# ALGEBRA

## Chapter 09


# 4th

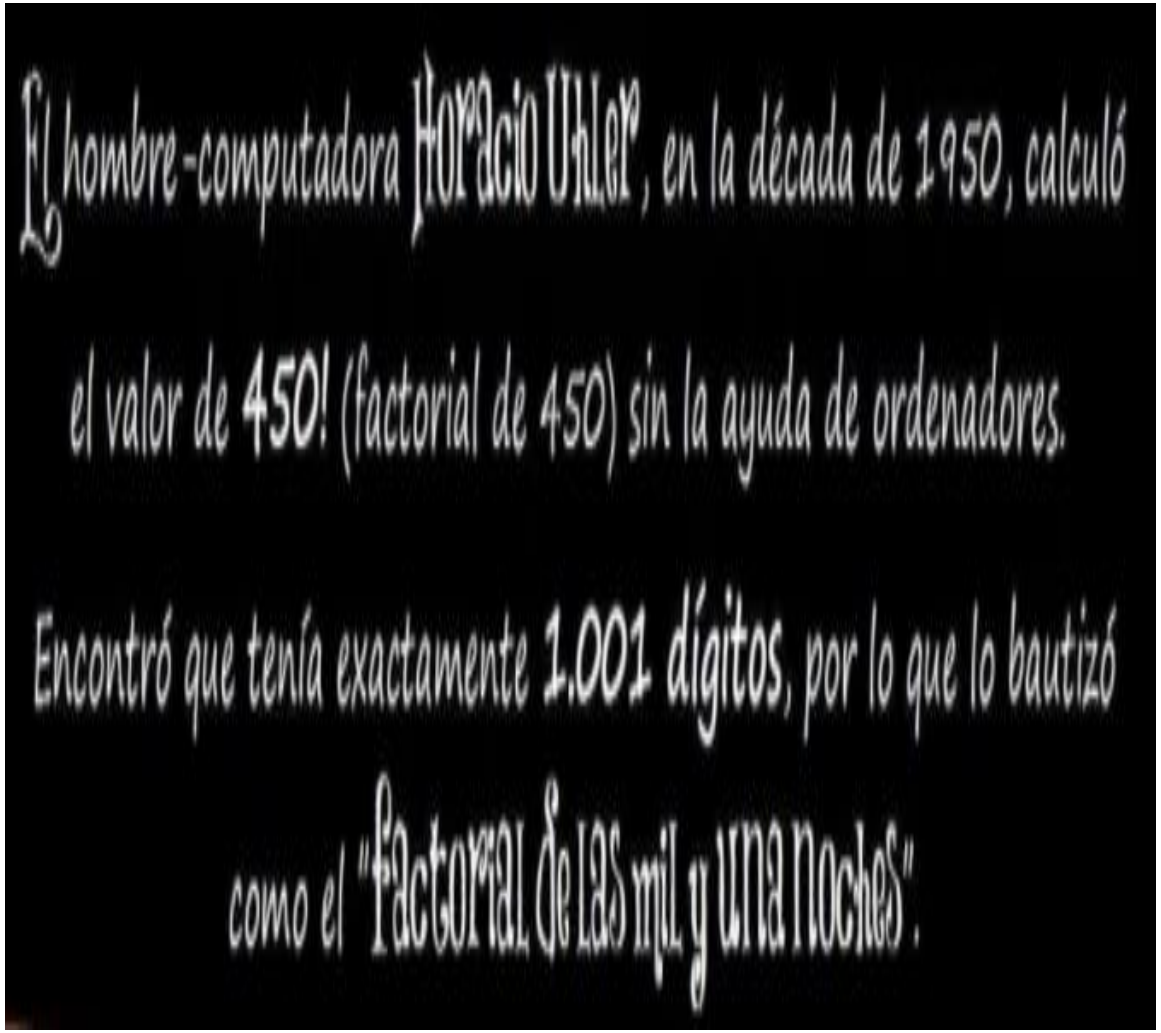
## FACTORIAL Y NÚMERO COMBINATORIO

SACO OLIVEROS

# HELICO
# MOTIVATING

SAGO OLIVEROS

# SABIAS QUE

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# HELICO THEORY

## CHAPTHE R 09

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# FACTORIAL

## DEFINICIÓN

Sea n ∈ N (además del cero), denotado por n! ; se define como:

$$n! = \begin{cases} 0, \ si\ n = 0 \ \vee \ n = 1 \\ 1x2x3 \ldots . n, \text{ si } n \in N \wedge n \geq 2 \end{cases}$$

## Ejemplos:

$5! = 5\,(4)(3)(2)(1) = 120$

$3! = 3(2)(1) = 6$

$14! = \underbrace{14\,(13)(12)(11)(10)\ 9!}_{\text{Degradación de factorial}} = 240240.\ 9!$

## Propiedades

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

$5! + 6! = 5!\,(5+2) = 5!\,(7)$

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

$4! + 5! + 6! = 4!\,(4+2)^2 = 5!\,(36)$

$(n+1)! - n! = n!\,(n)$

$5! - 4! = 4!\,(4)$

# NÚMERO COMBINATORIO

## DEFINICIÓN

El número combinatorio denotado por $C_k^n$ representa el número total de combinaciones que se pueden realizar con $n$ elementos tomados de $k$ en $k$.

$$C_k^n = \frac{n!}{k!.(n-k)!} \quad (n, k \in \mathbb{N} \wedge n \geq k)$$

**Ejemplo:**

$$C_2^7 = \frac{7!}{2!.(7-2)!} = \frac{7!}{2!.(5)!} = \frac{7(6).5!}{2(1).5!} = 21$$

**Caso Práctico:**

$$C_2^7 = \frac{7(6)}{2(1)} = 21$$

## Propiedades

$C_k^n = C_{n-k}^n$ **Ejemplo:** $C_2^7 = C_{7-2}^7 = C_5^7$

**Si:** $C_k^n = C_p^n \Rightarrow k = p \ \vee \ n = k + p$

**Ejemplo:** **Si:** $C_{10}^{15} = C_p^{15}$

$\Rightarrow p = 10 \ \vee \ 15 = p + 10$

$C_k^n + C_{k+1}^n = C_{k+1}^{n+1}$

**Ejemplo:** $C_4^{12} + C_5^{12} = C_5^{12+1} = C_5^{13}$

$C_k^n = \frac{n}{k} C_{k-1}^{n-1}$ **Ejemplo:** $C_9^{15} = \frac{15}{9} C_{9-1}^{15-1} = \frac{5}{3} C_8^{14}$

# HELICO PRACTICE

## CHAPTHE R 09

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**1.** Reduzca

$$P=\left(\frac{32!+33!}{34!}\right)\left(\frac{67!}{66!+65!}\right)$$

**RESOLUCIÓN**

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

$$P=\left(\frac{32!+33!}{34!}\right)\left(\frac{67!}{66!+65!}\right)$$

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

$$P=\left(\frac{32!\,(34)}{34(33)\,32!}\right)\left(\frac{67(66)\,65!}{65!\,(67)}\right)$$

$$P=\left(\frac{66}{33}\right)$$

$$P=2$$

**2.** Halle el valor de "x" en:

$$\frac{(x+4)!\,(x+2)!}{(x+3)!+(x+2)!}=720$$

**RESOLUCIÓN**

Degradación de factorial

$$\frac{(x+4)!\,(x+2)!}{(x+3)!+(x+2)!}=720$$

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

$$\frac{(x+4)(x+3)!.\,(x+2)!}{(x+2)!\,(x+4)}=720$$

$$(x+3)!=\underbrace{720}_{6!}$$

$$(x+3)!=6!$$

$$x=3$$

**3.** Halle el valor de x, si se cumple:

$$\frac{(x+2)! + (x+3)! + (x+4)!}{(x+3)! - (x+2)!} = \frac{25}{x+2}$$

**RESOLUCIÓN**

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

$$\frac{(x+2)! + (x+3)! + (x+4)!}{(x+3)! - (x+2)!} = \frac{25}{x+2}$$

$$(n+1)! - n! = n!\,(n)$$

$$\frac{(x+2)!\,(x+4)^2}{(x+2)!\,(x+2)} = \frac{25}{x+2}$$

$$(x+4)^2 = 25$$

$$x = 1$$

**4.** Halle el valor de "n" en:

$$3C_3^{2n} = 44C_2^n$$

**RESOLUCIÓN**

**Caso Práctico:**

$$3\left\{\frac{2n(2n-1)(2n-2)}{(3)(2)(1)}\right\} = \overset{22}{44}\left\{\frac{n(n-1)}{(2)(1)}\right\}$$

$$\overset{11}{n(2n-1)2(n-1)} = 22n(n-1)$$

$$(2n-1) = 11$$

$$n = 6$$

## 5. Calcule

$$P = \frac{C_4^{12}+C_5^{12}+C_7^{13}}{C_6^{14}+C_7^{14}}$$

**RESOLUCIÓN**

$$C_k^n + C_{k+1}^n = C_{k+1}^{n+1}$$

$$P = \frac{C_4^{12}+C_5^{12}+C_7^{13}}{C_6^{14}+C_7^{14}}$$

$$C_k^n + C_{k+1}^n = C_{k+1}^{n+1}$$

$$P = \frac{C_5^{13}+C_7^{13}}{C_7^{15}}$$

$$C_7^{13} = C_6^{13}$$

$$C_k^n + C_{k+1}^n = C_{k+1}^{n+1}$$

$$P = \frac{C_5^{13}+C_6^{13}}{C_7^{15}}$$

$$P = \frac{C_6^{14}}{C_7^{15}} = \frac{\frac{14!}{6!(8)!}}{\frac{15!}{7!(8)!}} = \frac{(14!)(7!)}{(6!)(15!)} = \frac{7}{15}$$

$$C_k^n = \frac{n!}{k!.(n-k)!}$$

$$P = \frac{7}{15}$$

$$P = \frac{7}{15}$$

**6.** Pedro le regala a su esposa una licuadora marca OSTER, cuyo precio fue el valor de 2T soles, donde T está dado por:

$$T = C_5^8 + C_6^8 + C_7^9 + C_8^{10} + C_2^{11}$$

¿Cuánto le costó la licuadora a Pedro?

**RESOLUCIÓN**

$$T = \underbrace{C_5^8 + C_6^8} + C_7^9 + C_8^{10} + C_2^{11}$$

$$C_k^n + C_{k+1}^n = C_{k+1}^{n+1}$$

$$T = \underbrace{C_6^9 + C_7^9} + C_8^{10} + C_2^{11}$$

$$C_k^n + C_{k+1}^n = C_{k+1}^{n+1}$$

$$T = \underbrace{C_7^{10} + C_8^{10}} + C_2^{11}$$

$$C_k^n + C_{k+1}^n = C_{k+1}^{n+1}$$

$$T = C_8^{11} + \underbrace{C_2^{11}}$$

$$C_k^n = C_{n-k}^n$$

$$T = \underbrace{C_8^{11} + C_9^{11}}$$

$$C_k^n + C_{k+1}^n = C_{k+1}^{n+1}$$

$$T = \underbrace{C_9^{12}}$$

$$C_k^n = \frac{n!}{k!.(n-k)!}$$

$$T = C_9^{12} = \frac{12!}{9!.(3)!} = \frac{\overset{2}{\cancel{12}}(11)(10)\overset{}{\cancel{9!}}}{\underset{}{\cancel{9!}}.\underset{}{\cancel{(3)}}\underset{}{\cancel{(2)}}(1)} = 220$$

$$El\ costo\ de\ la\ licuadora = S/.440$$

**7.** Halle el valor de M en:

$$\mathrm{M} = \frac{3C_2^{11} - 5C_9^{11} + 7C_2^{11}}{C_9^{11}}$$

Si 3M representa la edad de Arturito.
¿Cuál será su edad dentro de 5 años?

**RESOLUCIÓN**

$$C_k^n = C_{n-k}^n$$

$$\mathrm{M} = \frac{3C_2^{11} - 5C_9^{11} + 7C_2^{11}}{C_9^{11}}$$

$$C_k^n = C_{n-k}^n$$

$$\Rightarrow \mathrm{M} = \frac{3C_2^{11} - 5C_2^{11} + 7C_2^{11}}{C_2^{11}}$$

$$\Rightarrow \mathrm{M} = \frac{5C_2^{11}}{C_2^{11}} \Rightarrow \mathrm{M} = 5$$

***Su edad dentro de* 5 *años sera*: 20 *años***