

Permutation and Combination Practice (11.1 Part 1, 11.1 Part 2 and 11.2 Remote Learning Recap)

1. How many arrangements of the word ACTIVE are there if C and E must always be together?

CE A T I V

$$5! \cdot 2! = 240$$

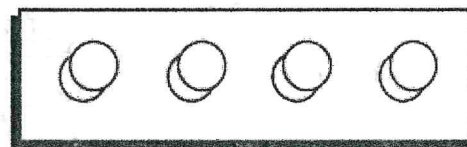
2. There are five toppings available for a pizza (mushroom, onions, pineapple, spinach, and tomatoes). If a pizza is ordered with three toppings and no topping ~~and no topping~~ may be repeated, how many different pizzas can be created?

$${}^5C_3 = \frac{5!}{3! \cdot 2!} = \frac{5 \cdot 4}{2} = 10$$

3. A coat hanger has four knobs, and each knob can be painted any colour. If six different colours of paint are available, how many ways can the knobs be painted?

paint

$$\underline{6} \cdot \underline{6} \cdot \underline{6} \cdot \underline{6} = 1296$$



4. A committee of 4 people is to be selected from a selection of 9 people. How many possible committees can be formed?

$${}^9C_4 = 126$$

5. An identification code consists of any two letters followed by any three digits. How many identification codes can be created if repetition is allowed?

$$\underline{26} \cdot \underline{26} \cdot \underline{10} \cdot \underline{10} \cdot \underline{10} = 676000$$

6. A committee of 5 people is to be formed from a selection pool of 12 people. If Carmen must be on the committee, how many unique committees can be formed?

$$1 \cdot {}_{11}C_4 = 330$$

7. How many ways can the letters in the word CINNCINATI be arranged?

$$\frac{10!}{3! \cdot 3! \cdot 2!} = 50400$$

8. A web development team of three members is to be formed from a selection pool of 10 people. The team members will be assigned roles of: programmer, graphic designer, and database analyst. How many unique teams are possible? You can assume that each person in the selection pool is capable of performing each task.

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

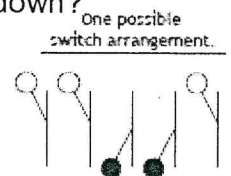
9. How many arrangements of the word ACTIVE are there if C and E must always be together and in the order CE?

$$\boxed{CE} \text{ A T I V } \quad 5! = 120$$

10. An electrical panel has five switches. How many ways can the switches be positioned up or down if three switches must be up and two switches must be down?

U U U D D

$$\frac{5!}{3! \cdot 2!} = 10 \text{ ways}$$



11. Six people (A, B, C, D, E, and F) are going to be seated in a line. How many different lines can be formed if:

a) F must be seated in the third chair.

$$\frac{5}{\cdot} \cdot \frac{4}{\cdot} \cdot \frac{1}{F} \cdot \frac{3}{\cdot} \cdot \frac{2}{\cdot} \cdot \frac{1}{\cdot} = 120$$

b) B or C must be in the second chair, and E must be in the third chair.

$$\frac{4}{\cdot} \cdot \frac{2}{\text{B or C}} \cdot \frac{1}{E} \cdot \frac{3}{\cdot} \cdot \frac{2}{\cdot} \cdot \frac{1}{\cdot} = 48$$

c) D cannot be at either end of the line.

$$\frac{5}{\text{not D}} \cdot \frac{4}{\cdot} \cdot \frac{3}{\cdot} \cdot \frac{2}{\cdot} \cdot \frac{1}{\cdot} \cdot \frac{4}{\text{not D}} = 480$$

d) Consonants and Vowels must alternate, with a consonant sitting in the first chair.

$$\frac{4}{\text{Cons}} \quad \frac{\quad}{\text{Vow}} \quad \frac{3}{\text{Cons}} \quad \frac{\quad}{\text{Vow}} \quad \frac{2}{\text{Cons}} \quad \frac{\quad}{\text{Vowel}}$$

impossible! there are only 2 vowels.

e) The line starts with a consonant, consonant, vowel pattern

$$\frac{4}{\text{Cons}} \cdot \frac{3}{\text{Cons}} \cdot \frac{2}{\text{vowel}} \cdot \frac{3}{\cdot} \cdot \frac{2}{\cdot} \cdot \frac{1}{\cdot} = 144$$

12. There are nine competitors in an Olympic event. How many ways can the bronze, silver, and gold medals be awarded?

$$\frac{9}{\cdot} \cdot \frac{8}{\cdot} \cdot \frac{7}{\cdot} = 504$$

13. six different vehicles (3 different brands of cars and 3 different brands of trucks) are going to be parked in a line. How many unique lines can be formed if the vehicles must alternate positions?

Case 1
Car 1st

$$\frac{3}{C} \frac{3}{T} \frac{2}{C} \frac{2}{T} \frac{1}{C} \frac{1}{T} = 36$$

Case 2
truck 1st

$$\frac{3}{T} \frac{3}{C} \frac{2}{T} \frac{2}{C} \frac{1}{T} \frac{1}{C} = 36$$

$$\underline{\quad\quad\quad} = 72$$

14. How many words (with at least 5 letters) can be formed using the letters in SUNDAY?

Case 1
5 letters

$$\frac{6}{S} \cdot \frac{5}{U} \cdot \frac{4}{N} \cdot \frac{3}{D} \cdot \frac{2}{A} = 720$$

Case 2
6 letters

$$6! = 720$$

$$\underline{\quad\quad\quad} = 1440$$

15. A Grade 12 student is taking Biology, English, Math and Physics in her first semester. If a student timetable has room for 5 courses (meaning this student has a spare), how many different ways can she schedule her courses?

$$\frac{5}{S} \cdot \frac{4}{E} \cdot \frac{3}{M} \cdot \frac{2}{P} \cdot \frac{1}{S} = 120$$

or

$$5! = 120$$

One Possible Timetable

Block	Course
Block 1	Math 30-1
Block 2	Spare
Block 3	Physics 30
Block 4	English 30-1
Block 5	Biology 30

16. A committee of 6 people is to be formed from a selection pool of 11 people. If Grant and Helen must be on the committee, but Aaron must not be on the committee, how many unique committees can be formed?

$$\begin{array}{ccc}
 1 & \cdot & 1 & \cdot & & & 8 & C & 4 & = & 70 \\
 \downarrow & & \downarrow & & & & \downarrow & & & & \\
 \text{grant} & & \text{helen} & & & & \text{not aaron} & & & &
 \end{array}$$

17. How many ways can the letters in the word MISSISSAUGA be arranged?

$$\frac{11!}{2! \cdot 4! \cdot 2!} = 415800$$

18. How many ways can the letters in the word BEDNARSKI be arranged?

$$\frac{9!}{1} = 362880$$

19. A signing competition has three rounds. In each round, the singer has to perform one song from a particular genre. How many different ways can the performer select the genres?

$$\begin{array}{l}
 4 \cdot 2 \cdot 3 \\
 = 24
 \end{array}$$

Round 1	Round 2	Round 3
Rock Metal Punk Alternative	Pop Dance	Country Blues Folk

20. A bouquet contains four types of flowers. A florist is making a bouquet that uses one type of floral flower, no fragrant flowers, three types of line flowers, and all of the filler flowers. ^{focal}

Flower Type	Examples
Focal Flowers: Large and eye-catching flowers that draw attention to one area of the bouquet.	Roses, Peonies, Hydrangeas, Chrysanthemums, Tulips, and Lilies
Fragrant Flowers: Flowers that add a pleasant fragrance to the bouquet.	Petunia, Daffodils, Daphnes, Gardenia, Lilacs, Violets, Magnolias
Line Flowers: Tall and narrow flowers used to establish the height of a floral bouquet.	Delphiniums, Snapdragons, Bells of Ireland, Gladioli, and Liatris
Filler Flowers: Unobtrusive flowers that give depth to the bouquet.	Daisies, Baby's Breath, Wax Flowers, Solidago, and Caspia

$$6C_1 \cdot 5C_3 \cdot 5C_5$$

$$\downarrow$$

focal

$$6 \cdot 10 \cdot 1 = \cancel{600}$$

$$60$$

21. A committee of 5 people is to be formed from a group of 4 men and 5 women. How many committees can be formed if at least 3 women are on the committee?

$$\begin{array}{l} \text{Case 1} \quad 3 \text{ women} \quad : \quad 5C_3 \cdot 4C_2 = 60 \\ \text{Case 2} \quad 4 \text{ women} \quad : \quad 5C_4 \cdot 4C_1 = 20 \\ \text{Case 3} \quad 5 \text{ women} \quad : \quad 5C_5 = 1 \\ \hline 81 \end{array}$$

22. If there are 2 different parkas, 5 different scarves, and 4 different tuques, how many winter outfits can be made if an outfit consists of one type of each garment?

$$2 \cdot 5 \cdot 4 \\ = 40$$

23. How many ways can three cars (red, green and blue) be parked in five parking stalls?



$$5 \cdot 4 \cdot 3 = 60$$

24. How many 6 person groups can be formed from 11 FRC students and 9 Acadia students if there must be 3 FRC and 3 Acadia students in the group?

$${}_{11}C_3 \cdot {}_9C_3 \\ 165 \cdot 84 = 13860$$

25. How many 3-digit odd numbers greater than 600 can be formed using the digits 2, 3, 4, 5, 6, and 7, if a number contains no repeating digits?

$$\begin{array}{l} \text{end in } 3 \\ \text{end in } 5 \\ \text{end in } 7 \end{array} \quad \begin{array}{l} \underline{2} \cdot \underline{4} \cdot \frac{1}{3} \\ \underline{2} \cdot \underline{4} \cdot \frac{1}{5} \\ \underline{1} \cdot \underline{4} \cdot \frac{1}{7} \end{array} \quad \begin{array}{l} = 8 \\ = 8 \\ = \frac{4}{7} \end{array}$$

$$20$$

26. Eight different cars (3 red, 3 blue and 2 yellow) are to be parked in a line. How many unique lines can be formed if the yellow cars must not be together.

All possible y_1, y_2 ~~together~~ $R_1, R_2, R_3, B_1, B_2, B_3$

$8! - 7! \cdot 2!$

$$40320 - 5040 (2) = 30240$$

28. A phone number in Manitoba consists of one of two area codes (204 and 431), followed by a 7-digit number that cannot begin with a 0 or a 1. How many unique phone numbers are there?

Case 1
204

$$\frac{1}{2} \cdot \frac{1}{0} \cdot \frac{1}{4} \cdot \frac{8}{\text{not } 0 \text{ or } 1} \cdot \frac{10}{10} \cdot \frac{10}{10} \cdot \frac{10}{10} \cdot \frac{10}{10} = 8000000$$

Case 2
431

$$\frac{1}{4} \cdot \frac{1}{3} \cdot \frac{1}{1} \cdot \frac{8}{\text{not } 0 \text{ or } 1} \cdot \frac{10}{10} \cdot \frac{10}{10} \cdot \frac{10}{10} \cdot \frac{10}{10} = 8000000$$

16,000,000

29. A research team of 5 people is to be formed from 3 biologists, 5 chemists, 4 engineers, and 2 programmers. How many teams have exactly one chemist and at least 2 engineers?

	chemist	engineers	bio/programmer	
Case 1 : 2 engineers	$5C_1$	$\cdot 4C_2$	$\cdot 5C_2$	= 300
Case 2 : 3 engineers	$5C_1$	$\cdot 4C_3$	$\cdot 5C_1$	= 100
Case 3 : 4 engineers	$5C_1$	$\cdot 4C_4$		= 5
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