**Binomial Theorem**

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## What is Binomial?

**Expression that contain 2 terms**

## Pascal Triangle

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Power | Pascal Triangle pattern | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | |
| 2 | 1 | | | | | | | | | | | | | | | 2 | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | | | | |
| 3 | 1 | | | | | | | | | | | 3 | | | | | | | | | | | | 3 | | | | | | | | | | | | 1 | | | | | | | | | | |
| 4 | 1 | | | | | | | | | 4 | | | | | | | | | 6 | | | | | | | | | | 4 | | | | | | | | | 1 | | | | | | | | |
| 5 | 1 | | | | | | | 5 | | | | | | | | 10 | | | | | | | | 10 | | | | | | | | 5 | | | | | | | | 1 | | | | | | |
| 6 | 1 | | | | | | 6 | | | | | | | 15 | | | | | | | 20 | | | | | | 15 | | | | | | | 6 | | | | | | | 1 | | | | | |
| 7 | 1 | | | | | 7 | | | | | | 21 | | | | | | 35 | | | | | | 35 | | | | | | 21 | | | | | | 7 | | | | | | 1 | | | | |
| 8 | 1 | | | | 8 | | | | | | 28 | | | | | 56 | | | | | | 70 | | | | 56 | | | | | | 28 | | | | | 8 | | | | | | 1 | | | |
| 9 | 1 | | | 9 | | | | | | 36 | | | | | 84 | | | | 126 | | | | | 126 | | | | | 84 | | | | 36 | | | | | 9 | | | | | | 1 | | |
| 10 | 1 | | 10 | | | | | | 45 | | | | 120 | | | | 210 | | | | | | 252 | | 210 | | | | | | 120 | | | | 45 | | | | 10 | | | | | | 1 | |
| 11 | 1 | 11 | | | | | | 55 | | | | 165 | | | | 330 | | | | 462 | | | | 462 | | | | 330 | | | | 165 | | | | 55 | | | | 11 | | | | | | 1 |

## Example Observe Expansion of Power and its’ coefficient

|  |  |  |
| --- | --- | --- |
| Power | Expand | Number of terms |
|  |  | 1 |
|  |  | 2 |
|  |  | 3 |
|  |  | 4 |
|  |  | 5 |
|  |  | 6 |

The coefficient follows the patterns of Pascal Triangle!

## Exercise – Expand the following (basic)

## Exercise – Expand the following (patterns)

1. Any term = 1, can be ignored

## Limitations of Pascal Triangle

* Pascal triangle can only do this much, how about the power of 20? Or 30?
* It becomes tedious and not practical to memorize the patterns

n = the power of expansion  
r = the term of the Pascal triangle of power n, starts from 0  
Example:

### Factorial

|  |  |  |
| --- | --- | --- |
| Term | Formula | Result |
| 0! | 1 | 1 |
| 1! | 1 | 1 |
| 2! | 2 \* 1 | 2 |
| 3! | 3 \* 2 \* 1 | 6 |
| 4! | 4 \* 3 \* 2 \* 1 | 24 |
| 5! | 5 \* 4 \* 3 \* 2 \* 1 | 120 |
| n! | n \* (n-1) \* (n-2) \* … \* 1 |  |

Use your calculator to calculate

### Binomial Theorem Full Formula

### Binomial Theorem General Formula

## Exercises

## Application I

## Application II – Solve for Unknown

1. 1st 4 term of
2. in

## Application III A – Finding the specific term or coefficient

## Application III B – Finding the specific term or coefficient using formulae (r+1)

Recall:

* 1. Method 1 by expansion:
  2. Method 2 by r+1:

## Exercise

1. Expand the following
2. Expand the 1st 3 term
   1. Find a