

# 2.4 Use the Binomial Theorem

**Goal** • Use the Binomial Theorem to expand binomials.

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Georgia  
Performance  
Standard(s)  
MM1A2d



## Pascal's Triangle

1					$n = 0$ (0th row)					
	1		1		$n = 1$ (1st row)					
		1	2	1	$n = 2$ (2nd row)					
			1	3	3	1	$n = 3$ (3rd row)			
					1	4	6	4	1	$n = 4$ (4th row)

The first and last numbers in each row are 1.  
Beginning with the second row, every other number is formed by adding the two numbers immediately above the number.



## Binomial expansion

$$(a + b)^0 = 1$$

$$(a + b)^1 = 1a + 1b$$

$$(a + b)^2 = 1a^2 + 2ab + 1b^2$$

$$(a + b)^3 = 1a^3 + 3a^2b + 3ab^2 + 1b^3$$

$$(a + b)^4 = 1a^4 + 4a^3b + 6a^2b^2 + 4ab^3 + 1b^4$$



Use the fourth row of Pascal's triangle to find the numbers in the fifth and sixth rows of Pascal's triangle.

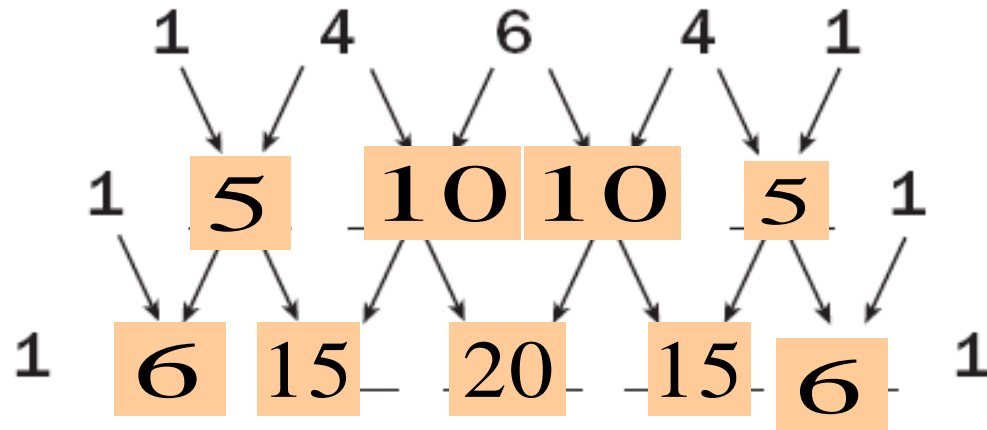
## Solution

Write the fifth row of Pascal's triangle by adding numbers from the *fourth* row. Write the sixth row of Pascal's triangle by adding numbers from the *fifth* row.

$n = 4$  (4th row)

$n = 5$  (5th row)

$n = 6$  (6th row)





Use the Binomial Theorem and Pascal's triangle to write the binomial expansion of  $(x + 5)^4$ .

## Solution

The binomial coefficients from the fourth row of Pascal's triangle are 1, 4, 6, 4 and 1. So, the expansion is as follows.

$$\begin{aligned}(x + 5)^4 &= \underline{1}(x^4) + \underline{4}(x^3)(5) + \underline{6}(x^2)(5)^2 \\ &\quad + \underline{4}(x)(5)^3 + \underline{1}(5)^4 \\ &= x^4 + 20x^3 + (6)25x^2 + (4)125x + 625\end{aligned}$$

$$x^4 + 20x^3 + 150x^2 + 500x + 625$$



2.  $(x + 3)^5$

*Fifth*: 1 5 10 10 5 1

$$1x^5 + 5x^4(3) + 10x^3(3)^2 + 10x^2(3)^3 + 5x(3)^4 + (3)^5$$

$$x^5 + 15x^4 + 10x^3(9) + 10x^2(27) + 5x(81) + 243$$

$$x^5 + 15x^4 + 90x^3 + 270x^2 + 405x + 243$$



4.  $(x - 7)^4$

$[x + (-7)]^4$

*Fourth: 1 4 6 4 1*

$$1x^4 + 4x^3(-7) + 6x^2(-7)^2 + 4x(-7)^3 + (-7)^4$$

$$x^4 - 28x^3 + 6x^2(49) + 4x(-343) + 2401$$

$$x^4 - 28x^3 + 294x^2 - 1372x + 2401$$



$$6. (8 - 5y)^4$$

$$[8 + (-5y)]^4$$

*Fourth:* 1 4 6 4 1

$$1(8)^4 + 4(8)^3(-5y) + 6(8)^2(-5y)^2 + 4(8)(-5y)^3 + (-5y)^4$$

$$4096 + 4(512)(-5y) + 6(64)(25y^2) + 32(-125y^3) + 625y^4$$

$$4096 - 10240y + 9600y^2 - 4000y^3 + 625y^4$$

$$625y^4 - 4000y^3 + 9600y^2 - 10240y + 4096$$



Assignment    change from calendar...this is  
online if you need to show your parents!  
p. 75 4, 10, 16, 20

Quiz 2: 1 – 3



7. Find the coefficient of  $x^2$  in the expansion of  $(7 - x)^5$ .

$$[7 + (-x)]^5$$

*Fifth*: 1 5 10 10 5 1

$$7^5 + 5(7)^4(-x) + 10(7)^3(-x)^2 + 10(7)^2(-x)^3 + 5(7)(-x)^4 + (-x)^5$$

$$16807 + 5(2401)(-x) + 10(343)x^2 + 10(49)(-x^3) - 35x^4 - x^5$$

$$16807 - 12005x + 3430x^2 - 490x^3 - 35x^4 - x^5$$

**3430**

