Expand and simplify $(a+b)^6$

Row 0:	1
Row 1:	1 1
Row 2:	1 2 1
Row 3:	1 3 3 1
Row 4:	1 4 6 4 1
Row 5:	1 5 10 10 5 1
Row 6:	1 6 15 20 15 6 1
Row 7:	1 7 21 35 35 21 7 1
Row 8:	1 8 28 56 70 56 28 8 1
Row 9:	1 9 36 84 126 126 84 36 9 1
Row 10:	1 10 45 120 210 252 210 120 45 10 1

$_6C_1 = 6$ OR $\binom{6}{1} = 6$

Pascal's Triangle

$\boxed{nCr}$

$$(a+b)^6 = 1a^6b^0 + 6a^5b^1 + 15a^4b^2 + 20a^3b^3 + 15a^2b^4 + 6ab^5 + 1a^0b^6$$

$$= \binom{6}{0}a^6b^0 + \binom{6}{1}a^5b^1 + \binom{6}{2}a^4b^2 + \binom{6}{3}a^3b^3 + \binom{6}{4}a^2b^4 + \binom{6}{5}ab^5 + \binom{6}{6}a^0b^6$$

$\binom{n}{0} = 1, n \in \mathbb{N}$ $\binom{n}{n} = 1, n \in \mathbb{N}$

If $f(x)=x^n$, prove $f'(x)=nx^{n-1}$, $n\in\mathbb{N}$

$$f'(x)=\lim_{h\to 0}\frac{f(x+h)-f(x)}{h} \text{ if limit exists.}$$

$$=\lim_{h\to 0}\frac{(x+h)^n-x^n}{h}$$

$$=\lim_{h\to 0}\frac{\binom{n}{0}x^n h^0+\binom{n}{1}x^{n-1}h^1+\binom{n}{2}x^{n-2}h^2+\dots+\binom{n}{n-1}x^1h^{n-1}+\binom{n}{n}x^0h^n-x^n}{h}$$

$$=\lim_{h\to 0}\frac{\cancel{x^n}+\binom{n}{1}x^{n-1}h^1+\binom{n}{2}x^{n-2}h^2+\dots+\binom{n}{n-1}x^1h^{n-1}+\binom{n}{n}x^0h^n-\cancel{x^n}}{h}$$

$$=\lim_{h\to 0}\frac{\cancel{h}x^{n-1}\left[\binom{n}{1}+\binom{n}{2}hx^{-1}+\dots+\binom{n}{n-1}x^{-n+2}h^{n-2}+\binom{n}{n}x^{-n+1}h^{n-1}\right]}{\cancel{h}}$$

$$=\lim_{h\to 0}x^{n-1}\left[\binom{n}{1}+0+0+\dots+0+0\right]$$

$$=\binom{n}{1}x^{n-1}$$

$$=nx^{n-1}$$

□