



## MATHS

### BOOKS - RS AGGARWAL MATHS (HINGLISH)

#### BINOMIAL THEOREM

##### Solved Example

1. Expand  $(x^2 + 2y)^5$  using binomial expansion.

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2. Expand  $\left(x^3 - \frac{2}{x^2}\right)^6$  using binomial expansion.

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3. Expand  $(1 + x + x^2)^3$  using binomial expansion.

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4. Expand  $(1 - x + x^2)^4$  using binomial expansion.

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5. Expand  $\{(a + b)^4 + (a - b)^4\}$  and use it to evaluate

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6. Find the 10th term in the expansion of  $\left(2x^2 + \frac{1}{x}\right)^{12}$ .

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7. Find the 6th in the expansion of  $\left(\frac{4x}{5} - \frac{5}{2x}\right)^9$ .



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8. Find the 4th term from the end in the expansion of  $\left(\frac{x^3}{2} - \frac{2}{x^2}\right)^9$ .



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9. Find  $n$ , if the ratio of the fifth term from the beginning to the fifth term from the end in the expansion of  $\left(24 + \frac{1}{34}\right)^n$  is  $\sqrt{6}:1$ .



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10. Find the term independent of  $x$ , where  $x \neq 0$ , in the expansion of  $\left(\frac{3x^2}{2} - \frac{1}{3x}\right)^{15}$ .



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11. find the term independent of  $x$  in the expansion of  $\left(\frac{\sqrt{x}}{\sqrt{3}} + \frac{\sqrt{3}}{2x^2}\right)^{10}$

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12. If the term free from  $x$  in the expansion of  $\left(\sqrt{x} - \frac{m}{x^2}\right)^{10}$  is 405, find the value of  $m$ .

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13. Find the coefficient of  $x^{32}$  and  $\frac{1}{x^{17}}$  in the expansion of  $\left(x^4 - \frac{1}{x^3}\right)^{15}$

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14. Prove that there is no term containing  $x^{10}$  in the expansion of  $\left(x^2 - \frac{2}{x}\right)^{18}$ .





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15. Find the middle term in the expansion of  $\left(ax - \frac{b}{x^2}\right)^{12}$



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16. Find the middle terms in the expansion  $\left(3x - \frac{x^3}{6}\right)^7$ .



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17. Show that the middle term in the expansion of  $(1+x)^{2n}$  is  $\frac{(1 \cdot 3 \cdot 5 \cdots (2n-1))}{n!} 2^n x^n$ , where  $n$  is a positive integer.



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18. If  $x^p$  occurs in the expansion of  $(x^2 + 1/x)^{2n}$ , prove that its coefficient is  $\frac{(2n)!}{\left[\frac{1}{3}(4n-p)\right]! \left[\frac{1}{3}(2n+p)\right]!}$ .



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19. Show that the coefficient of the middle term in the expansion of  $(1 + x)^{2n}$  is equal to the sum of the coefficients of two middle terms in the expansion of  $(1 + x)^{2n-1}$ .



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20. If  $a_0, a_1, a_2, \dots$  be the coefficients in the expansion of  $(1 + x + x^2)^n$  in ascending powers of  $x$ . prove that :  $(i) a_0 a_1 - a_1 a_2 + a_2 a_3 - \dots = 0$



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21. If  $m$  and  $n$  are positive integers, then prove that the coefficients of  $x^m$  and  $x^n$  are equal in the expansion of  $(1 + x)^{m+n}$



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22. (2) If the coefficients of  $(2r + 4)$ th,  $(r - 2)$ th terms in the expansion of  $(1 + x)^{18}$  are equal, find  $r$ .

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23. Find the coefficient of  $x^6y^3$  in the expansion of  $(x + 2y)^9$ .

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24. Write down the binomial expansion of  $(1 + x)^{n+1}$ , when  $x = 8$ .  
deduce that  $9^{n+1} - 8n - 9$  is divisible 64 where  $n$  is a positive integer.

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25. Using binomial theorem, prove that  $6^n - 5n$  always leaves remainder 1 when divided by 25.

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26. Show that  $2^{4n+4} - 15n - 16$ , where  $n \in \mathbb{N}$  is divisible by 225.

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27. If  $a$  and  $b$  are distinct integers then prove that  $(a-b)$  is a factor of  $(a^n - b^n)$ , whenever  $n$  is a positive integer.

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28. The second, third and fourth terms in the binomial expansion  $(x + a)^n$  are 240, 720 and 1080, respectively. Find  $x$ ,  $a$  and  $n$ .

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29. The coefficient of the  $(r-1)$ th,  $r$ th and  $(r+1)$ th terms in the expansion of  $(x + 1)^n$  are in the ratio 1:3:5. Find both  $n$  and  $r$ .

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30. Show that the coefficient of  $(r+1)$ th in the expansion of  $(1+x)^{n+1}$  is equal to the sum of the coefficients of the  $r$ th and  $(r+1)$ th term in the expansion of  $(1+x)^n$

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31. Find the coefficients of  $x^{50}$  in the expression  $(1+x)^{1000} + 2x(1+x)^{999} + 3x^2(1+x)^{998} + \dots + 1001x^{1000}$ .

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32. If  $n$  is a positive integer, find the coefficient of  $x^{-1}$  in the expansion of  $(1+x)^n \left(1 + \frac{1}{x}\right)^n$ .

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33. Find the coefficient of  $x^4$  in the expansion of  $(1 + x + x^2 + x^3)^{11}$ .

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34. Find the coefficient of  $x^4$  in the product  $(1 + 2x)^4 \times (2 - x)^5$ .

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35. If P be the sum of all odd terms and Q that of all even terms in the expansion of  $(x + a)^n$ , prove that

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36. Using binomial theorem, find the value of  $(103)^4$ .

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37. Using binomial theorem, find the value of  $(99)^4$ .

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38. Using binomial theorem, find the value of  $(0.99)^{15}$  up to four places of decimal.

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39. Using binomial theorem, prove that  $(101)^{50} > (100^{50} + 99^{50})$ .

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40. Which is larger,  $(1.01)^{1000000}$  or 10000?

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## Exercise 10 A

1. Using binomial theorem, expand each of the following:  $(1 - 2x)^5$

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2. Using binomial theorem, expand each of the following:  $(2x - 3)^6$

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3. Using binomial theorem, expand each of the following:  $(3x + 2y)^5$

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4. Using binomial theorem, expand each of the following:  $(2x - 3y)^4$

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5. Using binomial theorem, expand each of the following:  $\left(\frac{2x}{3} - \frac{3}{2x}\right)^6$

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6. Using binomial theorem, expand each of the following:  $\left(x^2 - \frac{2}{x}\right)^7$

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7. Using binomial theorem, expand each of the following:  $\left(x - \frac{1}{y}\right)^5$

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8. Using binomial theorem, expand each of the following:  $\left(\sqrt{x} + \sqrt{y}\right)^8$

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9. Using binomial theorem, expand each of the following:  $\left(\sqrt[3]{x} - \sqrt[3]{y}\right)^6$



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10. Using binomial theorem, expand each of the following:

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



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11. Using binomial theorem, expand each of the following:

$$\left(1 + \frac{x}{2} - \frac{2}{x}\right)^4, x \neq 0$$



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12. Using binomial theorem, expand each of the following:

$$(3x^2 - 2ax + 3a^2)^3$$



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13. Evaluate:  $(\sqrt{2} + 1)^6 + (\sqrt{2} - 1)^6$



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14. Evaluate:  $(\sqrt{3} + 1)^5 - (\sqrt{3} - 1)^5$



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15. Evaluate:  $(2 + \sqrt{3})^7 + (2 - \sqrt{3})^7$



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16. Evaluate:  $(\sqrt{3} + \sqrt{2})^6 - (\sqrt{3} - \sqrt{2})^6$



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17. Prove that  $\sum_n^{r=0} {}^n C_r \cdot 3^r = 4^n$ .



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18. Using binomial theorem, evaluate each of the following:

(i)  $(104)^4$  (ii)  $(98)^4$  (iii)  $(1.2)^4$



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19. Using binomial theorem, prove that  $(2^{3n} - 7n - 1)$  is divisible by 49,

where  $n \in \mathbb{N}$ .



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20. Prove that  $(2 + \sqrt{x})^4 + (2 - \sqrt{x})^4 = 2(16 + 24x + x^2)$ .



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21. Find the 7th term in the expansion of  $\left(\frac{4x}{5} + \frac{5}{2x}\right)^8$





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22. Find the 9th term in the expansion of  $\left(\frac{a}{b} - \frac{b}{(2a)^2}\right)^{12}$ .



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23. Find the 16th term in the expansion of  $(\sqrt{x} - \sqrt{y})^{17}$



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24. Find the 13<sup>th</sup> term in the expansion of  $\left(9x - \frac{1}{3\sqrt{x}}\right)^{18}$ ,  $x \neq 0$



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25. If the coefficients of  $x^7$  and  $x^8$  in the expansion of  $\left[2 + \frac{x}{3}\right]^n$  are equal, then the value of n is : (A) 15 (B) 45 (C) 55 (D) 56



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26. The ratio of the coefficient of  $x^{15}$  to the term independent of  $x$  in the expansion of  $\left(X^2 + \frac{2}{x}\right)^{15}$  is



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27. Prove that the ratio of the coefficient of  $x^{10}$  in  $(1 - x^2)^{10}$  & the term independent of  $x$  in  $\left(x - \frac{2}{x}\right)^{10}$  is 1:32



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28. Find the term independent of  $x$  in the expansion of  $(1 + x + 2x^3) \left[ \left( \frac{3x^2}{2} \right) - \left( \frac{1}{3} \right) \right]^9$



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29. Find the coefficient of  $x$  in the expansion of  $(1 - 3x + 7x^2)(1 - x)^{16}$ .

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30. Find the coefficient of (i)  $x^5$  in the expansion of  $(x + 3)^8$

(ii)  $x^6$  in the expansion of  $\left(3x^2 - \frac{a}{3x}\right)^9$

(iii)  $x^{-15}$  in the expansion of  $\left(3x^2 - \frac{a}{3x^3}\right)^{10}$ .

(iv)  $a^7b^5$  in the expansion of  $(a - 2b)^{12}$ .

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31. Show that the term containing  $x$  does not exist in the expansion of

$$\left(3x - \frac{1}{2x}\right)^8$$

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32. Does the expansion of  $\left(2x^2 - \frac{1}{x}\right)^{20}$  contain any term involving  $x^9$ ?

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33. Show that the expansion of  $\left(x^2 + \frac{1}{x}\right)^1$  does not contain any term involving  $x^{-1}$ .

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34. Write the general term in the expansion of  $(x^2 - y)^6$ .

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35. Find the 5th term from the end in the expansion of  $\left(x - \frac{1}{x}\right)^{12}$ .

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36. Find the 4th term from the end in the expansion of  $\left(\frac{4x}{5} - \frac{5}{2x}\right)^9$ .



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37. If the 7th terms from the beginning and end in the expansion of

$$\left(\sqrt[3]{2} + \frac{1}{\sqrt[3]{2}}\right)^n$$
 are equal, find the value of n.



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38. Find the middle term in the expansion of :

(i)  $3 + x$  (ii)  $\left(\frac{x}{3} + 3y\right)^8$

(iii)  $\left(\frac{x}{a} - \frac{a}{x}\right)^{10}$  (iv)  $\left(x^2 - \frac{2}{x}\right)^{10}$



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39. Find the two middle terms in the expansion of : (i)  $(x^2 + a^2)^5$  (ii)

$$\left(x^4 - \frac{1}{x^3}\right)^{11}$$

$$\left(\frac{p}{x} + \frac{x}{p}\right)^9 \quad (\text{iv}) \quad \left(3x - \frac{x^3}{6}\right)^9$$



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**40.** Find the term independent of  $x$  in the expansion of :

$$\begin{aligned} \text{(i)} \quad & \left(2x + \frac{1}{3x^2}\right)^9 & \text{(ii)} \quad & \left(\frac{3x^2}{2} - \frac{1}{3x}\right)^6 \\ \text{(iii)} \quad & \left(x - \frac{1}{x^2}\right)^{3n} & \text{(iv)} \quad & \left(3x - \frac{2}{x^2}\right)^{15} \end{aligned}$$



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**41.** Find the coefficient of  $x^5$  in the expansion of  $(1+x)^3(1-x)^6$ .



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**42.** Find numerically greatest term in the expansion of  $(2+3x)^9$ , when

$$x = \frac{3}{2}.$$



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43. 17. If the coefficients of 2nd, 3rd and 4th terms in the expansion of  $(1 + x)^{2n}$  are in A.P.. Show that  $2n^2 - 9n + 7 = 0$

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44. Find the 6th term of the expansion  $(y^{1/2} + x^{1/3})^n$ , if the binomial coefficient of 3rd term from the end is 45.

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45. If the 17th and 18th terms in the expansion of  $(2 + a)^{50}$  are equal, find the value of a.

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46. Find the coefficient of  $x^4$  in the expansion of  $(1 + x)^n(1 - x)^n$ .

Deduce

that

$C_2 = C_0C_4 - C_1C_3 + C_2C_2 - C_3C_1 + C_4C_0$ , where  $C_r$  stands for  ${}^nC_r$ .

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47. Prove that the coefficient of  $x^n$  in the binomial expansion of  $(1+x)^{2n}$  is twice the coefficient of  $x^n$  in the binomial expansion of  $(1+x)^{2n-1}$ .

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48. If the middle term in the expansion of  $\left(\frac{p}{2} + 2\right)^8$  is 1120, find  $p$ .

- A.  $\pm 1$
- B.  $\pm 2$
- C.  $\pm 3$
- D.  $\pm 4$

**Answer: B**

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## Exercise 10 B

1. Show that the term independent of  $x$  in the expansion of

$$\left(x - \frac{1}{x}\right)^{10} \text{ is } -252.$$

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2. If the coefficients of  $x^2$  and  $x^3$  in the expansion of  $(3 + px)^9$  are the same then prove that  $p = \frac{9}{7}$ .

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3. Show that coefficient of  $x^{-3}$  in the expansion of  $\left(x - \frac{1}{x}\right)^{11}$  is  $-330$ .

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4. Show that the middle term in the expansion of

$$\left(\frac{2x^2}{3} + \frac{3}{(2x)^2}\right)^{10} \text{ is } 252.$$

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5. Show that the coefficient of  $x^4$  in the expansion of

$$\left(\frac{x}{2} - \frac{3}{x^2}\right)^{10} \text{ is } \frac{405}{256}.$$

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6. Prove that there is no term involving  $x^6$  in the expansion of

$$\left(2x^2 - \frac{3}{x}\right)^{11}.$$

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7. Show that the coefficient of  $x^4$  in the expansion of  $(1 + 2x + x^2)^5$  is 212.

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8. Write the number of terms in the expansion of  $(\sqrt{2} + 1)^5 + (\sqrt{2} - 1)^5$ .

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9. Which term is independent of  $x$  in the expansion of  $\left(x - \frac{1}{3x^2}\right)^9$ ?

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10. Write the coefficient of the middle term in the expansion of  $(1 + x)^{2n}$ .

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11. Write the coefficient of  $x^7y^2$  in the expansion of  $(x + 2y)^9$ .

A. Least value  $-\frac{1}{4}$

B. Least value  $-\frac{9}{4}$

C. Greatest value  $\frac{1}{4}$

D. Greatest value  $\frac{9}{4}$

**Answer: 144**



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12. If the coefficient of  $(r - 5)th$  and  $(2r - 1)th$  terms in the expansion of  $(1 + x)^{34}$  are equal, find the value of  $r$ .



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13. Write the 4th term from the end in the expansion of  $\left(\frac{3}{x^2} - \frac{x^3}{6}\right)^7$

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14. Find the coefficient of  $x^n$  in the expansion of  $(1 + x)(1 + x)^n$ .

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15. In the binomial expansion of  $(a + b)^n$ , coefficients of the fourth and thirteenth terms are equal to each other. Find  $n$ .

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16. Find a positive value of  $m$  for which the coefficient of  $x^2$  in the expansion of  $(1 + x)^m$  is 6.

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