MATHS

BOOKS - KC SINHA ENGLISH

BINOMIAL THEOREM - FOR BOARDS

Solved Examples

1. Expand of the expression : $\left(x+\frac{1}{x}\right)^6$

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2. Expand: $\left(x-\frac{1}{y}\right)^{11}, y \neq 0$

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3. Expand $(2x - 3y)^4$ by binomial theorem.

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4. Expand $\left(x^2 + 2a\right)^5$ by binomial theorem.

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5. By using binomial theorem, expand: $\left(1 + x + x^2\right)^3$,

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6. Expand: $\left(1 - x + x^2\right)^4$

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7. Find the value of $\left(\sqrt{2}+1\right)^6-\left(\sqrt{2}-1\right)^6$.

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8. Evaluate the following: $\left(x+\sqrt{x^2-1}\right)^6+\left(x-\sqrt{x^2-1}\right)^6$

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9. Find the expansion of $\left(3x^2-2ax+3a^2\right)^3$ using binomial theorem.

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10. If A be the sum of odd terms and B be the sum of even terms in the expansion of $(x+a)^n$, prove that $A^2-B^2=\left(x^2-a^2\right)^n$

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11. If o be the sum of odd terms and E that of even terms in the expansion of $(x+a)^n$ prove that: (i)$O^2 - E^2 = \left(x^2 - a^2\right)^n$ (ii) $4OE = (x+a)^{2n} - (x-a)^{2n}$ (iii) $2\left(O^2 + E^2\right) = (x+a)^{2n} + (x-a)^{2n}$

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12. The first three terms in the expansion of a binomial are $1, 10$ and 40. Find the expansion.

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13. Using binomial theorem compute the following: $(99)^5$

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14. Using binomial theorem compute the following: $(10.\ 1)65$

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15. Which number is larger $(1.2)^{4000}$ or 800

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16. Using binomial theorem, indicate which number is larger $(1.\ 1)^{10000}$ or 1000.

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

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18. Prove that $\sum_{r=0}^{n} 3^r \hat{} nC_r = 4^n$.

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19. Find the 4^{th} term in the expansion of $(x - 2y)^{12}$.

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

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21. Find the 5 th term from the end in the expansion of $\left(\frac{x^3}{2} - \frac{2}{x^2}\right)^9$

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22. Write the general term in the expansion of $\left(x^2 - y\right)^6$.

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23. If the third term in the expansion of $\left(\frac{1}{x} + {}_{\mathrm{x}}(\log)_{10x}\right)^5$ is 1000, then find x.

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24. The 21st and 22nd terms in the expansion of $(1 + x)^{44}$ are equal. Then x:

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25. In the binomial expansion of $(a-b)^n, n \geq 5$, the sum of 5th and 6th terms is zero, then $\frac{a}{b}$ equals

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26. The number of rational terms in the expansion $\left(2^{\frac{1}{5}}+3^{\frac{1}{10}}\right)^{45}$ is

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27. Find the middle term in the expansion of : $\left(\frac{x}{3}+9y\right)^{10}$

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28. Find the middle term in the expansion of $\left(x-\frac{1}{2x}\right)^{12}$

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30. Find the middle term in the expansion of : $\left(1-2x+x^2\right)^n$

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31. Prove that the term independent of x in the expansin of $\left(x+\frac{1}{x}\right)^{2n} is \frac{1.3.5(2n-1)}{n!}.2^n.$

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32. Prove that the term independent of x in the expansin of $\left(x+\frac{1}{x}\right)^{2n} is \frac{1.3.5(2n-1)}{n!}.2^n.$

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33. 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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34. Find the coefficient of $\frac{1}{y^2}$ in $\left(y+\frac{c^3}{y^2}\right)^{10}$

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35. Find the coefficient of x^9 in $\left(1+3x+3x^2+x^3\right)^{15}$.

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36. Find the coefficient of x^{40} in the expansion of $\left(1+2x+x^2\right)^{54}$

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37. Find the term independent of x in $\left(\frac{3x^2}{2}-\frac{1}{3x}\right)^9$

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38. The term independent of x in $(1+x)^m\left(1+\frac{1}{x}\right)^n$ is

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39. If the fourth term in the expansion of $\left(ax+\frac{1}{x}\right)is\frac{5}{2}$, then find the values of $a\ and\ n$.

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40. The value of term independent of x in $\left(\sqrt{x}+\frac{a}{x^2}\right)^{10}$ is .

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41. If $(1+ax)^n = 1+8x+24x^2+\ldots$, then a =... and n= ....

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42. In the binomial expansion of $(1+a)^{m+n}$, prove that the coefficient of $a^m and\ a^n$ are equal.

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43. Find a if the coefficients of $x^2$and x^3in the expansion of $(3+ax)^9$are equal.

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44. If in the expansion of $(1+x)^m(1-x)^n$, the coefficients of x and x^2 are 3 and - 6 respectively, the value of m and n are

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45. If the coefficients of a^{r-1}, $a^r and\, a^{r+1}$ in the binomial expansion of $(1+a)^n$ are in A.P., prove that $n^2 - on(4r+1) + 4r^2 - 2 = 0.$

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46. Find the coefficient of x^5 in the expansioin of the product $(1+2x)^6(1-x)^7.$

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47. Find the coefficient of x^{-1} in $(1+3x^2+x^4)\left(1+\frac{1}{x}\right)^8$

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49. Show that there will be no term containing x^{2r} in the expansion of $\left(x+x^{-2}\right)^{n-3}$ if $n-2r$ is a positive integer but not a multiple of 3.

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50. Show that there will ve a term indepandent of x in the expansion of $\left(x^a+a^{-b}\right)$ only , if an is multiple of (a+b) .

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51. Find n if the coefficients of 4th the 13th terms in the expansion of $(a+b)^n$ are equal.

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52. In the binomial expansion of $(1+x)^{43}$, the coefficients of the $(2r+1)$ th and $(r+2)$ th terms are equal. Then r=

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53. The value of m, for which the coefficients of the $(2m+1)$ th terms in the expansion of $(1+x)^{10}$ are equal is 3 b. 1 c. 5 d. 8

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54. Find the greatest term in the expansion of $(7-5x)^{11}$ when $x=\frac{2}{3}$.

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55. Show that , if the greatest term in the expansion of $(1+x)^{2n}$ has also the greatest coefficient

then x lies between $\frac{n}{n+1}$ and $\frac{n+1}{n}$

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56. If n is a positive integer, then show that 6^n-5n-1 is divisible by 25

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57. Show that: $2^{4n} - 2^n(7n + 1)$ is some multiple of the square of 14, where n is a positive integer.

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58. Using binomial theorem show that $3^{4n+1} + 16n - 3$ is divisible by 256 if n is a positive integer.

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

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60. 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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61. If a and b are distinct integers, prove that $a-b$ is a factor of a^n-b^n, whenever n is a positive integer.

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62. If the coefficients of three consecutive terms in the expansion of $(1+x)^n$ are 165,330 and 462 respectively , the value of n is is

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63. If a_1, a_2, a_3, a_4 be the coefficient of four consecutive terms in the expansion of $(1+x)^n$, then prove that: $\frac{a_1}{a_1+a_2}+\frac{a_3}{a_3+a_4}=\frac{2a_2}{a_2+a_3}$.

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64. The 2nd, 3rd and 4th terms in the expansion of $(x+y)^n$ are $240, 720$ and 1080 respectively, find the values of x, y and n.

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65. The coefficient of three consecutive terms in the expansion of $(1+x)^k$. Are in the ratio $1:7:42$ find the value of k.

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66. I three consecutive coefficients in the expansion of $(1+x)^n$ are in the ratio 6:33:110, find n and r.

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67. If in the expansion of $(1+x)^n, a, , b, c$ are three consecutive coefficients, then n =

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68. In the binomial expansion of $(1+x)^n$, coefficients of the fifth, sixth and seventh terms are in A.P. find all values of n for which this can happen.

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Exercise

1. Expand the following by binomial theorem: $(x+y)^5$

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2. Expand the following by binomial theorem: $(1-x)^6$

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3. Expand the following by binomial theorem: $\left(x+\frac{1}{x}\right)^7$

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4. Expand the following by binomial theorem: $\left(x^2+\frac{2}{x}\right)^4, x \neq 0$

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5. Expand the following by binomial theorem: $\left(\frac{2x}{3} - \frac{3}{2x}\right)^6$

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6. Expand the following by binomial theorem: $\left(1 + 2x + x^2\right)^3$

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7. Expand the following by binomial theorem: $\left(x^2 + \frac{3}{x}\right)^5, x \neq 0$

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8. Expand the following by binomial theorem: $(2x - 3)^6$

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9. Expand the following by binomial theorem: $(1-2x)^5$

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10. Expand the following by binomial theorem: $\left(\frac{x}{3}+\frac{1}{x}\right)^5$

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11. Using binomial theorem expand $\left(1+\frac{x}{2}-\frac{2}{x}\right)^4,\ x\neq 0.$

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12. Expand the following: $\left(1+x+x^2\right)^4$

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13. Evaluate the following: $\left(x+\sqrt{x^2-1}\right)^6+\left(x-\sqrt{x^2-1}\right)^6$

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14. Find the value of $\left(a^2+\sqrt{a^2-1}\right)^4+\left(a^2-\sqrt{a^2-1}\right)^4$.

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15. Using binomial theorem, expand $\left\{(x+y)^5+(x-y)^5\right\}$. and hence find the value of $\left\{\left(\sqrt{2}+1\right)^5+\left(\sqrt{2}-1\right)^5\right\}$.

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16. Find $(a+b)^4-(a-b)^4$. Hence evaluate $\left(\sqrt{3}+\sqrt{2}\right)^4-\left(\sqrt{3}-\sqrt{2}\right)^4$

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

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

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

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

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21. Find the number of terms in the following expansion: $\left(1-2x+x^2\right)^{30}$

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22. Find the number of terms in the expansions of the following: $\left(\sqrt{x}+\sqrt{y}\right)^{10}+\left(\sqrt{x}-\sqrt{y}\right)^{10}$

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23. If P be the sum of odd terms and Q be the sum of even terms in the expansion of $(x+a)^n$, then $(x+a)^{2n}+(x-a)^{2n}$ is

(i) P^2-Q^2

(ii) P^2+Q^2

(iii) $2\left(P^2+Q^2\right)$

(iv) $4PQ$

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24. Find the value of $(0.99)^{10}$ correct of 4 places of decimal.

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25. Using Binomial theorem, evaluate $(0.99)^{15}$ correct to four places of decimal.

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26. Using binomial theorem, evaluate : $(101)^4$

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27. Using binomial theorem, evaluate : $(102)^5$

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28. Evaluate: $(999)^3$

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29. Using binomial theorem, evaluate : $(102)^5$

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30. Evaluate: $(51)^6$

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31. Evaluate: $(98)^4$

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32. Using binomial theorem evaluate each of the following: $(96)^3$

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33. Compute $(98)^5$.

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34. Find the value of $(1.01)^{10} + (0.99)^{10}$ correct 7 places of decimal.

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35. Find the greater of the two number: $(1.01)^{1000000}$ and 10000

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36. Using binomial theorem, indicate which number is larger $(1.\ 1)^{10000}$ or 1000.

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37. Prove that: . n ˆ $C_0 + 2.^n C_1 + \ldots 2^n.^n C_n = 3^n$ for every natural number n.

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38. Prove that:

ˆ $(2n)C_0 - 3.^{2n} C_1 + 3^2.^{2n} C_2 - \ldots + (-1)^{2n}. .3^{2n}$ ˆ $(2n)C_{2n} = 4^n$

for all value of N`

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39. Find an approximation of $(0.99)^5$ using the first three terms of its expansion.

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

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41. Find the 9th term in the expansion of $\left(\frac{x}{a} - \frac{3a}{x^2}\right)^{12}$.

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42. Find the fifth expansion of $\left(\frac{a}{3} - 3b\right)^7$

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43. Find the fifth expansion of $\left(2x^2 - \frac{1}{3x^2}\right)^{10}$

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44. Find a if the 7th and 18th terms of the expansion $(2+a)^{50}$ are equal.

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45. Find the r^{th} term from the end in the expansion of $(x+a)^n$.

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

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47. 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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48. Write the general term in the following expansions $\left(1-x^2\right)^{12}$

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49. Write the general term in the following expansion: $\left(x-\frac{3}{x^2}\right)^{10}$

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50. Write the general term in the following expansion: $\left(x^2-\frac{1}{x}\right)^{12}, x \neq 0$

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51. Find the middle term in $\left(\frac{2x}{3}-\frac{3y}{2}\right)^{20}$

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52. Find the middle term in the expansion of $\left(\frac{2x}{3}-\frac{3}{2x}\right)^{6}$

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53. Find the middle term in the expansion of $\left(\frac{x}{y}-\frac{y}{x}\right)^{7}$

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54. The middle term in the expansioin of $(1+x)^{2n}$ is

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55. Find the middle term in the expansion of : $\left(1-2x+x^{2}\right)^{n}$

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

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57. Find the general and middle term in the expansion of $\left(\frac{x}{y}+\frac{y}{x}\right)^{2n+1}$; n being a positive integer and show that there is no term free from $\frac{x}{y}$.

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58. Show that the middle term in the expansion of $(1+x)^{2n} is \frac{(1.3.5(2n-1))}{n!}2^n x^n, where n$ is a positive integer.

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59. Show that the middle term in the expansion $\left(x-\frac{1}{x}\right)^{2n} is$ $\frac{1.3.5(2n-1)}{n}(-2)^n$.

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60.) Find the coefficient of x in the expansion of $\left(2x - \frac{3}{x}\right)^9$.

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61. Find the coefficient of x^7 in the expansion of $\left(3x^2 + \frac{1}{5x}\right)^{11}$

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62. Find the coefficient of x^7 in the expansion of $\left(2x^2 \pm \frac{1}{x}\right)^{20}$

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63. Find the coefficient of x^{24} in the expansion of $\left(x^2 - 3\frac{a}{x}\right)^{15}$.

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65. Find the coefficient of x^{-7} in the expansion of $\left(2x - \frac{1}{3x^2}\right)^{11}$.

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66. Find the coefficient of $x^5 \in (x+3)^8$

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67. Find the coefficient of x^5 in the expansion of $(x+3)^9$

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68. Find the coefficient of $a^5b^7 \in (a-2b)^{12}$

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

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70. 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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71. Prove that the coefficients of x^n in $(1+x)^{2n}$ is twice the coefficient of x^n in $(1+x)^{2n-1}$.

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72. Find the coefficients of x^7 in $\left(ax^2+\frac{1}{bx}\right)^{11} and x^{-7} \in \left(a\frac{x^{-1}}{bx^2}\right)^{11}$ and find the relation between $a and b$ so that coefficients are equal.

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73. If the coefficients of second, third and fourth terms in the expansion of $(1+x)^{2n}$ are in A.P., show that $2n^2-9n+7=0$.

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74. Find the term independent of x in $\left(x+\frac{1}{x}\right)^{2n}$

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75. Find the term independent of x in the expression $\left(x - \frac{1}{x}\right)^{14}$

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76. Find the term independent of x in the following binomial expansions $(x \neq 0)$: $\left(2x^2 + \frac{1}{x}\right)^{13}$

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77. Find the term independent of x in the following binomial expansions $(x \neq 0)$: $\left(x^2 + \frac{1}{x}\right)^{12}$

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78. Find the term independent of x in the following binomial expansions $(x \neq 0)$: $\left(\sqrt{\frac{x}{3}} + \frac{3}{2x^2}\right)^{10}$

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79. Find the term independent of x in the expansion of the following binomials:

$\left(2x^2 - \frac{1}{x}\right)^{12}$ What is its value?

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80. Find the term independent of x in the expansion of $\left(2x^2 - \frac{3}{x^3}\right)^{25}$.

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81. Find the term independent of x in the expansion off the following expression: $\left(\frac{3}{2}x^2 - \frac{1}{3x}\right)^6$

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82. Which term in the expansion of $\left(x^3 - \frac{3}{x^2}\right)^{15}$ is independent of x?

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83. Find the term independent of x in the following binomial expansions $(x \neq 0)$: $\left(x^2 - \frac{3}{x^3}\right)^{10}$

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84. Find the term independent of x in the expansion of the following expressions: $\left(\frac{1}{2}x^{\frac{1}{3}}+x^{-\frac{1}{5}}\right)^{8}$ and $(1+x+2x^{3})\left(\frac{3}{2}x^{2}-\frac{1}{3x}\right)^{9}$

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85. Find the term independent of x in the expansion of: $\left(x-\frac{1}{x}\right)^{12}$.

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86. Find the term independent of x in the expansion of the following expression: $\left(\sqrt[3]{x}+\frac{1}{2\sqrt[3]{x}}\right)^{18}, x>2$

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87. If there is a term independent of x in $\left(x+\frac{1}{x^2}\right)^n$, show that it is equal to $\frac{n!}{\left(\frac{n}{3}\right)!\left(\frac{2n}{3}\right)!}$

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88. If x^p occurs in the expansion of $\left(x^2+1/x\right)^{2n}$, 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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89. Find the coefficient of a^4 in the product $(1+a)^4(2-a)^5$ using binomial theorem.

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

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

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93. If the coefficient of $(2r+5)$ th term and $(r-6)$ th term in the expansion $(1+x)^{39}$ are equal, find r

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94. If the integers $r > 1, n > 2$ and coefficients of $(3r)th$ and $(r+1)th$ terms in the Binomial expansion of $(1+x)^{2n}$ are equal, then

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95. If the coefficient of $(p+1)$ th term in the expansion of $(1+x)^{2n}$ be equal to that of the $(p+3)$ th term, show that $p = n-1$

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96. Find the two consecutive cocfficients in the expansion of $(3x-2)^{75}$ whose values are equal

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98. Find the greatest term in the expansion $(2+3x)^{10}$, when $x=\frac{3}{5}$

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99. Find the greastest term in the expansion of $(4-3x)^7, whenx=\frac{2}{3}$

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100. Find the greatest term in the expansion of $(a+x)^{13}, when a=5, x=2$

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101. Find the limits between which x must lie in order that the greatest term in the expansion of $(1+x)^{30}$ may have the greatest coefficient.

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102. If n is a positive integer, show that: $4^n - 3n - 1$ is divisible by 9

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103. If p is a natural number, then prove that $p^{n+1} + (p+1)^{2n-1}$ is divisible by $p^2 + p + 1$ for every positive integer n.

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104. Show that $9^{n+1} - 8n - 9$ is divisible by 64, where n is a positive integer.

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105. If p is a natural number, then prove that $p^{n+1} + (p+1)^{2n-1}$ is divisible by $p^2 + p + 1$ for every positive integer n.

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106. If n is a positive integer, show that: $3^{2n} - 1 + 24n - 32n^2$ is divisible by 512 if $n > 2$

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107. If three consecutive coefficients in the expansion of $(1 + x)^n$ be 56, 70 and 56, find n and the position of the coefficients.

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108. If three successive coefficients in the expansion of $(1 + x)^n$ be 220,495 and 972, find n.

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109. If 3rd, 4th, 5th terms in the expansion of $(x+a)^n$ be 84, 280 and 560, Find x, a and n.

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110. Find a, b and n in the expansion of $(a+b)^n$ if the first three terms of the expansion are 729, 7290 and 30375, respectively.

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112. The coefficients 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 n and r.

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114. If the four consecutive coefficients in any binomial expansion be a, b, c, d, then prove that (i) $\frac{a+b}{a}, \frac{b+c}{b}, \frac{c+d}{c}$ are in H.P. (ii) $(bc+ad)(b-c)=2\left(ac^2-b^2d\right)$

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115. If the four consecutive coefficients in any binomial expansion be a, b, c, d, then prove that (i) $\frac{a+b}{a}, \frac{b+c}{b}, \frac{c+d}{c}$ are in H.P. (ii) $(bc+ad)(b-c)=2\left(ac^2-b^2d\right)$

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116. If the coefficients of flour consecutive terms in the expansion of $(1+x)^n$ are a, b, c, d respectively then prove that:

$$\frac{a}{a+b}+\frac{C}{c+d}=\frac{2b}{b+c}$$

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117. If the coefficients of 5th, 6th , and 7th terms in the expansion of $(1+x)^n$ are in A.P., then $n=$ a. 7 only b. 14 only c. 7 or 14 d. none of these

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118. If the coefficient 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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119. If the coefficient of rth, $(r+1)^{th}$, and $(r+2)th$ terms in the binamial expansion of $(1+y)^m$ are in A.P. then prove that $m^2 - m(4r+1) + 4r^2 - 2 = 0$.

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120. The coefficients of three consecutive terms in the expansion of $(1+x)^n$ are in the ratio $182:84:30$. prove that $n = 18$

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121. The sum of the coefficients of the first three terms in the expansion of $\left(x - \frac{3}{x^2}\right)^m$, $x \neq 0$, m being a natural number, is 559. Find the term of the expansion containing x^3.

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