MATHS

BOOKS - S CHAND MATHS (ENGLISH)

BINOMIAL THEOREM

Example

1. The number of terms in the expansion of $\left(1+2x+x^2\right)^5+\left(1+4y+4y^2\right)^5$ after simplification is

A. (a) 12

B. (b) 120

C. (c) 21

D. (d) 22

Answer: C

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2. If the middle term in the expansion of $\left(x^2+\frac{1}{x}\right)^{2n}$ is $184756x^{10}$, then the value of

in is

A. 10

B. 8

C. 5

D. 4

Answer: A

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3. If the coefficient of middle term of the binomial expansion of $(1+x)^{2n}$ is α and those of two middle terms of the binomial expansion of $(1+x)^{2n-1}$ if β and γ, then which one of the following is correct?

(i) $\alpha > \beta + \gamma$

(ii) $\alpha < \beta + \gamma$

(iii) $\alpha = \beta + \gamma$

(iv) $\alpha = \beta\gamma$

A. $\alpha > \beta + \gamma$

B. $\alpha < \beta + \gamma$

C. $\alpha = \beta + \gamma$

D. $\alpha = \beta\gamma$

Answer: C

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4. If the coefficient of $(2r + 1)$ th and $(r + 2)$ th terms in the expansion of $(1 + x)^{43}$ are equal, then the value of $r(r \neq 1)$ is

A. 5

B. 14

C. 21

D. 22

Answer: B

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5. Find the number of terms in the following expansions.

$(2x - 3y)^5$

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6. Find the number of terms in the following expansions.

(ii) $\left(5x - \frac{1}{x^3}\right)^{17}$

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7. Find the number of terms in the following expansions.

$\left(1 + 6x + 9x^2\right)^{23}$

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8. Find the number of terms in the following expansions.

$(\sqrt{3}+\sqrt{5})^{7}(\sqrt{3}-\sqrt{5})^{7}$

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9. Find the number of terms in the following expansions.

(v) $(3x+7)^{8}+(3x-7)^{8}$

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10. Find the number of terms in the following expansions.

(vi) $\left(1+3\sqrt{5}x\right)^9-\left(1-3\sqrt{5}x\right)^9$

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11. Find the number of terms in the following expansions.

$(x+y)^{100}+(x-y)^{100}$

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12. Expand $(1+4x)^5$.

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13. Expand $(3x-2y)^4$.

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14. Expand $\left(x+\frac{1}{x}\right)^6$. $(x \neq 0)$

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15. Find the value of $(\sqrt{2}+1)^6+(\sqrt{2}-1)^6$ and show that the value of $(\sqrt{2}+1)^6$ lies between 197 and 198.

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16. Use the binomial theorem to find the exact value of $(10.1)^5$.

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17. Expand $\left(2+x+x^2\right)^3$.

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

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19.

$$\frac{{}^8C_0}{6} - {}^8C_1 + {}^8C_2.6 - {}^8C_3.6^2 + \ldots + {}^8C_8.6^7$$

is equal to (i) 0 (ii) 6^7 (iii) 6^5 (iv) $\frac{5^8}{6}$

A. 0

B. 6^7

C. 6^5

D. $\frac{5^8}{6}$

Answer: D

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20. Find the tenth term in the expansion $(2x - y)^{11}$.

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21. Write the middle term or terms in the expansion of

(i) $\left(x^2 - \frac{1}{x}\right)^6$

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22. Write the middle term or terms in the expansion of

$\left(3a - \frac{a^3}{6}\right)^9$

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23. Find the rth term from the end in $(x+a)^n$.

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24. (ii) Find 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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25. Find the coefficient of x^{15} in the expansion of $\left(x - x^2\right)^{10}$.

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26. If for positive integers $r > 1, n > 2$, the coefficients of the $(3r)$th and $(r+2)$th powers of x in the expansion of $(1+x)^{2n}$ are equal, then prove that $n = 2r + 1$.

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

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28. 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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Multiple Choice Questions

1. The number of terms in the expansion of $(x+a)^{53}+(x-a)^{53}$ after simplification is

A. 106

B. 26

C. 27

D. 53

Answer: C

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2. The number of terms in the expansion of $(x+a)^{46}-(x-a)^{46}$ after simplification is

A. 23

B. 24

C. 46

D. 92

Answer: A

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3. If the coefficients of x^7 and x^8 in the expansion of $\left(2+\frac{x}{3}\right)^n$ are equal then n =?

A. 56

B. 55

C. 45

D. 15

Answer: B

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4. If

$$(1+x+x)^{2n} = a_0 + a_1 x + a_2 x^2 + a_{2n} x^{2n},$$

then $a_1 + a_3 + a_5 + \ldots\ldots\ldots + a_{2n-1}$ is equal to

A. $\frac{3^n + 1}{2}$

B. $\frac{3^n - 1}{2}$

C. $\frac{1 - 3^n}{2}$

D. $\frac{3^n}{2} - 1$

Answer: B

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5. If the coefficient of $(r+1)$ th term and $(r+3)$ th term in the expansion of $(1+x)^{20}$ are equal, then the value of r is

(i) 8

(ii) 9

(iii) 16

(iv) None of these

A. 8

B. 9

C. 16

D. None of these

Answer: B

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6. If the coefficients of rth term and $(r+4)$ th term the expansion of $(1+x)^{34}$ are equal then the value of r is

(i) 15

(ii) 17

(iii) 16

(iv) None of these

A. 15

B. 17

C. 16

D. None of these

Answer: C

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7. The 13 th term in the expansion of $\left(9x - \frac{1}{3\sqrt{x}}\right)^{18}, x > 0$ is

(i) ${}^{18}C_{12}x^3$

(ii) ${}^{18}C_{12}x^6$

(iii) ${}^{18}C_{12}\frac{1}{x^6}$

(iv) ${}^{18}C_{12}$

A. ${}^{18}C_{12}x^3$

B. ${}^{18}C_6x^6$

C. ${}^{18}C_{12}\frac{1}{x^6}$

D. ${}^{18}C_6$

Answer: D

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8. If rth term in the expansion of $\left(2x^2 - \frac{1}{x}\right)^{12}$ is independent of x, then the value of r is

(i) 7

(ii) 8

(iii) 9

(iv) 10

A. 7

B. 8

C. 9

D. 10

Answer: C

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9. The term independent of x in the expansion of $\left(2x - \frac{1}{x}\right)^{10}$ is

A. $^{10}C_5.2^5$

B. $^{10}C_6.2^4$

C. $^{10}C_6.2^5(-1)^5$

D. None of these

Answer: C

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10. The coefficients of x^p and $x^q(p, q \in N)$ in the expansion of $(1+x)^{p+q}$ are

A. equal

B. equal with opposite sign

C. reciprocal of each other

D. None of these

Answer: A

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11. The coefficients of x^{11} in the expansion of $\left(2x^2 + x - 3\right)^6$ is

A. 186

B. 190

C. 192

D. 196

Answer: C

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12. The ratio of the coefficient of x^3 to the term independent of x in $\left(2x + \frac{1}{x^2}\right)^{12}$ is

A. $9:8$

B. $8:9$

C. $8:1$

D. $9:1$

Answer: B

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13. The middle term in the expansion of $\left(\frac{x^3}{3}+3\right)^{10}$, $x \in R$ is 252, then values of x

are

A. (a) $-3, 3$

B. (b) $-4, 4$

C. (c) $-1, 1$

D. (d) $-2, 2$

Answer: C

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14. If the seventh, terms from the beginning and the end in the expansion of $\left(\sqrt[3]{2}+\frac{1}{\sqrt[3]{3}}\right)^{n}$ are equal, then n is equal to

(i) 10

(ii) 11

(iii) 12

(iv) 13

A. 10

B. 11

C. 12

D. 13

Answer: C

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15. 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) $4PQ$

A. P^2-Q^2

B. P^2+Q^2

C. $2\left(P^2+Q^2\right)$

D. $4PQ$

Answer: C

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16. The coefficient of x^5 in the expansion of

$1 + (1 + x) + (1 + x)^2 + \ldots\ldots\ldots + (1 + x)^{10}$

is equal to

A. 462

B. 450

C. 543

D. 446

Answer: A

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

A. $n = 2r$

B. $n = 3r$

C. $n = 2r + 1$

D. $2r - 1$

Answer: A

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18. The two consecutive terms in the expansion of $(1+x)^{24}$ whose coefficients are in the ratio 1:4 are

A. (a) 3rd and 4th

B. (b) 4th and 5th

C. (c) 5th and 6th

D. (d) 6th and 7th

Answer: C

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19. The coefficients fo x^n in the expansion of $(1+x)^{2n}$ and $(1+x)^{2n-1}$ are in the ratio

A. $1:2$

B. $1:3$

C. $3:1$

D. $2:1$

Answer: D

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20. If the sum of the binomial coefficient in the expansion of $\left(2x + \frac{1}{x}\right)^n$ is 256, then the term independent of x is

(i) 1120

(ii) 1024

(iii) 512

(iv) None of these

A. 1120

B. 1024

C. 512

D. None of these

Answer: A

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21. If the middle term in the expansion of $\left(\frac{1}{x}+x\sin x\right)^{10}$ is equal to $7\frac{7}{8}$, then the value of x is

(i) $2n\pi+\frac{\pi}{6}$

(ii) $n\pi+\frac{\pi}{6}$

(iii) $n\pi+(-1)^n\frac{\pi}{6}$

(iv) $n\pi+(-1)^n\frac{\pi}{3}$

A. $2n\pi + \frac{\pi}{6}$

B. $n\pi + \frac{\pi}{6}$

C. $n\pi + (-1)^n \frac{\pi}{6}$

D. $n\pi + (-1)^n \frac{\pi}{3}$

Answer: C

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Exercise 13 A

1. What is the number of terms in the expansion of the following?

$\left[(x-2)^3\right]^3$

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2. What is the number of terms in the expansion of each of the following?

(ii) $(5a+7b)^3$

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3. What is the number of terms in the expansion of the following?

$$\left(6x - \frac{1}{x^3}\right)^{17}$$

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4. What is the number of terms in the expansion of the following?

$$\left(4x^2 + 12xy + 9y^2\right)^9$$

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5. What is the number of terms in the expansion of

$$(3+2\sqrt{5})^{18}-(3-2\sqrt{5})^{18}$$

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6. What is the number of terms in the expansion of each of the following?

(vi) $(5+7x)^{15}+(5-7x)^{15}$

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7. What is the number of terms in the expansion of the following?

$(a+bx)^{17}-(a-bx)^{17}$

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8. Write out the expansions of the following:

$(3x-y)^4$

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9. Write out the expansions of the following:

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

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10. Write out the expansions of the following:

(c) $\left(x - \frac{y}{2}\right)^4$

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11. Write out the expansion of the following:

$$\left(2x + \frac{y}{2}\right)^5$$

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12. Write out the expansions of the following:

(e) $(1 + 2x)^7$

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13. Write out the expansions of the following:

(f) $\left(\frac{2}{x}-\frac{x}{2}\right)^5, x \neq 0$

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14. Using binomial theorem, expand $\left[(x+y)^5+(x-y)^5\right]$ and hence find the value of $\left[\left(\sqrt{3}+1\right)^5-\left(\sqrt{3}-1\right)^5\right]$.

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15. Expand $(2+x)^5-(2-x)^5$ in ascending powers of x and simplify your result.

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16. Evaluate the following:

(i) $\left(2+\sqrt{5}\right)^5+\left(2-\sqrt{5}\right)^5$

(ii) $\left(\sqrt{3}+1\right)^5-\left(\sqrt{3}-1\right)^5$

Hence, show in (ii), without using tables, that the value of $\left(\sqrt{3}+1\right)^5$ lies between 152 and 153.

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17. If the first three terms in the expansion of $(1+ax)^n$ in ascending powers of x are $1+12x+64x^2$, find n and a.

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18. Find the first three terms in the expansion of $[2+x(3+4x)]^5$ in ascending powers of x.

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19. Expand $\left(1+2x+3x^2\right)^n$ in a series of ascending powers of x up to and including the term in x^2.

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20. Write down the expansion by the binomial theorem of $\left(3x-\frac{y}{2}\right)^4$. By giving x and y suitable values, deduce the value of $(29.5)^4$ correct to four significant figures.

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21. Using binomial theorem, evaluate : $(999)^3$.

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22. Write down in terms of x and n, the term containing x^3 in the expansion of $\left(1-\frac{x}{n}\right)^n$ by the binomial theorem. if this term equals $\frac{7}{8}$ when $x=-2$, and n is a positive integer, calculate the value of n.

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23. (i) Obtain the binomial expansion of $(2-\sqrt{3})^6$ in the form $a+b\sqrt{3}$, where a and b are integers. State the corresponding result for the expansion $(2+\sqrt{3})^6$

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24. Find the coefficient of x^5 in the expansion of $(1+2x)^6(1-x)^7$.

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25. 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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26. Let n be a positive integer. If the coefficients of 2nd, 3rd, 4th terms in the expansion of $(1+x)^n$ are in A.P., then find the value of n.

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27. In the binomial expansion of $\left(\sqrt[3]{4}+\sqrt{2}\right)^{5}$ find the term which does not contain Irrational expression.

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Exercise 13 B

1. Find the specified term of the expression in each of the following binomials:

(i) Fifth term of $(2a + 3b)^{12}$. Evaluate it when $a = \frac{1}{3}, b = \frac{1}{4}$.

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2. Find the specified term of the expression in each of the following binomials:

(ii) Sixth term of $\left(2x - \frac{1}{x^2}\right)^7$.

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3. Find the specified term of the expression in each of the following binomials:

(iii) Middle term of $\left(2x - \frac{1}{y}\right)^8$.

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4. Find the specified term of the expression in each of the following binomials:

(iv) Middle term of $\left(x^4 - \frac{1}{x^3}\right)^{11}$.

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5. Find the specified term of the expression in each of the following binomials:

(v) Middle term of $\left(\frac{x^2}{4} - \frac{4}{x^2}\right)^{10}$

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

(i) $\left(x - \frac{1}{x}\right)^{14}$

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

(ii) $\left(\sqrt{\frac{x}{3}} - \frac{\sqrt{3}}{2x}\right)^{12}$

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8. 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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9. Find the coefficient of

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

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10. Find the coefficient of

(ii) x^7 in the expansion of $\left(x^2 + \frac{1}{x}\right)^{11}$

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11. Find the coefficient of

(iii) $\frac{1}{x^{17}}$ in the expansion of $\left(x^4 - \frac{1}{x^3}\right)^{15}$.

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12. Find the coefficient of

(iv) x^4 in the expansion of $\left(\frac{x}{2} - \frac{3}{x^2}\right)^{10}$.

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13. If the coefficients of x^2 and x^3 in the expansion of $(3+ax)^9$ are the same, find the value of a.

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14. Write down the fourth term in the binomial expansion of $\left(px+\frac{1}{x}\right)^n$. If this term is independent of x, find the value of n. With this value of n, calculate the value of p given that the fourth term is equal to $\frac{5}{2}$.

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15. The expansion by the binomial theorem of $\left(2x+\frac{1}{8}\right)^{10}$ is $1024x^{10}+640x^{9}+ax^{8}+bx^{7}+...$ Calculate

(i) the numerical value of a and b

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16. The expansion by the binomial theorem of $\left(2x+\frac{1}{8}\right)^{10}$ is

$1024x^{10} + 640x^9 + ax^8 + bx^7 + \ldots$ Calculate

(ii) coefficient of x^8 in $(3x - 2)\left(2x + \frac{1}{8}\right)^{10}$,

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17. The expansion by the binomial theorem of $\left(2x + \frac{1}{8}\right)^{10}$ is $1024x^{10} + 640x^9 + ax^8 + bx^7 + \ldots$ Calculate

(iii) the value of x, for which the third ·and the fourth terms in the expansion of $\left(2x + \frac{1}{8}\right)^{10}$ are equal.

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

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19. In a binomial expansion, $(x + a)^n$, the first three terms are $1, 56$ and 1372 respectively. Find values of x and a.

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20. Write 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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21. The coefficients of $(2r+1)$th and $(r+2)$ th terms in the expansions of $(1+x)^{43}$ are equal. Find the value of r.

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22. The coefficient of the middle term in the binomial expansion in powers of x of $(1+\alpha x)^4$ and of $(1-\alpha x)^6$ is the same if α equals

A. A. $\frac{-3}{10}$

B. B. $\frac{10}{3}$

C. C. $\frac{-5}{3}$

D. D. $\frac{3}{5}$

Answer: A

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23. Find the sixth term of the expansion of $\left(y^{1/2}+x^{1/3}\right)^{n}$, if the binomial coefficient of the third term from the end is 45.

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24. Show that the coefficient of the middle term in the expansion of $(1+x)^{2n}$ is the sum

of the coefficients of two middle terms in the expansion of $(1+x)^{2n-1}$.

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25. 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 $n \in N$.

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26. Find the coefficient of x^5 in the expansion of $1+(1+x)+(1+x)^2+\ldots+(1+x)^{10}$.

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27. If x^p occurs in the expansion of $\left(x^2+\frac{1}{x}\right)^{2n}$, 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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28. If P be the sum of odd terms and Q be the sum of even terms in the expansion of $(x+a)^n$, prove that

(i) $p^2 - Q^2 = \left(x^2 - a^2\right)^n$

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

(ii) $4PQ = (x+a)^{2n} - (x-a)^{2n}$ and

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

(iii) $2\left(P^2+Q^2\right)=(x+a)^{2n}+(x-a)^{2n}$.

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31. If the coefficient of the rth, $(r+1)th$ and $(r+2)th$ terms in the expansion of $(1+x)^n$ are in A.P., prove that $n^2-n(4r+1)+4r^2-2=0$.

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32. In the expansion of $\left(x^2 + \frac{1}{x}\right)^n$, the coefficient of the fourth term is equal to the coefficient of the ninth term. Find n and the sixth term of the expansion.

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33. The coefficient of x^n in the expansion of $(1+x)(1-x)^n$ is

A. $(-1)^{n-1}(n-1)^2$

B. $(-1)^n(1-n)$

C. $n-1$

D. $(-1)^{n-1}.n$

Answer: B

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Chapter Test

1. Expand $\left(\frac{2}{x} - \frac{x}{2}\right)^5, x \neq 0.$

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2. Using binomial theorem, write the value of $(a+b)^6 + (a-b)^6$ and hence find the value of $\left(\sqrt{3}+\sqrt{2}\right)^6 + \left(\sqrt{3}-\sqrt{2}\right)^6$.

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3. Find the 9th term in the expansion of $\left(3x - \frac{1}{2x}\right)^8, x \neq 0.$

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

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

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6. In the binomial expansion of $(1+x)^{m+n}$, prove that the coefficients of x^m and x^n are equal.

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7. Use binomial theorem to evaluate $(10.1)^5$.

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8. Examine whether or not there is any term containing x^9 in the expansion of $\left(2x^2 - \frac{1}{x}\right)^{20}$.

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9. 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

A. (a) $\frac{n-5}{6}$

B. (b) $\frac{n-4}{5}$

C. (c) $\frac{5}{n-4}$

D. (d) $\frac{6}{n-5}$

Answer: B

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10. If $m = {}^{n}C_{2},$ then ${}^{m}C_{2}$ is equal to

A. $3.\ {}^{n}C_{4}$

B. ${}^{n+1}C_{4}$

C. $3.\ {}^{n+1}C_{4}$

D. $3.\ {}^{n+1}C_{3}$

Answer: C

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11. If the coefficient of r^{th} and $(r+4)^{th}$ terms are equal in the expansion of $(1+x)^{20}$, then the value of r will be

A. (a) 7

B. (b) 8

C. (c) 9

D. (d) 10

Answer: C

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12. If

$(1+x-2x^2)^6 = 1 + a_1x + a_2x^2 + \ldots + a_{12}x^{12}$

, then find $a_2 + a_4 + \ldots + a_{12}$

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13. If the coefficients of x^2 and x^3 in the expansion of $(3+ax)^9$ be same, then the value of a is

A. (a) $\frac{3}{7}$

B. (b) $\frac{7}{3}$

C. (c) $\frac{7}{9}$

D. (d) $\frac{9}{7}$

Answer: D

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14. Using binomial theorem, the value of $(0.999)^3$ correct to 3 decimal places is

A. (a) 0.999

B. (b) 0.998

C. (c) 0.997

D. (d) 0.995

Answer: C

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