# MA 12 LG 15 (Combinatorics)

## [illegible] The Fundamental Counting Principle

# of combinations = a x b x c x ...

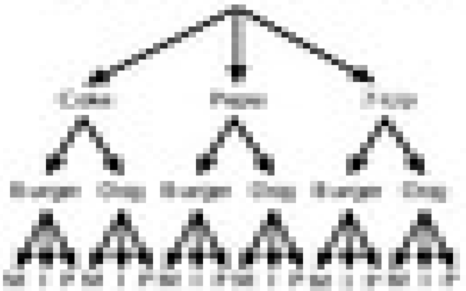
where a, b, c, are the number of choices in each category

### Example for [illegible]

Draw a tree diagram to list all the possibilities for the following.

How many different combinations can be made from:

| Drink | Dinner | Dessert |
|---|---|---|
| Coke | Burger | [illegible] |
| Pepsi | Hot Dog | Ice Cream |
| 7-Up | | Pie |



# of combos = 3 x 2 x 3 = 18 combos

## [illegible] Permutations

Factorial $n! = n(n-1)(n-2)(n-3)\ldots$

Permutations (order is important abc is different from acb)

Permutations = $\frac{n!}{a!b!c!\ldots}$  n = # of objects

a, b, c, ... = # of objects alike

$$_nP_r = \frac{n!}{(n-r)!}$$

### Example for [illegible]

Express in factorial notation.

8 x 7 x 6 x 5 x 4 x 3 x 2 x 1 = 8!

### Example for [illegible]

Express as a product of natural #'s in reduced form.

5! = 5 x 4 x 3 x 2 x 1

$$_{10}P_7 = \frac{10!}{(10-7)!} = \frac{10!}{3!}$$
$$= \frac{10 \times 9 \times 8 \times 7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1}{3 \times 2 \times 1}$$
$$= 10 \times 9 \times 8 \times 7 \times 6 \times 5 \times 4$$

### Example for [illegible]

Express 12 x 11 x 10 x 9 in the form $_nP_r$

$$_nP_r = \frac{n!}{(n-r)!}$$
$$12 \times 11 \times 10 \times 9 = \frac{12 \times 11 \times 10 \times 9 \times 8 \times 7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1}{8 \times 7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1}$$
$$= \frac{12!}{8!} = \frac{12!}{(12-4)!}$$
$$n = 12 \quad r = 4 \qquad = {}_{12}P_4$$

## [illegible] Combinations

Factorial $n! = n(n-1)(n-2)(n-3)\ldots$

$$_nP_r = \frac{n!}{(n-r)!}$$

Combinations (order not important abc is same as acb)

$$_nC_r = \frac{_nP_r}{r!} = \frac{n!}{(n-r)!r!}$$

### Example for [illegible]

Express as a product in reduced form.

$$_{10}P_5 = \frac{10!}{(10-5)!} = \frac{10!}{5!}$$
$$= \frac{10 \times 9 \times 8 \times 7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1}{5 \times 4 \times 3 \times 2 \times 1}$$
$$= 10 \times 9 \times 8 \times 7 \times 6$$
$$= 30240$$

$$_{10}C_5 = \frac{10!}{(10-5)!5!} = \frac{10!}{5!5!}$$
$$= \frac{10 \times 9 \times 8 \times 7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1}{5 \times 4 \times 3 \times 2 \times 1 \times 5 \times 4 \times 3 \times 2 \times 1}$$
$$= [illegible]$$
$$= 9 \times 7 \times 2 \times 2$$
$$= 252$$