot 2 \cdot 1 = 120$$

- ~~4. How many different ways can 5 students stand in a line in the cafeteria?~~

Remove

Permutations & Combinations  
Worksheet

Name Key  
Date \_\_\_\_\_ Period \_\_\_\_\_

Solve the problem using permutations or combinations. Show all calculator work.

1. A class has 30 students. In how many ways can committees be formed using the following number of students?

a) 3 students

b) 5 students

C  $30C_3 =$   
 $4,060$

$30C_5 =$   
 $142,506$

2. Twelve skiers compete in the final round of an Olympic skiing event. In how many ways can three of the skiers finish first, second, and third to win the gold, silver and bronze medals?

P  $12P_3 =$   $1,320$

3. The company Sea Esta has ten members on its board of directors. In how many different ways can it elect a president, vice-president, secretary and treasurer?

P  $10P_4 =$   $5,040$

4. There are 8 online songs that you want to download. If you only have enough money to download 3 of the songs, how many different groups of songs can you buy?

C  $8C_3 =$   $56$

5. Suppose you are asked to list, in order of **P** preference, the three best movies you have seen this year. If you saw 10 movies during the year, in how many ways can the three best be chosen and ranked?

P

$$10P_3 = \boxed{720}$$

6. A friend says that there are 6720 different ways to combine 5 out of 8 ingredients to make a stew. Explain the error and find the correct answer.

C

$\nwarrow$  permutation

$$8C_5 = \boxed{56}$$

7. For a segment of a radio show, a disc jockey (Dr. Jams) can play 4 songs. If there are 8 to select from, in how many ways can the program for this segment be arranged?

P

$$8P_4 = \boxed{1,680}$$

8. Seven bands have volunteered to perform at a benefit concert, but there is only enough time for four of the bands to play. How many lineups are possible?

P

$$7P_4 = \boxed{840}$$

9. A four-person committee is to be elected from an organization's membership of 11 people. How many different committees are possible?

C

$$11C_4 = \boxed{330}$$