

## Pre-Calculus 12 Factorial Notation

Factorials are products, indicated by an exclamation mark.

5! is read as "5 factorial" and means:

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

By definition,  $n! = n(n-1)(n-2) \dots 1$  where  $n \geq 1$  and  $0! = 1$

Ex. 1) Without using a calculator, simplify  $\frac{11!}{9!}$

$$\frac{11 \cdot 10 \cdot \cancel{9!}}{\cancel{9!}} \\ 110$$

\* keep subtracting until you can divide/cancel out the denominator

Ex. 2) Simplify  $\frac{n!}{(n-2)!}$

$$\frac{n(n-1)\cancel{(n-2)!}}{\cancel{(n-2)!}}$$

$$n(n-1) \quad \text{or} \quad n^2 - n$$

$$\begin{array}{l} n-1-1 \\ n-2 \end{array}$$

Ex. 3) Simplify  $\frac{(n-6)!}{(n-3)!}$

$$\frac{\cancel{(n-6)!}}{(n-3)\cancel{(n-4)}\cancel{(n-5)}\cancel{(n-6)!}} \\ \frac{1}{(n-3)(n-4)(n-5)}$$

\* always expand the larger one

$$\text{ie } \frac{n-6}{n-3} \leftarrow \text{larger}$$

if  $n=10$

$$\frac{10-6}{10-3} = \frac{4}{7} \leftarrow \text{larger}$$

# Factorial Notation.notebook

Ex. 4) Solve for  $n$ .

$$(n+1)! = 12(n-1)!$$

$$\frac{(n+1)!}{(n-1)!} = 12$$

divide to get factorials together

$$\frac{n+1}{n}$$

$$\frac{(n+1)(n)(\cancel{n-1})!}{(\cancel{n-1})!} = 12$$

expand factorials

$$(n+1)(n) = 12$$

$$n^2 + n = 12$$

$$n^2 + n - 12 = 0$$

$$(n+4)(n-3) = 0$$

solve

$$n+4 = 0$$

$$n-3 = 0$$

$$\therefore n = -4$$

$$n = 3$$

ry

$$n \geq 1$$

Ex. 5) Solve.

$$\frac{(n+3)!}{n!} = 24$$

$$\frac{(n+3)(n+2)(n+1)\cancel{n!}}{\cancel{n!}} = 24$$

$$(n+3)(n+2)(n+1) = 24$$

3 consecutive numbers

$$2 \cdot 3 \cdot 4 = 24$$

$$\therefore n = 1$$

Ex. 6) Evaluate

$$\frac{12!}{9!4!}$$

$$\frac{12 \cdot 11 \cdot 10 \cdot 9 \cdot \cancel{8!}}{\cancel{8!} \cdot 4!}$$

$$\frac{12 \cdot 11 \cdot 10 \cdot \cancel{9} \cdot \cancel{8} \cdot \cancel{7} \cdot \cancel{6} \cdot \cancel{5} \cdot \cancel{4} \cdot \cancel{3} \cdot \cancel{2} \cdot \cancel{1}}{\cancel{4} \cdot \cancel{3} \cdot \cancel{2} \cdot \cancel{1}}$$

\* can use calculator

$$11 \cdot 5$$

$$55$$