



## MATHS

### BOOKS - VIKAS GUPTA MATHS (HINGLISH)

### SEQUENCE AND SERIES

#### Exercise Single Choice Problems

1. If  $a, b, c$  are positive real numbers such that  $a + b + c = 1$ , then the greatest value of  $(1-a)(1-b)(1-c)$ , is

A. 1

B.  $\frac{2}{3}$

C.  $\frac{8}{27}$

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

**Answer: C**



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2. If  $xyz = (1 - x)(1 - y)(1 - z)$  Where  $0 \leq x, y, z \leq 1$ , then the minimum value of  $x(1 - z) + y(1 - x) + z(1 - y)$  is

A.  $\frac{3}{2}$

B.  $\frac{1}{4}$

C.  $\frac{3}{4}$

D.  $\frac{1}{2}$

Answer: C



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3. If  $\sec(\alpha - 2\beta), \sec \alpha, \sec(\alpha + 2\beta)$  are in arithmetical progression then  $\cos^2 \alpha = \lambda \cos^2 \beta$  ( $\beta \neq n\pi, n \in I$ ), the value of  $\lambda$  is:

A. 1

B. 2

C. 3

D.  $\frac{1}{2}$

**Answer: B**



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4. Let  $a, b, c, d, e$  are non-zero and distinct positive real numbers. If  $a, b, c$  are in A.P.,  $b, c, d$  are in G.P. and  $c, d, e$  are in H.P., then  $a, c, e$  are in :

A. A.P.

B. G.P.

C. H.P.

D. Nothing can be said

**Answer: B**



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5. if  $(m + 1)th$ ,  $(n + 1)th$  and  $(r + 1)th$  term of an AP are in GP. and  $m$ ,  $n$  and  $r$  in HP. . find the ratio of first term of A.P to its common difference

A.  $-\frac{n}{2}$

B.  $-n$

C.  $-2n$

D.  $+n$

**Answer: A**



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6. If the equation  $x^4 - 4x^3 + ax^2 + bx + 1 = 0$  has four positive roots, then the value of  $(a + b)$  is :

A.  $-4$

B.  $2$

C. 6

D. can not be determined

**Answer: B**



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7. If  $S_1$ ,  $S_2$  and  $S_3$  are the sums of first  $n$  natural numbers, their squares

and their cubes respectively, then  $\frac{S_1^4 S_2^2 - S_2^2 S_3^2}{S_1^2 + S_2^2} =$

A. 4

B. 2

C. 1

D. 0

**Answer: D**



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8. If  $S_n = \frac{1 \cdot 2}{3!} + \frac{2 \cdot 2^2}{4!} + \frac{3 \cdot 2^3}{5!} + \dots$  upto n terms then the sum infinite terms is

A. 1

B.  $\frac{2}{3}$

C.  $e$

D.  $\frac{\pi}{4}$

**Answer: A**



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9. If  $\tan\left(\frac{\pi}{12} - x\right), \tan\left(\frac{\pi}{12}\right), \tan\left(\frac{\pi}{12} + x\right)$  in G.P. then sum of all the solutions in  $[0, 314]$  is  $k\pi$ . Find k

A. 4950

B. 5050

C. 2525

D. 5010

Answer: A

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10. Let  $S_n = 1 + 2 + 3 + \dots + n$  and  $P_n = \frac{S_2}{S_2 - 1} \frac{S_3}{S_3 - 1} \frac{S_4}{S_4 - 1} \frac{S_n}{S_n - 1}$

Where  $n \in \mathbb{N}$ , ( $n \geq 2$ ). Then  $(\lim)_{x \rightarrow \infty} P_n = \dots$

A.  $\frac{1}{3}$

B. 1

C. 3

D. 0

Answer: C

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11. If  $a > 0, b > 0, c > 0$  are respectively the  $p^{\text{th}}, q^{\text{th}}, r^{\text{th}}$  terms of a G.P.,

Then the value of the determinant  $\begin{vmatrix} \log a & p & 1 \\ \log b & q & 1 \\ \log c & r & 1 \end{vmatrix}$  is

A.  $-1$

B.  $2$

C.  $1$

D.  $0$

**Answer: D**



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12. The numbers of natural numbers  $< 300$  that are divisible by 6 but not by 9 :

A.  $49$

B.  $37$



C. 33

D. 16

**Answer: C**



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13. If  $x, y, z > 0$  and  $x + y + z = 1$  then  $\frac{xyz}{(1-x)(1-y)(1-z)}$  is necessarily.

A.  $\geq 8$

B.  $\leq \frac{1}{8}$

C. 1

D. None of these

**Answer: B**



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14. If the roots of the equation  $px^2 + qx + r = 0$ , where  $2p, q, 2r$  are in G.P, are of the form  $\alpha^2, 4\alpha - 4$ . Then the value of  $2p + 4q + 7r$  is :

A. 82

B. 10

C. 14

D. 18

**Answer: A**



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15. Let  $x_1, x_2, x_3, \dots, x_k$  be the divisors of positive integer  $n$  (including 1 and  $x$ ). If  $x_1 + x_2 + \dots + x_k = 75$ , then  $\sum_{i=1}^k \frac{1}{x_i}$  is equal to

A.  $\frac{75}{k}$

B.  $\frac{75}{n}$

C.  $\frac{1}{n}$

D.  $\frac{1}{75}$

**Answer: B**



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16. If  $a_1, a_2, a_3, \dots, a_n$  are in H.P. and  $f(k) = \sum_{r=1}^n a_r - a_k$ , then

$\frac{a_1}{f(1)}, \frac{a_2}{f(2)}, \dots, \frac{a_n}{f(n)}$  are in :

A. A.P.

B. G.P.

C. H.P.

D. None of these

**Answer: C**



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17. if  $\alpha, \beta$  be roots of equation  $375x^2 - 25x - 2 = 0$  and  $s_n = \alpha^n + \beta^n$

then  $\lim_{n \rightarrow \infty} \left( \sum_{r=1}^n S_r \right) = \dots\dots$

A.  $\frac{1}{12}$

B.  $\frac{1}{4}$

C.  $\frac{1}{3}$

D. 1

**Answer: A**



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18. If  $a_i, i = 1, 2, 3, 4$  be four real members of same sign, then the

minimum value of  $\sum \left( \frac{a_i}{a_j} \right), i, j \in \{1, 2, 3, 4\}, i \neq j$  is : (a) 6 (b) 8 (c) 12

(d) 24

A. 6

B. 8

C. 12

D. 24

**Answer: C**



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19. Given that  $x, y, z$  are positive reals such that  $xyz = 32$ . The minimum value of  $x^2 + 4xy + 4y^2 + 2z^2$  is equal to :

A. 64

B. 256

C. 96

D. 216

**Answer: C**



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20. In an A.P. five times the fifth term is equal to eight times its eight term.

Then the sum of the first twenty five terms is equal to :

A. 25

B.  $\frac{25}{2}$

C.  $-25$

D. 0

**Answer: D**



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21. Let  $\alpha, \beta$  be two distinct values of  $x$  lying in  $(0, \pi)$  for which

$\sqrt{5} \sin x, 10 \sin x, 10(4 \sin^2 x + 1)$  are 3 consecutive terms of a G.P. Then

minimum value of  $|\alpha - \beta| =$

A.  $\frac{\pi}{10}$

B.  $\frac{\pi}{5}$

C.  $\frac{2\pi}{5}$

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

**Answer: B**

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22. In an infinite G.P. the sum of first three terms is 70. If the extreme terms are multiplied by 4 and the middle term is multiplied by 5, the resulting terms form an A.P. then the sum to infinite terms of G.P. is :

A. 120

B. 40

C. 160

D. 80

**Answer: D**

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23. Find the  $\sum_{k=1}^{\infty} \sum_{n=1}^{\infty} \frac{k}{2^{n+k}}$ .

A. 5

B. 4

C. 3

D. 2

**Answer: D**



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24. Let  $p, q, r \in R^+$  and  $27pqr \geq (p + q + r)^3$  and  $3p + 4q + 5r = 12$  then  $p^3 + q^4 + r^5$  is equal to

A. 3

B. 6

C. 2



D. 4

**Answer: A**



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25. Find the sum of the infinite series  $\frac{1}{9} + \frac{1}{18} + \frac{1}{30} + \frac{1}{45} + \frac{1}{63} + \dots$

A.  $\frac{1}{3}$

B.  $\frac{1}{4}$

C.  $\frac{1}{5}$

D.  $\frac{2}{3}$

**Answer: A**



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26. If  $S_r$  denotes the sum of  $r$  terms of an A.P. and  $\frac{S_a}{a^2} = \frac{S_b}{b^2} = c$ . Then

$$S_c = \text{(A) } c^3 \text{ (B) } \frac{c}{a}b \text{ (C) } abc \text{ (D) } a + b + c$$

A.  $c^2$

B.  $c^3$

C.  $c^4$

D.  $abc$

**Answer: B**



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27. In an infinite  $G. P.$  second term is  $x$  and its sum is 4, then complete set of values of  $x$  is in

A.  $(-8, 0)$

B.  $\left[-\frac{1}{8}, \frac{1}{8}\right) - \{0\}$

C.  $\left[-1, -\frac{1}{8}\right) \cup \left(\frac{1}{8}, 1\right]$

D.  $(-8, 1] - \{0\}$

**Answer: D**



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**28.** The number of terms of an A.P. is odd. The sum of the odd terms  $(1^{st}, 3^{rd} \text{ etc,})$  is 248 and the sum of the even terms is 217. The last term exceeds the first by 56 then :

- A. the number of terms is 17
- B. the first term is 3
- C. the number of terms is 13
- D. the first term is 1

**Answer: B**



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29. Let  $A_1, A_2, A_3, \dots, A_n$  be squares such that for each  $n \geq 1$  the length of a side of  $A_n$  equals the length of a diagonal of  $A_{n+1}$ . If the side of  $A_1$  be 20 units then the smallest value of 'n' for which area of  $A_n$  is less than 1.

A. 7

B. 8

C. 9

D. 10

**Answer: D**

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30. Let  $S_k = \lim_{n \rightarrow \infty} \sum_{i=0}^n \frac{1}{(k+1)^i}$ . Then  $\sum_{k=1}^n kS_k$  equals

A.  $\frac{n(n+1)}{2}$

B.  $\frac{n(n-1)}{2}$

C.  $\frac{n(n+2)}{2}$

D.  $\frac{n(n+3)}{2}$

**Answer: D**



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31. The sum of the series  $\frac{2}{1.2} + \frac{5}{2.3}2^1 + \frac{10}{3.4}2^2 + \frac{17}{4.5}2^3 + \dots$  upto  $n$  terms is equal :

A.  $\frac{n2^n}{n+1}$

B.  $\left(\frac{n}{n+1}\right)2^n + 1$

C.  $\frac{n2^n}{n+1} - 1$

D.  $\frac{(n-1)2^2}{n+1}$

**Answer: A**



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32. If  $(1.5)^{30} = k$ , then the value of  $\sum_{(n=2)}^{29} (1.5)^n$ , is :

A.  $2k - 3$

B.  $k + 1$

C.  $2k + 7$

D.  $2k - \frac{9}{2}$

**Answer: D**



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33. Suppose that  $n$  arithmetic means are inserted between the numbers 7 and 49. If the sum of these means is 364 then the sum of their squares is

A. 11

B. 12

C. 12

D. 14

**Answer: C**



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**34.** The third term of a G.P. is 2. Then the product of the first five terms, is :

A.  $2^3$

B.  $2^4$

C.  $2^5$

D. None of these

**Answer: C**



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**35.** The sum of first  $n$  terms of an A.P. is  $5n^2 + 4n$ , its common difference

is :

A. 9

B. 10

C. 3

D.  $-4$

**Answer: B**



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**36.** If  $x + y = a$  and  $x^2 + y^2 = b$ , then the value of  $(x^3 + y^3)$ , is

A.  $ab$

B.  $a^2 + b$

C.  $a + b^2$

D.  $\frac{3ab - a^3}{2}$

**Answer: D**



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37. If  $S_1, S_2, S_3, \dots, S_n$  are the sum of infinite geometric series whose first terms are  $1, 3, 5, \dots, (2n - 1)$  and whose common ratios are  $\frac{2}{3}, \frac{2}{5}, \dots, \frac{2}{2n + 1}$  respectively, then

$$\left\{ \frac{1}{S_1 S_2 S_3} + \frac{1}{S_2 S_3 S_4} + \frac{1}{S_3 S_4 S_5} + \dots \text{upon infinite terms} \right\} =$$

- A.  $\frac{1}{15}$
- B.  $\frac{1}{60}$
- C.  $\frac{1}{12}$
- D.  $\frac{1}{3}$

**Answer: B**

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38. Sequence  $\{t_n\}$  of positive terms is a G.P If  $t_6, 5, t_{14}$  form another G.P in that order then the product  $t_1 t_2 t_3 \dots t_{18} t_{19}$  is equal to

A.  $10^9$

B.  $10^{10}$

C.  $10^{17/2}$

D.  $10^{19/2}$

**Answer: D**



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39. The minimum value of  $\frac{(A^2 + A + 1)(B^2 + B + 1)(C^2 + C + 1)}{ABCD}$

where  $A, B, C, D > 0$  is :

A.  $\frac{1}{3^4}$

B.  $\frac{1}{2^4}$

C.  $2^4$

D.  $3^4$

**Answer: D**



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40. if  $\sum_1^{20} r^3 = a$ ,  $\sum_1^{20} r^2 = b$  then sum of products of 1,2,3,4,...,20 taking

two at a time is :

A.  $\frac{a - b}{2}$

B.  $\frac{a^2 - b^2}{2}$

C.  $a - b$

D.  $a^2 - b^2$

Answer: A



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41. The sum of first  $2n$  terms of an  $AP$  is  $\alpha$ . and the sum of next  $n$  terms is  $\beta$ , its common difference is

A.  $\frac{\alpha - 2\beta}{3n^2}$

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

C.  $\frac{x - 2y}{3n}$

D.  $\frac{2y - x}{3n}$

**Answer: B**



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42. The number of non-negative integers 'n' satisfying  $n^2 = p + q$  and  $n^3 = p^2 + q^2$  where p and q are integers

A. 2

B. 3

C. 4

D. Infinite

**Answer: B**



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43. Concentric circles of radii  $1, 2, 3, \dots, 100\text{cm}$  are drawn. The interior of the smallest circle is colored red and the angular regions are colored alternately green and red, so that no two adjacent regions are of the same color. Then, the total area of the green regions in sq. cm is equal to  $1000\pi$  b.  $5050\pi$  c.  $4950\pi$  d.  $5151\pi$

A.  $1000\pi$

B.  $5050\pi$

C.  $4950\pi$

D.  $5151\pi$

**Answer: B**



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44. If  $\log_2(4)$ ,  $\log_{\sqrt{2}}(8)$  and  $\log_3(9k - 1)$  are consecutive terms of a geometric sequence, then the number of integers that satisfy the system

of inequalities  $x^2 - x > 6$  and  $|x| < k^2$  is

A. 193

B. 194

C. 195

D. 196

**Answer: A**



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**45.** Let  $T_r$  be the  $r$ th term of an A.P. whose first term is  $-1/2$  and common

difference is 1, then  $\sum_{r=1}^n \sqrt{1 + T_r T_{r+1} T_{r+2} T_{r+3}}$

A.  $\frac{n(n+1)(2n+1)}{6} - \frac{5n}{4}$

B.  $\frac{n(n+1)(2n+1)}{6} - \frac{5n}{4} + \frac{1}{4}$

C.  $\frac{n(n+1)(2n+1)}{6} - \frac{5n}{4} + \frac{1}{2}$

D.  $\frac{n(n+1)(2n+1)}{12} - \frac{5n}{8} + 1$

**Answer: C**

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46. If  $\sum_{r=1}^n T_r = \frac{n(n+1)(n+2)}{3}$ , then  $\lim_{x \rightarrow \infty} \sum_{r=1}^n \frac{2008}{T_r} =$

A. 2008

B. 3012

C. 4016

D. 8032

**Answer: A**

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47. The sum of the infinite series,

$$1^2 - \frac{2^2}{5} + \frac{3^2}{5^3} + \frac{3^2}{5^3} + \frac{5^2}{5^4} - \frac{6^2}{5^5} + \dots \text{ is:}$$

A.  $\frac{1}{2}$

B.  $\frac{25}{24}$

C.  $\frac{25}{54}$

D.  $\frac{125}{252}$

**Answer: C**



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**48.** The absolute term in  $P(x) =$

$\sum_{r=1}^n \left(x - \frac{1}{r}\right) \left(x - \frac{1}{r+1}\right) \left(x - \frac{1}{r+2}\right)$  as  $n$  approaches to infinity is :

A.  $\frac{1}{2}$

B.  $\frac{-1}{2}$

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

D.  $\frac{-1}{4}$

**Answer: D**





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49. Suppose A, B, C are defined as  $A = a^2b + ab^2 - a^2c - ac^2$ ,  $B = b^2c + bc^2 - a^2b - ab^2$ , and  $C = a^2c + ac^2 - b^2c - bc^2$ , where  $a > b > c > 0$  and the equation  $Ax^2 + Bx + C = 0$  has equal roots, then a, b, c are in

A. A.P.

B. G.P.

C. H.P.

D. None of these

Answer: C



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50. It  $T_k$  denotes the  $k^{th}$  term of an H.P. from the beginning and  $\frac{T_2}{T_6} = 9$ , then  $\frac{T_{10}}{T_4}$  equals :

A.  $\frac{17}{5}$

B.  $\frac{5}{17}$

C.  $\frac{7}{19}$

D.  $\frac{19}{7}$

**Answer: B**



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51. Number of terms common to the two sequences

17, 21, 25, ..... , 417 and 16, 21, 26, ..... , 466 is

A. 19

B. 20

C. 21

D. 22

**Answer: B**

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52. The sum of the series  
 $1 + \frac{2}{3} + \frac{1}{3^2} + \frac{2}{3^3} + \frac{1}{3^4} + \frac{2}{3^5} + \frac{1}{3^6} + \frac{2}{3^7} + \dots$  upto infinite terms  
is equal to :

A.  $\frac{15}{8}$

B.  $\frac{8}{15}$

C.  $\frac{27}{8}$

D.  $\frac{21}{8}$

**Answer: A**

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53. The coefficient of  $x^8$  in the polynomial  
 $(x - 1)(x - 2)(x - 3)\dots(x - 10)$  is :

A. 2640

B. 1320

C. 1370

D. 2740

**Answer: B**



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54. Let  $\alpha = \lim_{x \rightarrow \infty} \left( (1^3 - 1^2) + (2^3 - 2^2) + \dots + \frac{n^3 n^2}{\pi^4} \right)$ , then  $\alpha$  is

equal is:

A.  $\frac{1}{3}$

B.  $\frac{1}{4}$

C.  $\frac{1}{2}$

D. non-existent

**Answer: B**



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55. If  $16x^4 - 32x^3 + ax^2 + bx + 1 = 0$ ,  $a, b \in R$  has positive real roots only, then  $a - b$  is equal to :

A.  $-32$

B.  $32$

C.  $49$

D.  $-49$

Answer: B



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56. if ABC is a triangle and  $\tan\left(\frac{A}{2}\right), \tan\left(\frac{B}{2}\right), \tan\left(\frac{C}{2}\right)$  are in H.P.

Then find the minimum value of  $\cot\left(\frac{B}{2}\right)$

A.  $\sqrt{3}$

B. 1

C.  $\frac{1}{\sqrt{2}}$

D.  $\frac{1}{\sqrt{3}}$

**Answer: A**



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57. If  $\alpha$  and  $\beta$  are the roots of the quadratic equation  $4x^2 + 2x - 1 = 0$

then the value of  $\sum_{r=1}^{\infty} (\alpha^r + \beta^r)$  is :

A. 2

B. 3

C. 6

D. 0

**Answer: D**



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58. The sum of the series  $(2)^2 + 2(4)^2 + 3(6)^2 + \dots$  upto 10 terms is

A. 11300

B. 12100

C. 12300

D. 11200

**Answer: B**



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59. If  $a$  and  $b$  are positive real numbers such that  $a + b = c$ , then the

minimum value of  $\left(\frac{4}{a} + \frac{1}{b}\right)$  is equal to :

A.  $\frac{2}{3}$

B.  $\frac{1}{3}$

C. 1

D.  $\frac{3}{2}$

**Answer: D**



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60. The first term of an infinite G.R is the value of satisfying the equation  $\log_4(4^x - 15) + x - 2 = 0$  and the common ratio is  $\cos\left(2011\frac{\pi}{3}\right)$  The sum of G.P is ?

A. 1

B.  $\frac{4}{3}$

C. 4

D. 2

**Answer: C**



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61. Let  $a, b, c$  be positive numbers, then the minimum value of

$$\frac{a^4 + b^4 + c^2}{abc}$$

A. 4

B.  $2^{3/4}$

C.  $\sqrt{2}$

D.  $2\sqrt{2}$

**Answer: D**



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62. If  $xy = 1$ , then minimum value of  $x^2 + y^2$  is :

A. 1

B. 2

C.  $\sqrt{2}$

D. 4

**Answer: B**



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63. Find the value of

$$\frac{2}{1^3} + \frac{6}{1^3 + 2^3} + \frac{12}{1^3 + 2^3 + 3^3} + \frac{20}{1^3 + 2^3 + 3^3 + 4^3} + \dots \text{ upto } 60$$

terms :

A. 2

B.  $\frac{1}{2}$

C. 4

D.  $\frac{1}{4}$

**Answer: C**



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64. 
$$\sum_{n=1}^{\infty} \frac{1}{(n+1)(n+2)(n+3)\dots(n+k)}$$

A.  $\frac{1}{(k-1)(k-1)!}$

B.  $\frac{1}{k \cdot kl}$

C.  $\frac{1}{(-1)kl}$

D.  $\frac{1}{kl}$

**Answer: C**



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**65.** Consider two positive numbers  $a$  and  $b$ . If arithmetic mean of  $a$  and  $b$  exceeds their geometric mean by  $3/2$ , and geometric mean of  $a$  and  $b$  exceeds their harmonic mean by  $6/5$  then the value of  $a^2 + b^2$  will be

A. 150

B. 153

C. 156

D. 159

**Answer: D**



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66. Sum of first 10 terms of the series,

$$S = \frac{7}{2^2 \cdot 5^2} + \frac{13}{5^2 \cdot 7^2} + \frac{19}{8^2 \cdot 11^2} + \dots \text{ is :}$$

A.  $\frac{255}{1024}$

B.  $\frac{88}{1024}$

C.  $\frac{264}{1024}$

D.  $\frac{85}{1024}$

**Answer: D**



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67.  $\sum_{r=1}^{10} \frac{r}{1 - 3r^2 + r^4}$

A.  $-\frac{50}{109}$

B.  $-\frac{54}{109}$

C.  $-\frac{55}{111}$

D.  $-\frac{55}{109}$

**Answer: D**



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68. The  $r$ th term of a series is given by  $t_r = \frac{r}{1 + r^2 + r^4}$ , then

$$\lim (n \rightarrow \infty) \sum_{r=1}^n (t_r)$$

A.  $\frac{1}{2}$

B. 1

C. 2

D.  $\frac{1}{4}$

**Answer: A**



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69. The sum to infinity of the series

$$1 + \frac{4}{5} + \frac{7}{5^2} + \frac{10}{5^3} + \dots, \text{ is}$$

A.  $\frac{31}{12}$

B.  $\frac{41}{16}$

C.  $\frac{45}{16}$

D.  $\frac{35}{16}$

Answer: D



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70. The third term of a G.P. is 2. Then product of the first five terms, is :

A.  $2^3$

B.  $2^4$

C.  $2^5$

D. None of these

**Answer: C**

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71. If  $x_1, x_2, x_3, \dots, x_{2n}$  are in A.P, then  $\sum_{r=1}^{2n} (-1)^{r+1} x_r^2$  is equal to

A.  $\frac{n}{(2n-1)} (x_1^2 - x_{2n}^2)$

B.  $\frac{2n}{(2n-1)} (x_1^2 - x_{2n}^2)$

C.  $\frac{n}{(n-1)} (x_1^2 - x_{2n}^2)$

D.  $\frac{n}{(2n+1)} (x_1^2 - x_{2n}^2)$

**Answer: A**

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72. Let two numbers have arithmetic mean 9 and geometric mean 4. Then these numbers are roots of the equation (a)  $x^2 + 18x + 16 = 0$  (b)  $x^2 - 18x - 16 = 0$  (c)  $x^2 + 18x - 16 = 0$  (d)  $x^2 - 18x + 16 = 0$

A.  $x^2 + 18x + 16 = 0$

B.  $x^2 - 18x - 16 = 0$

C.  $x^2 + 18x - 16 = 0$

D.  $x^2 - 18x + 16 = 0$

**Answer: D**



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73. If  $p$  and  $q$  are positive real numbers such that  $p^2 + q^2 = 1$ , then the maximum value of  $p+q$  is

A. 2

B.  $\frac{1}{2}$



C.  $\frac{1}{\sqrt{2}}$

D.  $\sqrt{2}$

**Answer: D**



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**74.** A person is to count 4500 currency notes. Let  $a_n$  denote the number of notes he counts in the  $n$ th minute. If  $a_1 = a_2 = \dots = a_{10} = 150$  and  $a_{10}, a_{11}, \dots$  are in A.P. with common difference 2, then the time taken by him to count all notes is (1) 34 minutes (2) 125 minutes (3) 135 minutes (4) 24 minutes

A. 34 minutes

B. 24 minutes

C. 125 minutes

D. 35 minutes

**Answer: A**



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75. A non constant arithmetic progression has common difference  $d$  and first term is  $(1 - ad)$  If the sum of the first 20 term is 20, then the value of  $a$  is equal to :

A.  $\frac{2}{19}$

B.  $\frac{19}{2}$

C.  $\frac{2}{9}$

D.  $\frac{9}{2}$

**Answer: B**



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76. The value of  $\sum_{n=3}^{\infty} \frac{1}{n^5 - 5n^3 + 4n}$  is equal to -

A.  $\frac{1}{120}$

B.  $\frac{1}{96}$

C.  $\frac{1}{24}$

D.  $\frac{1}{144}$

**Answer: B**



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77. Find the value of

$$\frac{2}{1^3} + \frac{6}{1^3 + 2^3} + \frac{12}{1^3 + 2^3 + 3^3} + \frac{20}{1^3 + 2^3 + 3^3 + 4^3} + \dots \text{ upto infinite terms}$$

A. 2

B.  $\frac{1}{2}$

C. 4

D.  $\frac{1}{4}$

**Answer: C**



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78. The minimum value of the expression  $2^x + 2^{2x+1} + \frac{5}{2^x}$ ,  $x \in R$  is :

A. 7

B.  $(7.2)^{1/7}$

C. 8

D.  $(3.10)^{1/3}$

Answer: C



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79. 
$$\sum_{r=1}^{\infty} \frac{(4r + 5)5^{-r}}{r(5r + 5)}$$

A.  $\frac{1}{5}$

B.  $\frac{2}{5}$

C.  $\frac{1}{25}$

D.  $\frac{2}{25}$

**Answer: A**



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**Exercise One Or More Than One Answer Is Are Correct**

1. If first and  $(2n - 1)^{th}$  terms of an AP, GP. and HP. are equal and their  $n^{th}$  terms are  $a, b, c$  respectively, then (a)  $a=b=c$  (b)  $a+c=b$  (c)  $a>b>c$  and  $ac - b^2 = 0$  (d) none of these

A.  $a + c = 2b$

B.  $a \geq b \geq c$

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

D.  $ac = b^2$

**Answer: B::D**



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2. If  $a, b, c$  are distinct positive real numbers such that the quadratic expression  $Q_1(x) = ax^2 + bx + c$ ,

$Q_2(x) = bx^2 + cx + a$ ,  $Q_3(x) = cx^2 + x + b$  are always non-negative,

then possible integer in the range of the expression  $y = \frac{a^2b^2 + c^2}{ab + bc + ca}$  is

A. 1

B. 2

C. 3

D. 4

**Answer: B::C**

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3. If  $a, b, c$  are in H.P, where  $a > c > 0$ , then :

A.  $b > \frac{a + c}{2}$

$$B. \frac{1}{a-b} - \frac{1}{b-c} < 0$$

$$C. ac > b^2$$

D.  $bc(1-a)$ ,  $ac(1-b)$ ,  $ab(1-c)$  are in A.P.

**Answer: B::C::D**

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4. In an A.P. let  $T_r$  denote  $r^{\text{th}}$  term from beginning,

$$T_p = \frac{1}{q(p+q)}, T_q = \frac{1}{p(p+q)}, \text{ then :}$$

A.  $T_1 =$  common difference

$$B. T_{p+q} = \frac{1}{pq}$$

$$C. T_{pq} = \frac{1}{p+q}$$

$$D. T_{p+q} = \frac{1}{p^2q^2}$$

**Answer: A::B::C**

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5. Which of the following statement (s) is (are) correct ?

A. Sum of the reciprocal of all the  $n$  harmonic means inserted between  $a$  and  $b$  is equal to  $n$  times the harmonic mean between two given numbers  $a$  and  $b$ .

B. Sum of the cubes of first  $n$  natural number is equal to square of the sum of the first  $n$  natural numbers.

C. If  $a, A_1, A_2, A_3, \dots, A_{2n}, b$  are in A.P. then  $\sum_{l=1}^{2n} A_l = n(a + b)$ .

D. If the first term of the geometric progression  $g_1, g_2, g_3, \dots, \infty$  is unity, then the value of the common ratio of the progression such that  $(4g_2 + 5g_3)$  is minimum equals  $\frac{2}{5}$ .

**Answer: B::C**



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6. If  $a, b, c$  are in 3 distinct numbers in H.P.  $a, b, c > 0$ , then :

A.  $\frac{b+c-a}{a}, \frac{a+b-c}{b}, \frac{a+b-c}{c}$  are in AP

B.  $\frac{b+c}{a}, \frac{c+a}{b}, \frac{a+b}{c}$  ar in A.P.

C.  $a^5 + c^5 \geq 2b^5$

D.  $\frac{a-b}{b-c} = \frac{a}{c}$

Answer: A::B::C::D



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7. All roots of equation  $x^5 - 40x^4 + \alpha x^3 + \beta x^2 + \gamma x + \delta = 0$  are in G.P.

if the sum of their reciprocals is 10, then  $\delta$  can be equal to :

A. 32

B. - 32

C.  $\frac{1}{32}$

D.  $-\frac{1}{32}$

**Answer: A::B**



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8. Let  $a_1, a_2, a_3, \dots$  be a sequence of non-zero real numbers which are in A.P. for  $k \in \mathbb{N}$ . Let  $f_k(x) = a_k x^2 + 2a_{k+1}x + a_{k+2}$

A.  $f_k(x) = 0$  has real roots for each  $k \in \mathbb{N}$ .

B. Each of  $f_k(x) = 0$  has one root in common.

C. Non-common roots of  $f_1(x) = 0, f_2(x) = 0, f_3(x) = 0, \dots$

from an A.P.

D. None of these

**Answer: A::B**



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9. Given  $a, b, c$  are in A.P.  $b, c, d$  are in G.P. and  $c, d, e$  are in H.P. if  $a = 2$  and  $e = 18$ , then the possible value of 'c' can be :

A. 9

B.  $-6$

C. 6

D.  $-9$

**Answer: B::C**



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10. The number  $a, b, c$  in that order form a term A.P and  $a + b + c = 60$ .

The number  $(a - 2), b, (c + 3)$  in that order form a three G.P. All possible values of  $(a^2 + b^2 + c^2)$  is/are

A. 1218

B. 1208

C. 1288

D. 1298

**Answer: B::D**



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11.

If

$$(x^2 + x + 1) + (x^2 + 2x + 3) + (x^2 + 3x + 5) + \dots + (x^2 + 20x + 39)$$

then x is equal to :

A. 10

B. - 10

C. 20.5

D. - 20.5

**Answer: A::D**



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12. For  $\triangle ABC$ , if  $81 + 144a^4 + 16b^4 + 9c^4 = 144abc$ , (where notations have their usual meaning), then :

A.  $a > b > c$

B.  $A < B < C$

C. Area of  $\triangle ABC = \frac{3\sqrt{3}}{8}$

D. Triangle ABC is right angled

**Answer: B::C::D**



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13. Let  $x, y, z \in \left(0, \frac{\pi}{2}\right)$  are first three consecutive terms of an arithmetic

progression such that

$\cos x + \cos y + \cos z = 1$  and  $\sin x + \sin y + \sin z = \frac{1}{\sqrt{2}}$ , then

which of the following is/are correct ?

A.  $\cot y = \sqrt{2}$

$$B. \cos(x - y) = \frac{\sqrt{3} - \sqrt{2}}{2\sqrt{2}}$$

$$C. \tan 2y = \frac{2\sqrt{2}}{3}$$

$$D. \sin(x - y) + \sin(y - z) = 0$$

**Answer: A::B**



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**14.** If the number 16, 20, 16,  $d$  form a A.G.P. then  $d$  can be equal to :

A. 3

B. 11

C. - 8

D. - 16

**Answer: D**



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15. If  $S_r = \sqrt{r + \sqrt{r + \sqrt{r + \sqrt{\dots\infty}}}}$ ,  $r > 0$  then which the following is\are correct.

- A.  $S_2, S_6, S_{13}, S_{20}$  are in A.P.
- B.  $S_4, S_9, S_{16}$  are irrational
- C.  $(2S_3 - 1)^2, (2S_4 - 1)^2, (2S_2 - 1)^2$  are in A.P.
- D.  $S_2, S_{12}, S_{36}$  are in G.P.

**Answer: A::B::C::D**



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16. Consider the A.P. 50, 48, 46, 44,..... If  $S_n$  denotes the sum to n terms of this A.P. then

- A.  $S_n$  is maximum for  $n = 25$
- B. the first negative terms is  $26^{th}$  term
- C. the first negative term is  $27^{th}$  term

D. the maximum value of  $S_n$  is 650

Answer: A::C::D



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17. Let  $S_n$  be the sum to  $n$  terms of the series

$$\frac{2}{1^2} + \frac{5}{1^2 + 2^2} + \frac{7}{1^2 + 2^2 + 3^2} + \frac{9}{1^2 + 2^2 + 3^2 + 6^2} + \dots \text{ then}$$

A.  $S_5 = 5$

B.  $S_{50} = \frac{100}{17}$

C.  $\left( S_{1001} = \frac{1001}{97} \right)$

D.  $S_\infty = 6$

Answer: A::B::D



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18. For  $\Delta ABC$ , if  $81 + 144a^4 + 16b^4 + 9c^4 = 144abc$ , (where notations have their usual meaning), then :

A.  $a > b > c$

B.  $A < B < C$

C. Area of  $\Delta ABC = \frac{3\sqrt{3}}{8}$

D. Triangle ABC is right angled

**Answer: B::C::D**



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## Exercise Comprehension Type Problems

1. The first four terms of a sequence are given by

$T_1 = 0, T_2 = 1, T_3 = 1, T_4 = 2$ . The  $\geq \neq$  raltermsisgivenby

$T_n = A\alpha^{n-1} + B\beta^{n-1}$  where  $A, B$  alpha, beta

$\alpha \in \mathbb{R}$  and  $A$  is positive. The value of  $(\alpha^2 + \beta^2) + \alpha\beta$  is equal to :

A. 1

B. 2

C. 5

D. 4

**Answer: B**



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2. The first four terms of a sequence are given by

$T_1 = 0, T_2 = 1, T_3 = 1, T_4 = 2$ . The  $\geq n$  terms is given by

$T_n = A\alpha^{n-1} + B\beta^{n-1}$  where  $A, B, \alpha, \beta$

are  $\in \mathbb{R}$  and  $A$  is positive. The value of  $5(A^2 + B^2)$  is equal to :

A. 2

B. 4

C. 6

D. 8

**Answer: A**



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3. There are two sets A and B each of which consists of three numbers in A.P. whose sum is 15 and where  $D$  and  $d$  are the common differences such that  $D - d = 1$ . If  $\frac{p}{q} = \frac{7}{8}$ , where  $p$  and  $q$  are the product of the numbers, respectively, and  $d > 0$  in the two sets .

The sum of the product of the numbers in set B taken two at a time is

A. 51

B. 71

C. 74

D. 86

**Answer: B**



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4. There are two sets A and B each of which consists of three numbers in A.P. whose sum is 15 and where D and d are the common differences such that  $D - d = 1$ . If  $\frac{p}{q} = \frac{7}{8}$ , where p and q are the product of the numbers, respectively, and  $d > 0$  in the two sets .

The sum of the product of the numbers in set B taken two at a time is

A. 52

B. 54

C. 64

D. 74

**Answer: D**



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5. Let  $x, y, z$  are positive reals and  $x + y + z = 60$  and  $x > 3$ .

Maximum value of  $(x - 3)(y + 1)(x + 5)$  is :

A.  $(17)(21)(25)$

B.  $(20)(21)(23)$

C.  $(21)(21)(21)$

D.  $(23)(19)(15)$

**Answer: C**



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6. Let  $x, y, z$  are positive reals and  $x + y + z = 60$  and  $x > 3$ .

Maximum value of  $(x - 3)(2y + 1)(3z + 5)$  is:

A.  $\frac{(355)^3}{3^3 \cdot 6^2}$

B.  $(355)^3$

C.  $\frac{(355)^3}{3^2 \cdot 6^3}$

D. None of these

**Answer: A**



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7. Let  $x, y, z$  are positive reals and  $x + y + z = 60$  and  $x > 3$ .

Maximum value of  $xyz$  is :

A.  $8 \times 10^3$

B.  $27 \times 10^3$

C.  $64 \times 10^3$

D.  $125 \times 10^3$

**Answer: A**



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8. Two consecutive number from  $n$  natural numbers  $1, 2, 3, \dots, n$  are removed. Arithmetic mean of the remaining numbers is  $\frac{105}{4}$ .

The value of  $n$  is:

A. 48

B. 50

C. 52

D. 49

**Answer: B**



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9. Two consecutive number from  $n$  natural numbers  $1, 2, 3, \dots, n$  are removed. Arithmetic mean of the remaining numbers is  $\frac{105}{4}$ .

The G.M. of the removed numbers is :

A.  $\sqrt{30}$

B.  $\sqrt{42}$

C.  $\sqrt{56}$

D.  $\sqrt{72}$

**Answer: C**



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**10.** Two consecutive number from  $n$  natural numbers  $1, 2, 3, \dots, n$  are removed. Arithmetic mean of the remaining numbers is  $\frac{105}{4}$ .

Let removed numbers are  $x_1, x_2$  then  $x_1 + x_2 + n =$

A. 61

B. 63

C. 65

D. 69

**Answer: C**



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11. The sequence  $\{a_n\}$  is defined by formula  $a_0 = 4$  and  $a_{m+1} = a_n^2 - 2a_n + 2$  for  $n \geq 0$ . Let the sequence  $\{b_n\}$  is defined by formula  $b_0 = \frac{1}{2}$  and  $b_n = \frac{2a_0a_1a_2 \dots a_{n-1}}{\forall n \geq 1}$ .

The value of  $a_{10}$  is equal to :

A.  $1 + 2^{1024}$

B.  $4^{1024}$

C.  $1 + 3^{1024}$

D.  $6^{1024}$

**Answer: C**

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12. The sequence  $\{a_n\}$  is defined by formula  $a_0 = 4$  and  $a_{m+1} = a_n^2 - 2a_n + 2$  for  $n \geq 0$ . Let the sequence  $\{b_n\}$  is

defined by formula  $b_0 = \frac{1}{2}$  and  $b_n = \frac{2a_0a_1a_2 \dots a_{n-1}}{\forall n \geq 1}$ .

The value of  $n$  which  $b_n = \frac{3280}{3281}$  is :

A. 2

B. 3

C. 4

D. 5

**Answer: B**

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13. The sequence  $\{a_n\}$  is defined by formula

$a_0 = 4$  and  $a_{m+1} = a_n^2 - 2a_n + 2$  for  $n \geq 0$ . Let the sequence  $\{b_n\}$  is

defined by formula  $b_0 = \frac{1}{2}$  and  $b_n = \frac{2a_0a_1a_2 \dots a_{n-1}}{\forall n \geq 1}$ .

The sequence  $\{b_n\}$  satisfies the recurrence formula :

A.  $b_{n+1} = \frac{2b_n}{1 - b_n^2}$

B.  $b_{n+1} = \frac{2b_n}{1 + b_n^2}$

C.  $\frac{b_n}{1 + b_n^2}$

D.  $\frac{b_n}{1 - b_n^2}$

**Answer: B**



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**14.**

Let

$$f(n) = \sum_{r=2}^n \frac{r}{{}^{\textcircled{R}}C_{2r+1}C_2}, a = \lim_{x \rightarrow \infty} f(n) \text{ and } x^2 - \left(2n - \frac{1}{2}\right)x + t = 0$$

has two positive roots  $\alpha$  and  $\beta$ .

If value of  $f(7) + f(8)$  is  $\frac{p}{q}$  where  $p$  and  $q$  are relatively prime, then

$(p - q)$  is :

A. 53

B. 55

C. 57

D. 59

Answer: D



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15.

Let

$$f(n) = \sum_{r=2}^n \frac{r}{{}^r C_2 {}^{r+1} C_2}, a = \lim_{x \rightarrow \infty} f(n) \text{ and } x^2 - \left(2n - \frac{1}{2}\right)x + t = 0$$

has two positive roots  $\alpha$  and  $\beta$ .

minimum value of  $\frac{4}{\alpha} + \frac{1}{\beta}$  is :

A. 2

B. 6

C. 3

D. 4

Answer: B



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16. Given the sequence of numbers  $x_1, x_2, x_3, \dots, x_{1005}$  which satisfy

$$\frac{x_1}{x_1 + 1} = \frac{x_2}{x_2 + 3} = \frac{x_3}{x_3 + 5} = \dots = \frac{x_{1005}}{x_{1005} + 2009}.$$

Also,

$$x_1 + x_2 + \dots + x_{1005} = 2010. \text{ Nature of the sequence is}$$

A. A.P.

B. G.P.

C. A.G.R

D. H.R.

**Answer: A**



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17. Given that sequence of number  $a_1, a_2, a_3, \dots, a_{1005}$  which satisfy

$$\frac{a_1}{a_1 + 1} = \frac{a_2}{a_2 + 3} + \frac{a_3}{a_3 + 5} = \dots = \frac{a_{1005}}{a_{1005} + 2009}$$

$a_1 + a_2 + a_3 + \dots + a_{1005} = 2010$  find the  $21^{st}$  term of the sequence is

equal to :

A.  $\frac{86}{1065}$

B.  $\frac{83}{1005}$

C.  $\frac{82}{1005}$

D.  $\frac{79}{1005}$

**Answer: C**



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### Exercise Subjective Type Problems

1. Let  $a, b, c, d$  be four distinct real numbers in A.P. Then half of the smallest positive value of  $k$  satisfying  $a(a - b) + k(b - c)^2 = (c - a)^3 = 2(a - x) + (b - d)^2 + (c - d)^3$  is \_\_\_\_\_.



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2. The sum of all digits of  $n$  for which  $\sum_{r=1}^n r2^r = 2 + 2^{n+10}$  is :

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3. If  $\lim_{x \rightarrow \infty} \frac{r+2}{2^{r+1}r(r+1)} = \frac{1}{k}$ , then  $k =$

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4. The value of  $\sum_{r=1}^{\infty} \frac{8r}{4r^4 + 1}$  is equal to :

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5. Three non-zero real numbers from an A.P. and the squares of these numbers taken in same order from a G.P. Then, the number of all possible value of common ratio of the G.P. is

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6. The sum of the fourth and twelfth term of an arithmetic progression is 20. What is the sum of the first 15 terms of the arithmetic progression?

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7. In an increasing sequence of four positive integers, the first 3 terms are in A.P., the last 3 terms are in G.P. and the fourth term exceed the first term by 30, then the common difference of A.P. lying in interval  $[1, 9]$  is:

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8. The limit of  $\frac{1}{n^4} \sum_{k=1}^n k(k+2)(k+4)$  as  $n \rightarrow \infty$  is equal to  $\frac{1}{\lambda}$ , then  $\lambda =$

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9. Which is the last digit of  $1 + 2 + 3 + \dots + n$  if the last digit of  $1^3 + 2^3 + \dots + n^3$  is 1?

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10. Three distinct positive numbers,  $a, b, c$  are in G.P. while  $\log_c a, \log_b c, \log_a b$  are in A.P. with non-zero common difference  $d$ , then  $2d =$

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11. The numbers  $\frac{1}{3}, \frac{1}{3}\log_x y, \frac{1}{3}\log_y z, \frac{1}{7}\log_x x$  are in H.P. If  $y = x^{\otimes}$  and  $z = x^s$ , then  $4(r + s) =$

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12. If  $\sum_{k=1}^{\infty} \frac{k^2}{3^k} = \frac{p}{q}$ , where  $p$  and  $q$  are relatively prime positive integers.

Find the value of  $(p + q)$ ,



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13. The sum of the terms of an infinitely decreasing Geometric Progression (GP) is equal to the greatest value of the function  $f(x) = x^3 + 3x - 9$  where  $x \in [-4, 3]$  and the difference between the first and second term is  $f'(0)$ . The common ratio  $r = \frac{p}{q}$  where  $p$  and  $q$  are relatively prime positive integers. Find  $(p + q)$ .



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14. A cricketer has to score 4500 runs. Let  $a_n$  denotes the number of runs he scores in the  $n^{th}$  match. If  $a_1 = a_2 = \dots a_{10} = 150$  and  $a_{10}, a_{11}, a_{12}, \dots$  are in A.P. with common difference  $(-2)$ . If  $N$  be the

total number of matches played by him to score 4500 runs. Find the sum of the digits of  $N$ .

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15. If  $x = 10 \sum_{r=3}^{100} \frac{1}{(r^2 - 4)}$ , then  $[x] =$

(where  $[.]$  denotes greatest integer function)

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16. Let  $f(n) = \frac{4n + \sqrt{4n^2 + 1}}{\sqrt{2n + 1} + \sqrt{2n - 1}}$ ,  $n \in N$  then the remainder when  $f(1) + f(2) + f(3) + \dots + f(60)$  is divided by 9 is.

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17. Find the sum of series  $1 + \frac{1}{2} + \frac{1}{3} + \frac{1}{4} + \frac{1}{6} + \frac{1}{8} + \frac{1}{9} + \frac{1}{12} + \dots + \infty$ , where the term are

the reciprocals of the positive integers whose only prime factors are two's and three's :

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18. Let  $a_1, a_2, a_3, \dots, a_n$  be real numbers in arithmetic progression such that  $a_1 = 15$  and  $a_2$  is an integer. Given

$\sum_{r=1}^{10} (a_r)^2 = 1185$ . If  $S_n = \sum_{r=1}^n a_r$  and maximum value of  $n$  is  $N$  for which  $S_n \geq S_{(n+1)}$ , then find  $N - 10$ .

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19. Let the roots of the equation  $24x^3 - 14x^2 + kx + 3 = 0$  form a geometric sequence of real numbers. If absolute value of  $k$  lies between the roots of the equation  $x^2 + \alpha^2x - 122 = 0$ , then the largest integral value of  $\alpha$  is :

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20. How many ordered pair (s) satisfy

$$\log\left(x^2 + \frac{1}{3}y^3 + \frac{1}{9}\right) = \log x + \log y$$

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21. The value of  $xyz$  is 55 or  $343/55$  according as the sequence  $a,x,yz,b$  is an H.P or A.P Find the sum  $(a+b)$  given that  $a$  and  $b$  are positive integers

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