C12 - 11.2 - Factorials Notes

Factorial: The product of the consecutive numbers from n to 1.

Examples:

$5! = 5(4)(3)(2)(1) = 120$ $\qquad$ $n! = n(n-1)(n-2)\dots(3)(2)(1)$

$3! = 3 \times 2 \times 1$

$\dfrac{7!}{4!} = \dfrac{7(6)(5)\cancel{(4)(3)(2)(1)}}{\cancel{4(3)(2)(1)}} = \dfrac{7(6)(5)}{1} = 7(6)(5) = 210$

$-3! = -3 \times 2 \times 1$

$(-3)! = no\ solution$

$(0.5)! = no\ solution$

Factorials with numbers

$0! = 1$
$1! = 1$
$2! = 2 \times 1 = 2$
$3! = 3 \times 2 \times 1 = 6$
$4! = 4 \times 3 \times 2 \times 1 = 24$
$5! = 5 \times 4 \times 3 \times 2 \times 1 = 120$
$6! = 6 \times 5 \times 4 \times 3 \times 2 \times 1 = 720$
$7! = 7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1 = 5040$
$8! = 8 \times 7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1 = 40320$

Factorials with variables

$n! = n(n-1)(n-2)(n-3)\dots \times 3 \times 2 \times 1$

$(n-1)! = (n-1)(n-2)(n-3)\dots \times 3 \times 2 \times 1$

$(n-2)! = (n-2)(n-3)\dots \times 3 \times 2 \times 1$

$(n+2)! = (n+2)(n+1)(n)(n-1)\dots \times 3 \times 2 \times 1$

$(n+1)! = (n+1)(n)(n-1)(n-2)\dots \times 3 \times 2 \times 1$

You may close the factorial any time you want.

$6! = 6 \times 5 \times 4!$

$10! = 10 \times 9!$

$99! = 99 \times 98 \times 97!$

$n! = n(n-1)(n-2)!$

$(n-1)! = (n-1)(n-2)(n-3)!$

$(n+2)! = (n+2)(n+1)(n)!$

$\dfrac{7!}{4!} = \dfrac{7 \times 6 \times 5 \times \cancel{4!}}{\cancel{4!}} = 7 \times 6 \times 5 = 210$ $\qquad$ $\dfrac{n!}{(n-2)!} = \dfrac{n(n-1)\cancel{(n-2)!}}{\cancel{(n-2)!}} = n(n-1) = n^2 - n$

Expand the bigger one

$\dfrac{10! - 9!}{8!} = \dfrac{10!}{8!} - \dfrac{9!}{8!}$ $\qquad\qquad$ Separate Fractions