

MATHS

BOOKS - ARIHANT MATHS (ENGLISH)

DETERMINANTS

Examples

1. Find the value of the determinant

$$\begin{vmatrix} 1 & 2 & 4 \\ 3 & 4 & 9 \\ 2 & -1 & 6 \end{vmatrix}$$



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2. If $\Delta = \begin{vmatrix} 1 & \sin \theta & 1 \\ -\sin \theta & 1 & \sin \theta \\ -1 & -\sin \theta & 1 \end{vmatrix}$ prove that $2 \leq \Delta \leq 4$.



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3. Expand $\begin{vmatrix} 3 & 2 & 5 \\ 9 & -1 & 4 \\ 2 & 3 & -5 \end{vmatrix}$ by Sarrus rule.



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4. If $a, b, c \in \mathbb{R}$, find the number of real root of the equation

$$\begin{vmatrix} x & c & -b \\ -c & x & a \\ b & -a & x \end{vmatrix} = 0$$



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5. Expand $\begin{vmatrix} 1 & 2 & 3 \\ 4 & 6 & 2 \\ 5 & 9 & 4 \end{vmatrix}$



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6. Find the value of the determinant

$$\begin{vmatrix} -1 & 2 & 1 \\ 3 + 2\sqrt{2} & 2 + 2\sqrt{2} & 1 \\ 3 - 2\sqrt{2} & 2 - 2\sqrt{2} & 1 \end{vmatrix}$$



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7. Find the determinants of minors of the determinant

$$\begin{vmatrix} 1 & 2 & 3 \\ -4 & 3 & 6 \\ 2 & -7 & 9 \end{vmatrix}$$



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8. If the value of a third order determinant is 11, find the value of the square of the determinant formed by the cofactors.



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9. Evaluate

$$\begin{vmatrix} 13 & 16 & 19 \\ 14 & 17 & 20 \\ 15 & 18 & 21 \end{vmatrix}.$$



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10. Prove that $\begin{vmatrix} \alpha & \beta & \gamma \\ \theta & \phi & \psi \\ \lambda & \mu & \nu \end{vmatrix} = \begin{vmatrix} \beta & \mu & \phi \\ \alpha & \lambda & \theta \\ \gamma & \nu & \psi \end{vmatrix}.$



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11. Using properties of determinants, prove that

$$|b + cq + ry + zc + ar + pz + xc + bp + qx + y| = 2 |apxbqyrcz|$$



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12. Solve for x,

$$\begin{vmatrix} 4x & 6x + 2 & 8x + 1 \\ 6x + 2 & 9x + 3 & 12x \\ 8x + 1 & 12x & 16x + 2 \end{vmatrix} = 0$$



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13. Using properties of determinants, prove that :

$$\begin{vmatrix} a^2 + 1 & ab & ac \\ ba & b^2 + 1 & bc \\ ca & cb & c^2 + 1 \end{vmatrix} = a^2 + b^2 + c^2 + 1$$



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14. If a,b, and c are all different and if

$$\begin{vmatrix} a & a^2 & 1 + a^3 \\ b & b^2 & 1 + b^3 \\ c & c^2 & 1 + c^3 \end{vmatrix} = 0 \text{ Prove that } abc = -1.$$



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15. find the largest value of a third- order determinant whose elements are 0 or 1.



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16. Find the largest value of a third order determinant whose elements are 0 or -1.



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17. Show that the value of a third order determinant whose all elements are 1 or -1 is an even number.



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18. Evaluate
$$\begin{vmatrix} 1 & 2 & 3 \\ -2 & 3 & 2 \\ 3 & 4 & -4 \end{vmatrix} \times \begin{vmatrix} -2 & 1 & 3 \\ 3 & -2 & 1 \\ 2 & 1 & -2 \end{vmatrix}$$
. Using the concept of multiplication of determinants.



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19.

If

$$ax_{12} + by_{12} + cz_{12} = ax_{22} + by_{22} + cz_{22} = ax_{32} + by_{32} + cz_{32} = d, \text{ where } ax$$

then prove that $|x_1y_1z_1x_2y_2z_2x_3y_3z_3| = (d-f)\left\{\frac{(d+2f)}{abc}\right\}^{1/2}$



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20. Prove that $\begin{vmatrix} a_1\alpha_1 + b_1\beta_1 & a_1\alpha_2 + b_1\beta_2 & a_1\alpha_3 + b_1\beta_3 \\ a_2\alpha_1 + b_2\beta_1 & a_2\alpha_2 + b_2\beta_2 & a_2\alpha_3 + b_2\beta_3 \\ a_3\alpha_1 + b_3\beta_1 & a_3\alpha_2 + b_3\beta_2 & a_3\alpha_3 + b_3\beta_3 \end{vmatrix} = 0.$



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21. Prove that

$$\begin{vmatrix} 2 & \alpha + \beta + \gamma + \delta & \alpha\beta + \gamma\delta \\ \alpha + \beta + \gamma + \delta & 2(\alpha + \beta)(\gamma + \delta) & \alpha\beta(\gamma + \delta) + \gamma\delta(\alpha + \beta) \\ \alpha\beta + \gamma\delta & \alpha\beta(\gamma + \delta) + \gamma\delta(\alpha + \beta) & 2\alpha\beta\gamma\delta \end{vmatrix}$$



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22. For all values of A, B, C and P, Q, R show that
 $|\cos(A-P)\cos(A-Q)\cos(A-R)\cos(B-P)\cos(B-Q)\cos(B-R)\cos(C-P)\cos(C-Q)\cos(C-R)|$



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23. If α, β, γ are real numbers, then without expanding at any stage, show that

$$|\cos(\beta - \alpha)\cos(\gamma - \alpha)\cos(\alpha - \beta) \cos(\gamma - \beta)\cos(\alpha - \gamma)\cos(\beta - \gamma)| = 1$$



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24. Solve the following system of equation by Cramer's rule.

$$x+y=4 \text{ and } 3x-2y=9$$



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25. Solve the following system of equation by Cramer's rule.

$$x+y+z=9$$

$$2x+5y+7z=52$$

$$2x+y-z=0$$



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26. For what values of p and q the system od equations

$$x+y+z=6$$

$$x+2y+3z=10$$

$$x+2y+pz=q$$
 has

- (i) unique sollution ?
- (ii) an infinitely many solutions ?
- (iii) no solution ?



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27. If the following equations

$$x + y - 3z = 0, (1 + \lambda)x + (2 + \lambda)y - 8z = 0, x - (1 + \lambda)y + (2 + \lambda)z = 0$$

are consistent then the value of λ is



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28. The equation $(\lambda - 1)x + (3\lambda + 1)y + 2\lambda z = 0$.

$$(\lambda - 1)x + (4\lambda - 2)y + (\lambda + 3)z = 0$$

and

$$2x + (3\lambda + 1)y + 3(\lambda - 1)z = 0$$

gives non-trivial solution for some values of λ , then the ratio $x : y : z$ when λ has the smallest of these values :

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29. Given $x=cy+bz$, $y=az+cx$ and $z=bx+ay$, then prove $a^2 + b^2 + c^2 + 2abc = 1$.

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30. If $f(x) = \begin{vmatrix} \sin x & \cos x & \sin x \\ \cos x & -\sin x & \cos x \\ x & 1 & 1 \end{vmatrix}$ find the value of $2[f'(0)] + [f'(1)]^2$

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31. Let $f(x) = \begin{vmatrix} \cos x & \sin x & \cos x \\ \cos 2x & \sin 2x & 2 \cos 2x \\ \cos 3x & \sin 3x & 3 \cos 3x \end{vmatrix}$ then find the value of $f'\left(\frac{\pi}{2}\right)$.

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32. Let α be a repeated root of a quadratic equation $f(x) = 0$ and $A(x), B(x), C(x)$ be polynomials of degrees 3, 4, and 5, respectively, then show that $|A(x)B(x)C(x)A(\alpha)B(\alpha)C(\alpha)A'(\alpha)B'(\alpha)C'(\alpha)|$ is divisible by $f(x)$, where prime (') denotes the derivatives.



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33. If $\Delta(x) = \begin{vmatrix} \alpha + x & \theta + x & \lambda + x \\ \beta + x & \varphi + x & \mu + x \\ \gamma + x & \psi + x & v + x \end{vmatrix}$ show that $\Delta'(x) = 0$ and $\Delta(0) + Sx$, where S denotes the sum of all the cofactors of all elements in $\Delta(0)$ and dash denotes the derivative with respect of x .



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34. if $= \begin{vmatrix} x^n & n! & 2 \\ \cos x & \cos \frac{n\pi}{2} & 4 \\ \sin x & \sin \frac{n\pi}{2} & 8 \end{vmatrix}$, then find the value of $\frac{d^n}{dx^n}[f(x)]_{x=0}$. ($n \in \mathbb{Z}$).



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35. If $\Delta(x) = \begin{vmatrix} a & b & c \\ 6 & 4 & 3 \\ x & x^2 & x^3 \end{vmatrix}$ then find $\int_0^1 \Delta(x) dx$.



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36.

Let

$$f(x) = |\sec x \cos x \sec^2 x + \cot x \cos x \sec x \cos^2 x \cos x|^2$$

. Prove that $\int_0^{\pi/2} f(x) dx = -\frac{\pi}{4} - \frac{8}{15}$.



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37. Let $\text{Delta}_r = \left| rx \frac{n(n+1)}{2} 2r - 1yn^2 3r - 2z \frac{n(3n-1)}{2} \right|$. Show that $\sum_{r=1}^n \text{Delta}_r = 0$



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38. Let n be a positive integer and

$$\Delta_r = \begin{vmatrix} r^2 + r & r + 1 & r - 2 \\ 2r^2 + 3r - 1 & 3r & 3r - 3 \\ r^2 + 2r + 3 & 2r - 1 & 2r - 1 \end{vmatrix} \text{ and}$$

$$\sum_{r=1}^n \Delta_r = an^2 + bn + c \text{ find the value of } a+b+c.$$



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39.

if

$$(x_1 - x_2)^2 + (y_1 - y_2)^2 = a^2, (x_2 - x_3)^2 + (y_2 - y_3)^2 = b^2, (x_3 - x_1)^2 + (y_3 - y_1)^2 = c^2$$

where a, b, c are positive then prove that

$$4 \begin{vmatrix} x_1 & y_1 & 1 \\ x_2 & y_2 & 1 \\ x_3 & y_3 & 1 \end{vmatrix} = (a + b + c)(b + c - a)(c + a - b)(a + b - c)$$

A. 1

B. 2

C. 4

D. 8

Answer:



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40. If a, b, c are complex numbers and $z = \begin{vmatrix} 0 & -b & -c \\ \bar{b} & 0 & -a \\ \bar{c} & \bar{a} & 0 \end{vmatrix}$ then show that z is purely imaginary

A. a non-zero real number

B. purely imaginary

C. 0

D. None of these

Answer:



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41. The equation

$$\begin{vmatrix} (1+x)^2 & (1-x)^2 & -(2+x^2) \\ 2x+1 & 3x & 1-5x \\ x+1 & 2x & 2-3x \end{vmatrix} + \begin{vmatrix} (1+x)^2 & 2x+1 & x+1 \\ (1-x)^2 & 3x & 2x \\ 1-2x & 3x-2 & 2x-3 \end{vmatrix} = 0$$

- A. no real solution
- B. 4 real solution
- C. two real and two non-real solutions
- D. infinite number of solution real or non-real

Answer:



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42. If X, Y and Z are positive numbers such that Y and Z have respectively 1 and 0 at their unit's place and Δ is the determinant

$$\begin{vmatrix} X & 4 & 1 \\ Y & 0 & 1 \\ Z & 1 & 0 \end{vmatrix}$$

If $(\Delta + 1)$ is divisible by 10, then x has at its unit's place

A. 0

B. 1

C. 2

D. 3

Answer:



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43. The number of distinct values of a 2×2 determinant whose entries are from the set $\{-1, 0, 1\}$, is

A. 3

B. 4

C. 5

D. 6

Answer:



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44. Consider the polynomial function

$$f(x) = \begin{vmatrix} (1+x)^2 & (1+2x)^b & 1 \\ 1 & (1+x)^a & (1+2x)^b \\ (1+2x)^b & 1 & (1+x)^a \end{vmatrix}$$

a,b being positive integers.

Which of the following is true ?

A. constant term in $f(x)$ is 4

B. constant term in $f(x)$ is 0

C. constant term in $f(x)$ is $(a-b)$

D. constant term in $f(x)$ is $(a+b)$

Answer:



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45. Let $\Delta_a = \begin{vmatrix} (a-1) & n & 6 \\ (a-1)^2 & 2n^2 & 4n-2 \\ (a-1)^3 & 3n^3 & 3n^2 - 3n \end{vmatrix}$ the value of $\sum_{a=1}^n \Delta_a$ is

A. 0

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

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

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

Answer:



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46. If $\Delta(x) = \begin{vmatrix} 1 & \cos x & 1 - \cos x \\ 1 + \sin x & \cos x & 1 + \sin x - \cos x \\ \sin x & \sin x & 1 \end{vmatrix}$ then $\int_0^{\pi/2} \Delta(x) \, dx$

is equal to

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

B. 0

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

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

Answer: A



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47. Number of values of a for which the system of equations

$ax + (2 - a)y = 4 + a^2$ and $ax + (2a-1)y = a^5 - 2$ possess no solution is

A. 0

B. 1

C. 2

D. infinite

Answer:



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48. The value of determinant $\begin{vmatrix} a^2 & a^2 - (b - c)^2 & bc \\ b^2 & b^2 - (c - a)^2 & ca \\ c^2 & c^2 - (a - b)^2 & ab \end{vmatrix}$ is

A. $a+b+c$

B. $(a+b)(b+c)(c+a)$

C. $a^2 + b^2 + c^2$

D. $(a-b)(b-c)(c-a)$

Answer:



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49. The value of θ lying between $-\frac{\pi}{4}$ and $\frac{\pi}{2}$ and $0 \leq A \leq \frac{\pi}{2}$ and satisfying the equation

$$\begin{vmatrix} 1 + \sin^2 A & \cos^2 A & 2 \sin 4\theta \\ \sin^2 A & 1 + \cos^2 A & 2 \sin 4\theta \\ \sin^2 A & \cos^2 A & 1 + 2 \sin 4\theta \end{vmatrix} = 0 \text{ are}$$

A. $A = \frac{\pi}{4}, \theta = -\frac{\pi}{8}$

B. $A = \frac{3\pi}{8} = \theta$

C. $A = \frac{\pi}{5}, \theta = -\frac{\pi}{8}$

D. $A = \frac{\pi}{6}, \theta = -\frac{3\pi}{8}$

Answer:



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50. The digits A,B,C are such that the three digit numbers A88, 6B8, 86C are divisible by 72 the determinant

$$\begin{vmatrix} A & 6 & 8 \\ 8 & B & 6 \\ 8 & 8 & C \end{vmatrix} \text{ is divisible by}$$

A. 72

B. 144

C. 288

D. 216

Answer:



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51. If p, q, r and s are in AP and $f(x) = \begin{vmatrix} p + \sin x & q + \sin x & q - r + \sin x \\ q + \sin x & r + \sin x & -1 + \sin x \\ r + \sin x & s + \sin x & s - q + \sin x \end{vmatrix}$

such that

$$\int_0^1 f(x) dx = -2, \text{ the common difference of the AP can be}$$

A. -1

B. 1/2

C. 1

D. 2

Answer:



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52. Find the value of a and b if the system of equation $a^2x - by = a^2 - b$ and $bx - b^2y = 2 + 4b$ (i) posses unique solution (ii) infinite solutions

A. $a=1, b=-1$

B. $a=1, b=-2$

C. $a=-1, b=-1$

D. $a=-1, b=-2$

Answer:



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53. If $\Delta_r = \begin{vmatrix} r & r-1 \\ r-1 & r \end{vmatrix}$ where r is a natural number, the value of $\sqrt[10]{\sum_{r=1}^{1024} \Delta_r}$ is

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54. If P, Q and R are the angles of a triangle the value of $\begin{vmatrix} \tan P & 1 & 1 \\ 1 & \tan Q & 1 \\ 1 & 1 & \tan R \end{vmatrix}$ is

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55. Expand $\begin{vmatrix} 2 & 0 \\ 3x & 6 \end{vmatrix}$

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56. Suppose a, b and c are distinct and x, y and z are connected by the system of equations

$$x + ay + a^2z = a^3, x + by + b^2z = b^3 \text{ and } x + cy + c^2z = c^3.$$

	Column I		Column II
(A)	For $x = 1, y = 2$ and $z = 3, (a + b + c)^{-(ab + bc + ca)}$ is divisible by	(p)	3
(B)	For $x = 4, y = 3$ and $z = 2, (ab + bc + ca)^{abc}$ is divisible by	(q)	6
(C)	For $x = 6, y = 4$ and $z = 2, (abc)^{a+b+c}$ is divisible by	(r)	9
		(s)	12



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57. Consider the determinant

$$f(x) = \begin{vmatrix} 0 & x^2 - a & x^3 - b \\ x^2 + a & 0 & x^2 + c \\ x^4 + b & x - c & 0 \end{vmatrix}$$

Statement -1 $f(x) = 0$ has one root $x = 0$.

Statement -2 The value of skew-symmetric determinant of odd order is always zero.



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58. A determinant of second order is made with the elements 0 and 1.

Find the number of determinants with non-negative values.



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59. Prove that $\begin{vmatrix} 1+a & 1 & 1 \\ 1 & 1+b & 1 \\ 1 & 1 & 1+c \end{vmatrix} = abc \left(1 + \frac{1}{a} + \frac{1}{b} + \frac{1}{c} \right)$



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61.

Prove

that:

$$|-2aa + ba + cb + a - 2 + ac + b - 2c| = 4(a + b)(b + c)(c + a)$$



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62. if $bc + qr = ca + rp = ab + pq = -1$ then prove that

$$\begin{vmatrix} ap & a & p \\ bq & b & q \\ cr & c & r \end{vmatrix} = 0$$



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63. If α and β are the roots of the equations

$$x^2 - 2x + 4 = 0, \text{ find the value of } \begin{vmatrix} \sum \alpha & \sum \alpha^2 & \sum \alpha^3 \\ \sum \alpha^2 & \sum \alpha^3 & \sum \alpha^4 \\ \sum \alpha^3 & \sum \alpha^4 & \sum \alpha^5 \end{vmatrix}.$$



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64. If $a^2 + b^2 + c^2 = 1$, then prove that

$$\begin{vmatrix} a^2 + (b^2 + c^2) \cos\theta & ab(1 - \cos\theta) & ac(1 - \cos\theta) \\ ba(1 - \cos\theta) & b^2(c^2 + a^2) \cos\theta & bc(1 - \cos\theta) \\ ca(1 - \cos\theta) & cb(1 - \cos\theta) & c^2 + (a^2 + b^2) \cos\theta \end{vmatrix}$$

independent of a, b, c ?



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65. If $a \neq 0$ and $a \neq 1$, show that

$$\begin{vmatrix} x+1 & x & x \\ x & x+a & x \\ x & x & x+a^2 \end{vmatrix} = a^3 \left[1 + x \frac{(a^3 - 1)}{a^2(a-1)} \right].$$



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66. If $a \neq 0$ and $a \neq 1$, show that

$$\begin{vmatrix} x+1 & x & x \\ x & x+a & x \\ x & x & x+a^2 \end{vmatrix} = a^3 \left[1 + x \frac{(a^3 - 1)}{a^2(a-1)} \right].$$



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67. If α, β are the roots of the equation $ax^2 + bx + c = 0$ and

$$S_n = \alpha^n + \beta^n \text{ then evaluate } \begin{vmatrix} 3 & 1+s_1 & +s_2 \\ 1+s_1 & 1+s_2 & 1+s_3 \\ 1+s_2 & 1+s_3 & 1+s_4 \end{vmatrix}$$



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68. Without expanding at any stage, evaluate the value of the determinant

$$\begin{vmatrix} 2 & \tan A \cot B + \cot A \tan B & \tan A \cot C + \cot A \\ \tan B \cot A + \cot B \tan A & 2 & \tan B \cot C + \cot B \\ \tan C \cot A + \cot C \tan A & \tan B \cot C + \cot B \tan C & 2 \end{vmatrix}$$



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70. If $\Delta = \begin{vmatrix} \sin x & \sin(x+h) & \sin(x+2h) \\ \sin(x+2h) & \sin x & \sin(x+h) \\ \sin(x+h) & \sin(x+2h) & \sin x \end{vmatrix}$

find $\lim_{h \rightarrow 0} \left(\frac{\Delta}{h^2} \right)$.



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71. If $f(x) = \begin{vmatrix} x + c_1 & x + a & x + a \\ x + b & x + c_2 & x + a \\ x + b & x + b & x + c_3 \end{vmatrix}$ then show that $f(x)$ is linear in x .

Hence deduce $f(0) = \frac{bg(a) - ag(b)}{(b - a)}$ where

$$g(x) = (c_1 - x)(c_2 - x)(c_3 - x)$$



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72. If $f(a,b) = \frac{f(b) - f(a)}{b - a}$ and

$f(a, b, c) = \frac{f(b, c) - f(a, b)}{c - a}$ prove that

$$f(a, b, c) = \left| \begin{array}{ccc} f(a) & f(b) & f(c) \\ 1 & 1 & 1 \\ a & b & c \end{array} \right| \div \left| \begin{array}{ccc} 1 & 1 & 1 \\ a & b & c \\ a^2 & b^2 & c^2 \end{array} \right|.$$



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73. the value of the determinant

$$\begin{vmatrix} (a_1 - b_1)^2 & (a_1 - b_2)^2 & (a_1 - b_3)^2 & (a_1 - b_4)^2 \\ (a_2 - b_1)^2 & (a_2 - b_2)^2 & (a_2 - b_3)^2 & (a_3 - b_4)^2 \\ (a_3 - b_1)^2 & (a_3 - b_2)^2 & (a_3 - b_3)^2 & (a_3 - b_4)^2 \\ (a_4 - b_1)^2 & (a_4 - b_2)^2 & (a_4 - b_3)^2 & (a_4 - b_4)^2 \end{vmatrix} \text{ is}$$



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Expansion Of Determinant

1. Show that $\begin{vmatrix} a^2 + x^2 & ab - cx & ac + bx \\ ab + cx & b^2 + x^2 & bc - ax \\ ac - bx & bc + ax & c^2 + x^2 \end{vmatrix} = \begin{vmatrix} x & c & -b \\ -c & x & a \\ b & -a & x \end{vmatrix}^2.$



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2. Prove the following by multiplication of determinants and power cofactor formula

$$\begin{aligned} & \begin{vmatrix} 0 & c & b \\ c & 0 & a \\ b & a & 0 \end{vmatrix}^2 = \begin{vmatrix} b^2 + v^2 & ab & ac \\ ab & c^2 + a^2 & bc \\ ac & bc & a^2 + b^2 \end{vmatrix} \\ &= \begin{vmatrix} -a^2 & ab & ac \\ ab & -b^2 & bc \\ ac & bc & -c^2 \end{vmatrix} = 4a^2b^2c^2 \end{aligned}$$



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3.

Prove

that

$$\left| (a-x)^2(a-y)^2(a-z)^2(b-x)^2(b-y)^2(b-z)^2(c-x)^2(c-y)^2(c-z)^2 \right|$$

$$\left| (1+ax)^2(1+bx)^2(1+cx)^2(1+ay)^2(1+by)^2(1+cy)^2(1+az)^2(1+bz)^2 \right|$$



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4. Find the coefficient of x in the determinant

$$\begin{vmatrix} (1+x)^{a_1b_1} & (1+x)^{a_1b_2} & (1+x)^{a_1b_3} \\ (1+x)^{a_2b_1} & (1+x)^{a_2b_2} & (1+x)^{a_2b_3} \\ (1+x)^{a_3b_1} & (1+x)^{a_3b_2} & (1+x)^{a_3b_3} \end{vmatrix}$$



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5. Expand $\begin{vmatrix} \sin x & 2 \\ 3x & \sin x \end{vmatrix}$



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Single Option Correct Type Questions

1. If $f_i = \sum_{i=0}^2 a_{ij}x^i$, $j=1,2,3$ and f_j and are denoted by $\frac{df}{dx}$ and $\frac{d^2f}{dx^2}$
respectively then $g(x) = \begin{vmatrix} f_1, f_2, f_3 \\ f'_1, f'_2, f'_3 \\ f^{''}_1, f^{''}_2, f^{''}_3 \end{vmatrix}$ is

A. a constant

B. a linear in x

C. a quadratic in x

D. a cubic in x

Answer:



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2. The system has unique solution if

A. $a=2, b=3$

B. $a=2, b \neq 3$

C. $a \neq 2, b=3$

D. $a \neq 2, b \neq 3$

Answer:

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3. The system has infinite solution , if

A. $a=2, b \in \mathbb{R}$

B. $a=3, b \in \mathbb{R}$

C. $a \in \mathbb{R}, b=2$

D. $a \in \mathbb{R}, b=3$

Answer:

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4. The system has no solution if ,

A. $a=2,b=3$

B. $a=2,b \neq 3$

C. $a \neq 2,b=3$

D. $a \neq 2,b \neq 3$

Answer:



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5. If $f(x)$ is a polynomial of degree $n (> 2)$ and $f(x) = f(\alpha - x)$,

(where α is a fixed real number), then the degree of $f'(x)$ is

A. 6

B. 10

C. 14

D. 18

Answer:



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6. Expand $\begin{vmatrix} 2a & 3b \\ 5a & 7a \end{vmatrix}$



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7. If A,B and C are the angle of a triangle show that

$$\begin{vmatrix} \sin 2A & \sin C & \sin B \\ \sin C & \sin 2B & \sin A \\ \sin B & \sin A & \sin 2C \end{vmatrix} = 0.$$



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8. If $g(x) = \frac{f(x)}{(x - a)(x - b)(x - c)}$, where f(x) is a polynomial of degree < 3 , then prove that

$$\frac{dg(x)}{dx} = \begin{vmatrix} 1 & a & f(a)(x - a)^{-2} \\ 1 & b & f(b)(x - b)^{-2} \\ 1 & c & f(c)(x - c)^{-2} \end{vmatrix} \div \begin{vmatrix} a^2 & a & 1 \\ b^2 & b & 1 \\ c^2 & c & 1 \end{vmatrix}.$$



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9. Let S be the sum of all possible determinants of order 2 having 0,1,2 and 3 as their elements,. Find the common root α of the equations

$$x^2 + ax + [m + 1] = 0,$$

$$x^2 + bx + [m + 4] = 0$$

$$\text{and } x^2 - cx + [m + 15] = 0$$

such that $\alpha > S$ where $a+b+c=0$ and

$$m = \sum_{n=0}^{\infty} \frac{1}{n} \sum_{r=1}^{2n} \frac{r}{\sqrt{n^2 + r^2}}$$

and $[.]$ denotes the greatest integer function.



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10. Solve
$$\begin{vmatrix} 0 & 0 & 7 \\ 1 & 2 & 3 \\ 0 & 8 & 2 \end{vmatrix}$$



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[Exercise For Session 1](#)

1. Sum of real roots of the equation $\begin{vmatrix} 1 & 4 & 20 \\ 1 & -2 & 5 \\ 1 & 2x & 5x^2 \end{vmatrix} = 0$ is

A. -2

B. -1

C. 0

D. 1

Answer: D



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2. If $\begin{vmatrix} 6i & -3i & 1 \\ 4 & 3i & -1 \\ 20 & 3 & i \end{vmatrix} = x + iy$, then a. $x = 3, y = 1$ b. $x = 1, y = 3$ c.

$x = 0, y = 3$ d. $x = 0, y = 0$

A. $x=3, y=1$

B. $x=1, y=3$

C. x=0,y=3

D. x=0, y=0

Answer: D



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3. Let $p\lambda^4 + q\lambda^3 + r\lambda^2 + s\lambda + t = \begin{vmatrix} \lambda^2 + 3\lambda & \lambda - 1 & \lambda + 3 \\ \lambda + 1 & -2\lambda & \lambda - 4 \\ \lambda - 3 & \lambda + 4 & 3\lambda \end{vmatrix}$

be an identity in λ p,q, r s and r are constants. Then find the value of t.

A. 7

B. 14

C. 21

D. 28

Answer: C



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4. If one root of the equation

$$\begin{vmatrix} 7 & 6 & x^2 - 13 \\ 2 & x^2 - 13 & 2 \\ x^2 - 13 & 3 & 7 \end{vmatrix} = 0 \text{ is } x=2 \text{ the}$$

sum of all other five roots is

- A. $2\sqrt{15}$
- B. -2
- C. $\sqrt{20} + \sqrt{15} - 2$
- D. None of these

Answer: B



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5. about to only mathematics

- A. 0
- B. 1
- C. 2

D. 3

Answer: C



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6. If $\Delta = \begin{vmatrix} 1 & 3 \cos \theta & 1 \\ \sin \theta & 1 & 3 \cos \theta \\ 1 & \sin \theta & 1 \end{vmatrix}$, the maximum value of Δ is

A. -10

B. $-\sqrt{10}$

C. $\sqrt{10}$

D. 10

Answer: D



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7. If the value of the determinant $|(a, 1, 1)(1, b, 1)(1, 1, c)|$ is positive then
a. $abc > 1$ b. $abc > -8$ c. $abc < -8$ d. $abc > -2$

A. $abc > 1$

B. $abc > -8$

C. $abc < -8$

D. $abc > -2$

Answer: B



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Exercise For Session 2

1. If λ and μ are the cofactors of 3 and -2 respectively in the determinant

$$\begin{vmatrix} 1 & 0 & -2 \\ 3 & -1 & 2 \\ 4 & 5 & 6 \end{vmatrix} \quad \text{the value of } \lambda + \mu \text{ is}$$

A. 5

B. 7

C. 9

D. 11

Answer: C



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2. If a, b and c are distinct and $D = \begin{vmatrix} a & b & c \\ b & c & a \\ c & a & b \end{vmatrix}$. then the square of the determinant of its cofactors is divisible by

A. $(a^2 + b^2 + c^2)^2$

B. $(ab + bc + ca)^2$

C. $(a + b + c)^2$

D. $(a + b + c)^4$

Answer: D



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3. An equilateral triangle has each of its sides of length 4 cm. If (x_r, y_r)

$(r=1,2,3)$ are its vertices the value of $\begin{vmatrix} x_1 & y_1 & 1 \\ x_2 & y_2 & 1 \\ x_3 & y_3 & 1 \end{vmatrix}^2$

A. 192

B. 768

C. 1024

D. 128

Answer: A



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4. If the lines $ax+y+1=0$, $x+by+1=0$ and $x+y+c=0$ (a,b and c being distinct and different from 1) are concurrent the value of $\frac{a}{a-1} + \frac{b}{b-1} + \frac{c}{c-1}$ is

A. 0

B. 1

C. 2

D. 3

Answer: C



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5. if $p + q + r = 0 = a + b + c$ then the value of the determinant

$$\begin{vmatrix} pa & qb & rc \\ qc & ra & pb \\ rb & pc & qa \end{vmatrix}$$

A. 0

B. $pa+qb+rc$

C. 1

D. None of these

Answer: A



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6. If p, q, r are in A.P. then value of determinant

$$\begin{vmatrix} a^2 + 2^{n+1} + 2p & b^2 + 2^{n+2} + 3q & c^2 + p \\ 2^n + p & 2^{n+1} & 2q \\ a^2 + 2^n + p & b^2 + 2^{n+1} & c^2 - r \end{vmatrix} \text{ is } \begin{array}{ll} \text{(a) 0} & \text{(b) Independent} \end{array}$$

from a, b, c (c) $a^2b^2c^2 - 2^n$ (d) Independent from n

A. 1

B. 0

C. $a^2 + b^2 + c^2 - 2^n$

D. $(a^2 + b^2 + c^2) - 2^n q$

Answer: B



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7. Let $\{D_1, D_2, D_3, D_n\}$ be the set of third order determinant that can be made with the distinct non-zero real numbers a_1, a_2, a_q . Then

a. $\sum_{i=1}^n D_i = 1$ b. $\sum_{i=1}^n D_i = 0$ c. $D_i = D_j, \forall i, j$ d. none of these

A. $\sum_{i=1}^n D_i = 1$

B. $\sum_{i=1}^n D_i = 0$

C. $D_i = D_j, \forall i, j$

D. None of these

Answer: B



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8. If $\begin{vmatrix} x & 3 & 6 \\ 3 & 6 & x \\ 6 & x & 3 \end{vmatrix} = \begin{vmatrix} 2 & x & 7 \\ x & 7 & 2 \\ 7 & 2 & x \end{vmatrix} = \begin{vmatrix} 4 & 5 & x \\ 5 & x & 4 \\ x & 4 & 5 \end{vmatrix} = 0$, then x is equal to a. 0 b.

-9 c. 3 d. none of these

A. 0

B. -9

C. 3

D. None of these

Answer: B



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9. If $a + b + c = 0$, one root of $|a - xcbcb - xabac - x| = 0$ is $x = 1$ b.

$x = 2$ c. $x = a^2 + b^2 + c^2$ d. $x = 0$

A. 1

B. 2

C. $a^2 + b^2 + c^2$

D. 0

Answer: D



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10. If $a^2 + b^2 + c^2 = -2$ and $f(x) =$

$|1 + a^2x(1 + b^2)x(1 + c^2)x(1 + a^2)x| + b^2x(1 + c^2)x(1 + a^2)x(1 + b^2)x$

, then $f(x)$ is a polynomial of degree 0 b. 1 c. 2 d. 3

A. 0

B. 1

C. 2

D. 3

Answer: C



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11. If a, b, c, d, e , and f are in G.P. then the value of $|a^2d^2xb^2e^2yc^2f^2z|$
depends on x and y b. x and z c. y and z d. independent of x, y , and z
- A. depends on x and y
- B. depends on x and z
- C. dependes on y and z
- D. independent of x, y and z

Answer: D



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Exercise For Session 3

1. Number of second order determinants which have maximum values whose each entry is either -1 or 1 is equal to
- A. 2

B. 4

C. 6

D. 8

Answer: B



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2. Minimum value of a second order determinant whose each is either 1 or 2 is equal to

A. 0

B. -1

C. -2

D. -3

Answer: C



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3. If $l_i^2 + m_i^2 + n_i^2 = 1$, (i=1,2,3) and

$$l_i l_j + m_i m_j + n_i n_j = 0, (i \neq j, i, j = 1, 2, 3) \text{ and } \Delta = \begin{vmatrix} l_1 & m_1 & n_1 \\ l_2 & m_2 & n_2 \\ l_3 & m_3 & n_3 \end{vmatrix}$$

then

A. $|\Delta|=3$

B. $|\Delta|=2$

C. $|\Delta|=1$

D. $|\Delta|=0$

Answer: C



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4. Let $A = [a_{ij}]$ be a 3×3 matrix and let A_1 denote the matrix of the cofactors of elements of matrix A and A_2 be the matrix of cofactors of

elements of matrix A_1 and so on. If A_n denote the matrix of cofactors of elements of matrix A_{n-1} , then $|A_n|$ equals

A. Δ_0^{2n}

B. Δ_0^{2n}

C. $\Delta_0^{n^2}$

D. Δ_0^2

Answer: B



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5. if $\begin{vmatrix} 1 & x & x^2 \\ x & x^2 & 1 \\ x^2 & 1 & x \end{vmatrix} = 3$ then find the value of

$$\Delta_c = \begin{vmatrix} x^3 - 1 & 0 & x - x^4 \\ 0 & x - x^4 & x^3 - 1 \\ x - x^4 - 1 & x^3 - 1 & 0 \end{vmatrix}$$

A. 6

B. 9

C. 18

D. 27

Answer: B



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6. the value of the determinant

$$\begin{vmatrix} (a_1 - b_1)^2 & (a_1 - b_2)^2 & (a_1 - b_3)^2 & (a_1 - b_4)^2 \\ (a_2 - b_1)^2 & (a_2 - b_2)^2 & (a_2 - b_3)^2 & (a_3 - b_4)^2 \\ (a_3 - b_1)^2 & (a_3 - b_2)^2 & (a_3 - b_3)^2 & (a_3 - b_4)^2 \\ (a_4 - b_1)^2 & (a_4 - b_2)^2 & (a_4 - b_3)^2 & (a_4 - b_4)^2 \end{vmatrix} \text{ is}$$

A. depends on $a_i, i=1,2,3,4$

B. depends on $b_i, i=1,2,3,4$

C. dependes on $c_i, i=1,2,3,4$

D. 0

Answer: D



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7. Value of $\begin{vmatrix} 1 + x_1 & 1 + x_1x & 1 + x_1x^2 \\ 1 + x_2 & 1 + x_2x & 1 + x_2x^2 \\ 1 + x_3 & 1 + x_3x & 1 + x_3x^2 \end{vmatrix}$ depends upon

- A. only x
- B. only x_1
- C. only x_2
- D. None of these

Answer: D



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8. if the system of linear equations
 $x + y + z = 6$, $x + 2y + 3z = 14$ and $2x + 5y + \lambda z = \mu$ ($\lambda, \mu \in R$)
has a unique solution then

- A. $\lambda \neq 8$

B. $\lambda = 8$ and $\mu \neq 36$

C. $\lambda = 8$ and $\mu = 36$

D. None of these

Answer: A



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9. The system of equations $ax - y - z = a - 1$, $x - ay - z = a - 1$, $x - y - az = a - 1$ has no solution if a is:

A. either -2 or 1

B. -2

C. 1

D. not(-2)

Answer: B::C



10. The system of equations $x+2y-4z=3$, $2x-3y+2z=5$ and $x -12y +16z =1$ has

- A. inconsistent solution
- B. unique solution
- C. infinitely many solutions
- D. None of these

Answer: C



11. if $c < 1$ and the system of equations $x+y-1=0$, $2x-y-c=0$ and $-bx+3by -c=0$

is consistent then the possible real values of b are

- A. $b \in \left(-3, \frac{3}{4} \right)$
- B. $b \in \left(-\frac{3}{2}, 1 \right)$

C. $b \in \left(-\frac{3}{4}, 3 \right)$

D. None of these

Answer: B



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12. The equation $x+2y=3$, $y-2x=1$ and $7x-6y+a=0$ are consistent for

A. $a=7$

B. $a=1$

C. $a=11$

D. None of these

Answer: A



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13. The values of $k \in R$ for which the system of equations

$x + ky + 3z = 0, kx + 2y + 2z = 0, 2x + 3uy + 4z = 0$ has nontrivial solution are

A. $\left\{ 2, \frac{5}{4} \right\}$

B. $\left\{ 2, -\frac{5}{4} \right\}$

C. $\left\{ 2, -\frac{5}{9} \right\}$

D. $\left\{ -2, -\frac{5}{4} \right\}$

Answer: A



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Exercise For Session 4

1. If $f(x) = \begin{vmatrix} x & x^2 & x^3 \\ 1 & 2 & 3 \\ 0 & 1 & x \end{vmatrix}$ $\lim_{x \rightarrow 1} f(x)$ is equal to

A. -1

B. 0

C. 1

D. 2

Answer: A



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2. Let $f(x) = \begin{vmatrix} \sec x & x^2 & x \\ 2 \sin x & x^3 & 2x^2 \\ \tan 3x & x^2 & x \end{vmatrix}$ $\lim_{x \rightarrow 0} \frac{f(x)}{x^4}$ is equal to

A. 0

B. -1

C. 2

D. 3

Answer: B

3. Let $\begin{vmatrix} x & 2 & x \\ x^2 & x & 6 \\ x & x & 6 \end{vmatrix} = Ax^4 + Bx^3 + Cx^2 + Dx + E$ the value of $5A+4B+3C+2D+E$ is equal to

A. -16

B. -11

C. 0

D. 16

Answer: B



4. Let $f(x) = \begin{vmatrix} x^3 & \sin x & \cos x \\ 6 & -1 & 0 \\ p & p^2 & p^3 \end{vmatrix}$, where p is a constant. Then $\frac{d^3}{dx^3}(f(x))$ at $x = 0$ is

(a) p (b) $p - p^3$ (c) $p + p^3$ (d) independent of p

A. p

B. $p+p^2$

C. $p+p^3$

D. independent of p

Answer: D



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5. if $y = \sin mx$, then the value of the determinant

$$\begin{vmatrix} y & y_1 & y_2 \\ y_3 & y_4 & y_5 \\ y_6 & y_7 & y_8 \end{vmatrix} \quad \text{Where } y_n = \frac{d^n y}{dx^n} \text{ is}$$

A. m^2

B. m^3

C. m^9

D. None of these

Answer: D



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6. Let $f(x) = \begin{vmatrix} 2\cos^2 x & \sin 2x & -\sin x \\ \sin 2x & 2\sin^2 x & \cos x \\ \sin x & -\cos x & 0 \end{vmatrix}$. Then the value of $\int_0^{\pi/2} [f(x) + f'(x)]dx$ is

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

B. π

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

D. 2π

Answer: B



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7. Find $\frac{dy}{dx}$ if $y = \sin(ax+b)$



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8. Evaluate $\int \sin^2 x dx$



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9. If $D_k = \begin{vmatrix} 1 & n & n \\ 2k & n^2 + n + 1 & n^2 + n \\ 2k - 1 & n^2 & n^2 + n + 1 \end{vmatrix}$ and $\sum_{k=1}^n D_k = 56$. then

n equals 4 b. 6 c. 8 d. none of these

A. 4

B. 6

C. 8

D. None of these

Answer: D



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10. the value of

$$\sum_{r=2}^n (-2)^r \begin{vmatrix} \cdot^{n-2} C_{r-2} & \cdot^{n-2} C_{r-1} & \cdot^{n-2} C_r \\ -3 & 1 & 1 \\ 2 & -1 & 0 \end{vmatrix} \quad (n > 2)$$

A. $2n - 1 + (-1)^n$

B. $2n + 1 + (-1)^n$

C. $2n - 3 + (-1)^n$

D. None of these

Answer: A



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Exercise Single Option Correct Type Questions

1. if $\alpha, \beta \neq 0$ and $f(n) = \alpha^n + \beta^n$

and
$$\begin{vmatrix} 3 & 1 + f(1) & 1 + f(2) \\ 1 + f(1) & 1 + f(2) & 1 + f(3) \\ 1 + f(2) & 1 + f(3) & 1 + f(4) \end{vmatrix}$$

$= k(1 - \alpha)^2(1 - \beta)^2(\alpha - \beta)^2$ then k is equal to

A. 1

B. -1

C. $\alpha\beta$

D. $\alpha\beta\gamma$

Answer: A



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2. Let $\Delta(x) = \begin{vmatrix} x+a & x+b & x+a-c \\ x+b & x+c & x-1 \\ x+c & x+d & x-b+d \end{vmatrix}$ and $\int_0^2 \Delta(x)dx = -16$,

where a, b, c, d are in A.P. then the common difference (i) 1 (ii) 2 (iii) 3 (iv) 4

A. ± 1

B. ± 2

C. ± 3

D. ± 4

Answer: B



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3. If $\Delta(x) = \begin{vmatrix} x & 1+x^2 & x^3 \\ \log(1+x^2) & e^x & \sin x \\ \cos x & \tan x & \sin^2 x \end{vmatrix}$ then

A. $\Delta(x)$ is divisible by x

B. $\Delta(x)=0$

C. $\Delta'(x)=0$

D. None of these

Answer: A



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4. If a, b, c are sides of a triangle and $\begin{vmatrix} a^2 & b^2 & c^2 \\ (a+1)^2 & (b+1)^2 & (c+1)^2 \\ (a-1)^2 & (b-1)^2 & (c-1)^2 \end{vmatrix} =$

then

- A. ΔABC is an equilateral triangle
- B. ΔABC is a right angled isosceles triangle
- C. ΔABC is an isosceles triangle
- D. None of the above

Answer: C



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5. Find $\frac{dy}{dx}$ if $x^2 + xy + y^2 = 100$



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6. If $\begin{vmatrix} a & b - c & c + b \\ a + c & b & c - a \\ a - b & a + b & c \end{vmatrix} = 0$, then the line $ax + by + c = 0$ passes through the fixed point which is

A. (1,2)

B. (1,1)

C. (-2,1)

D. (1,0)

Answer: B



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7. If $f(x) = a + bx + cx^2$ and α, β, γ are the roots of the equation

$x^3 = 1$, then $\begin{vmatrix} a & b & c \\ b & c & a \\ c & a & b \end{vmatrix}$ is equal to

A. $f(\alpha) + f(\beta) + f(\gamma)$

B. $f(\alpha)f(\beta) + f(\beta)f(\gamma) + f(\gamma)f(\alpha)$

C. $f(\alpha)f(\beta)f(\gamma)$

D. $-f(\alpha)f(\beta)f(\gamma)$

Answer: D



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8. when the determinant

$$\begin{vmatrix} \cos 2x & \sin^2 x & \cos 4x \\ \sin^2 x & \cos 2x & \cos^2 x \\ \cos 4x & \cos^2 x & \cos 2x \end{vmatrix}$$

expanded in powers of $\sin x$ then the constant term in that expression is

A. 1

B. 0

C. -1

D. 2

Answer: C



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9. If $[]$ denotes the greatest integer less than or equal to the real number under consideration, and $-1 \leq x < 0, 0 \leq y < 1, 1 \leq z < 2$, then the

value of the determinant $\begin{vmatrix} [x] + 1 & [y] & [z] \\ [x] & [y] + 1 & [z] \\ [x] & [y] & [z] + 1 \end{vmatrix}$ is a. $[x]$ b. $[y]$ c. $[z]$

d. none of these

A. $[x]$

B. $[y]$

C. $[z]$

D. None of these

Answer: C



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10. The determinant $|y^2 - xyx^2abca'b'c'|$ is equal to

$|bx + aycx + byb'x + a'y c'x + b'y|$ b.

$|ax + bybx + cya'x + b'yb'x + c'y|$ c.

d.

$$|bx + cyax + byb'x + c'ya'x + b'y|$$

$$|ax + bybx + cya'x + b'yb'x + c'y|$$

A. (a) $\begin{vmatrix} bx + ay & cx + by \\ b'x + a'y & c'x + b'y \end{vmatrix}$

B. $\begin{vmatrix} a'x + b'y & bx + cy \\ ax + by & b'x + c'y \end{vmatrix}$

C. $\begin{vmatrix} bx + cy & ax + by \\ b'x + c'y & a'x + b'y \end{vmatrix}$

D. (d) $\begin{vmatrix} ax + by & bx + cy \\ a'x + b'y & b'x + c'y \end{vmatrix}$

Answer: D



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11. If A, B, C are angles of a triangles, then the value of

$$e^{2iA}e^{-iC}e^{-iB}e^{-iC}e^{2iB}e^{-iA}e^{-iB}e^{-iA}e^{2iC}$$

is 1 b. -1 c. -2 d. -4

A. 1

B. -1

C. -2

Answer: D**Watch Video Solution**

12. If $\begin{vmatrix} x^n & x^{n+2} & x^{2n} \\ 1 & x^a & a \\ x^{n+5} & x^{a+6} & x^{2n+5} \end{vmatrix} = 0, \forall x \in R, \text{ where } n \in N,$ then value of
a is a. n b. $n - 1$ c. $n + 1$ d. none of these

A. n

B. n-1

C. n+1

D. None of these

Answer: C**Watch Video Solution**

13. If x, y and z are the integers in AP lying between 1 and 9 and $x = 51, y = 41$

and $z = 31$ are three digits number the value of $\begin{vmatrix} 5 & 4 & 3 \\ x51 & y41 & z31 \\ x & y & z \end{vmatrix}$ is

- A. $x+y+z$
- B. $x-y+z$
- C. 0
- D. None of these

Answer: C



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14. if $a_1b_1c_1, a_2b_2c_2$ and $a_3b_3c_3$ are three-digit even natural numbers

and $\Delta = \begin{vmatrix} c_1 & a_1 & b_1 \\ c_2 & a_2 & b_2 \\ c_3 & a_3 & b_3 \end{vmatrix}$ then Δ is

- A. divisible by 2 but not necessarily by 4
- B. divisible by 4 but not necessarily by 8

C. divisible by 8

D. None of these

Answer: A



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15. Expand $\begin{vmatrix} 4 & 8 \\ 6 & 7 \end{vmatrix}$



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16. If x_1, x_2 and y_1, y_2 are the roots of the equations

$3x^2 - 18x + 9 = 0$ and $y^2 - 4y + 2 = 0$ the value of the determinant

$$\begin{vmatrix} x_1x_2 & y_1y_2 & 1 \\ x_1 + x_2 & y_1 + y_2 & 2 \\ \sin(\pi x_1x_2) & \cos(\pi/2y_1y_2) & 1 \end{vmatrix} \text{ is}$$

A. (a)0

B. (b)1

C. (c)2

D. (d)None of these

Answer: A



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17. If $\begin{vmatrix} .^9 C_4 & .^9 C_5 & .^{10} C_r \\ .^{10} C_6 & .^{10} C_7 & .^{11} C_{r+2} \\ .^{11} C_8 & .^{11} C_9 & .^{12} C_{r+4} \end{vmatrix} = 0$, then the value of r is equal to

A. 6

B. 4

C. 5

D. None of these

Answer: C



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18. If $f(x), h(x)$ are polynomials of degree 4 and

$$\begin{vmatrix} f(x) & g(x) & h(x) \\ a & b & c \\ p & q & r \end{vmatrix}$$

$$= mx^4 + nx^3 + rx^2 + sx + r \quad \text{be an identity in } x, \text{ then}$$

$$\begin{vmatrix} f'''(0) - f''(0) & g'''(0) - g''(0) & h'''(0) - h''(0) \\ a & b & c \\ p & q & r \end{vmatrix} \text{ is}$$

A. $2(3n + r)$

B. $3(2n - r)$

C. $3(2n + r)$

D. $2n(3n - r)$

Answer: D



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19. If $f(x) = \begin{vmatrix} \cos(x + \alpha) & \cos(x + \beta) & \cos(x + \gamma) \\ \sin(x + \alpha) & \sin(x + \beta) & \sin(x + \gamma) \\ \sin(\beta + \gamma) & \sin(\gamma + \alpha) & \sin(\alpha + \beta) \end{vmatrix}$ then

$f(\theta) - 2f(\phi) + f(\psi)$ is equal to

A. (A) 0

B. (B) $\alpha - \beta$

C. (C) $\alpha + \beta + \gamma$

D. (D) $\alpha + \beta \pm \gamma$

Answer: A



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20. if
$$\begin{vmatrix} 1 & 1 & 1 \\ a & b & c \\ a^3 & b^3 & c^3 \end{vmatrix} = (a - b)(b - c)(c - a)(a + b + c)$$

where a,b,c are all different then the determinant

$$\begin{vmatrix} 1 & 1 & 1 \\ (x - a)^2 & (x - b)^2 & (x - c)^2 \\ (x - b)(x - c) & (x - c)(x - a) & (x - a)(x - b) \end{vmatrix} \text{ vanishes when}$$

A. $a+b+c=0$

B. $x = \frac{1}{3}(a+b+c)$

C. $x = \frac{1}{2}(a+b+c)$

D. $x=a+b+c$

Answer: B



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21. about to only mathematics

A. 0

B. 3

C. 6

D. 12

Answer: B



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22. If a, b, c are non-zero real numbers and if the system of equations $(a - 1)x = y = z$ $(b - 1)y = z + x$ $(c - 1)z = x + y$ has a non-trivial solution, then prove that $ab + bc + ca = abc$

A. $a+b+c=0$

B. abc

C. 1

D. None of these

Answer: B



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23. the set of equations $\lambda x - y + (\cos \theta)z = 0$, $3x + y + 2z = 0$

$(\cos \theta)x + y + 2z = 0$, $0 \leq \theta < 2\pi$ has non-trivial solution (s)

A. A. for no value of λ and θ

B. B. for all value of λ and θ

C. C. for all value of λ and only two values of θ

D. D. for only one value of λ and all values of θ

Answer: A



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Exercise More Than One Correct Option Type Questions

1. If $f(x) = \begin{vmatrix} x + a^2 & ab & ac \\ ab & x + b^2 & bc \\ ac & bc & x + c^2 \end{vmatrix}$, then find $f'(x)$.

A. x

B. x^2

C. x^3

D. x^4

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



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2. the determinant $\begin{vmatrix} a & b & a\alpha + b \\ b & c & b\alpha + c \\ a\alpha + b & b\alpha + c & 0 \end{vmatrix} = 0$ is equal to zero if

A. a,b and c are in AP

B. a,b,c, are in GP

C. a,b, and c are in HP

D. $(x - \alpha)$ is a factor of $ax^2 + 2bx + c$

Answer: B::D



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3. Let $f(x) = \begin{vmatrix} \cos x & 1 & 0 \\ 1 & 2\cos x & 1 \\ 0 & 1 & 2\cos x \end{vmatrix}$ then

A. $f\left(\frac{\pi}{3}\right) = -1$

B. $f'\left(\frac{\pi}{3}\right) = \sqrt{3}$

C. $\int_0^\pi f(x)dx = 0$

D. $\int_{-\pi}^\pi f(x)dx = 0$

Answer: A::C::D



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4. If $\Delta(x) = \begin{vmatrix} x^2 - 5x + 3 & 2x - 5 & 3 \\ 3x^2 + x + 4 & 6x + 1 & 9 \\ 7x^2 - 6x + 9 & 14x - 6 & 21 \end{vmatrix} = ax^3 + bx^2 + cx + d$, then

A. $a=0$

B. $b=0$

C. $c=0$

D. $d=141$

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



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5. If a, b , and c are the side of a triangle and A, B and C are the angles opposite to a, b , and c respectively, then

$$\Delta = \begin{vmatrix} a^2 & b \sin A & C \sin A \\ b \sin A & 1 & \cos A \\ C \sin A & \cos A & 1 \end{vmatrix}$$

is independent of

A. (A)a

B. (B)b=0

C. (C)c

D. (D)A,B,C

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



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$$6. \Delta = \begin{vmatrix} a & a^2 & 0 \\ 1 & 2a+b & (a+b) \\ 0 & 1 & 2a+3b \end{vmatrix} \text{ is divisible by}$$

A. (a+b) is a factor of $f'(a,b)$

B. (a+2b) is a factor of $f'(a,b)$

C. (2a+b) is a factor of $f'(a,b)$

D. a is a factor of $f(a,b)$

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

7. Expand $\begin{vmatrix} 2 & 5 \\ 4x & 7x \end{vmatrix}$



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8. If $f(x) = \begin{vmatrix} 3 & 3x & 3x^2 + 2a^2 \\ 3x & 3x^2 + 2a^2 & 3x^3 + 6a^2x \\ 3x^2 + 2a^2 & 3x^3 + 6a^2x & 3x^4 + 12a^2x^2 + 2a^4 \end{vmatrix}$

then

A. $f'(x)=0$

B. $y=f(x)$ is a straight line parallel to X-axis

C. $\int_0^2 f(x)dx = 32a^4$

D. None of these

Answer: A::B



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9. If $a > b > c$ and the system of equations $ax + by + cz = 0$, $bx + cy + az = 0$, has a non-trivial solution then both the roots of the quadratic equation $at^2 + bt + c$ are

- A. (a) real
- B. (b) of opposite sign
- C. (c) positive
- D. (d) complex

Answer: A::B



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10. The values of λ and b for which the equations $x + y + z = 3$, $x + 3y + 2z = 6$, and $x + \lambda y + 3z = b$ have

- A. (a) a unique solution if $\lambda \neq 5, b \in R$
- B. (b) no solution if $\lambda \neq 5, b = 9$

C. (c) infinite many solution $\lambda = 5, b = 9$

D. (d) None of the above

Answer: A::C



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11. Let λ and α be real. Then the numbers of intergral values λ for which the system of linear equations

$$\lambda x + (\sin \alpha)y + (\cos \alpha)z = 0$$

$$x + (\cos \alpha)y + (\sin \alpha)z = 0$$

$-x + (\sin \alpha)y - (\cos \alpha)z = 0$ has non-trivial solutions is

A. (-1,1)

B. $[-\sqrt{2}, -1]$

C. $[1, \sqrt{2}]$

D. (-2,2)

Answer: A::B::C



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Exercise Passage Based Questions

1. Consider the system of equations

$$x+y+z=5, x+2y+3z=9, x+3y+\lambda z = \mu$$

The system is called smart brilliant good and lazy according as it has solution unique solution infinitely many solution respectively.

The system is smart if

A. $\lambda \neq 5$ or $\lambda = 5$ and $\mu = 13$

B. $\lambda \neq 5$

C. $\lambda \neq 5$ and $\mu \neq 13$

D. $\lambda \neq 5$ or $\lambda = 5$ and $\mu \neq 13$

Answer: A



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2. Consider the system of equations

$$x+y+z=5, x+2y+3z=9, x+3y+\lambda z = \mu$$

The system is called smart brilliant good and lazy according as it has solution unique solution infinitely many solution respectively.

The system is good if

- A. $\lambda \neq 5$ or $\lambda = 5$ and $\mu \neq 13$
- B. $\lambda = 5$ and $\mu = 13$
- C. $\lambda = 5$ and $\mu \neq 13$
- D. $\lambda \neq 5$ and μ is any real number

Answer: B



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3. Consider the system of equations

$$x+y+z=5, x+2y+3z=9, x+3y+\lambda z = \mu$$

The system is called smart brilliant good and lazy according as it has

solution unique solution infinitely many solution respectively.

The system is smart if

A. $\lambda \neq 5$ or ' $\lambda = 5$ ' and $\mu = 13$

B. $\lambda = 5$ and $\mu = 13$

C. $\lambda = 5$ and $\mu \neq 13$

D. $\lambda \neq 5$ or $\lambda = 5$ and $\mu \neq 13$

Answer: C



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4. If $\Delta = \begin{vmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{vmatrix}$ then cofactor of a_{23} represented as



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5. Find $|A|$ if $A = \begin{vmatrix} 5 & 2 \\ 6 & 3 \end{vmatrix}$

A. -7

B. 7

C. -2401

D. 2401

Answer: B



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6. If $\Delta = \begin{vmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{vmatrix}$ and $C_{ij} = (-1)^{i+j} M_{ij}$, where M_{ij} is a

determinant obtained by deleting i th row and j th column then then

$$\begin{vmatrix} C_{11} & C_{12} & C_{13} \\ C_{21} & C_{22} & C_{23} \\ C_{31} & C_{32} & C_{33} \end{vmatrix} = \Delta^2.$$

Suppose $a, b, c \in R, a + b + c > 0, A = bc - a^2, B = ca - b^2$ and

$$c = ab - c^2 \text{ and } \begin{vmatrix} A & B & C \\ B & C & A \\ C & A & B \end{vmatrix} = 49 \text{ then the value of } a^3 + b^3 + c^3 - 3abc \text{ is}$$

A. -3

B. 3

C. -9

D. 9

Answer: B



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7. If α, β, γ are the roots of $x^3 + 2x^2 - x - 3 = 0$ The value of

$$\begin{vmatrix} \alpha & \beta & \gamma \\ \gamma & \alpha & \beta \\ \beta & \gamma & \alpha \end{vmatrix}$$
 is equal to

A. A. 14

B. B. -2

C. C. 10

D. D. -14

Answer: D



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8. Let α, β, γ be the roots of $x^3 + 2x^2 - x - 3 = 0$. If the absolute value of the expression $\frac{\alpha - 1}{\alpha + 2} + \frac{\beta - 1}{\beta + 2} + \frac{\gamma - 1}{\gamma + 2}$ can be expressed as $\frac{m}{n}$ where m and n are co-prime the value of $\begin{vmatrix} m & n^2 \\ m - n & m + n \end{vmatrix}$ is

A. 17

B. 27

C. 37

D. 47

Answer: C



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9. If α, β, γ are the roots of $x^3 + 2x^2 - x - 3 = 0$. If $a = \alpha^2 + \beta^2 + \gamma^2, b = \alpha\beta + \beta\gamma + \gamma\alpha$ the value of $\begin{vmatrix} a & b & b \\ b & a & b \\ b & b & a \end{vmatrix}$ is

A. A. 14

B. B. 49

C. C. 98

D. D. 196

Answer: D



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10. Suppose $f(x)$ is a function satisfying the following conditions:

(i) $f(0)=2, f(1)=1$

(ii) $f(x)$ has a minimum value at $x = \frac{5}{2}$

(iii) for all x $f'(x) = \begin{vmatrix} 2ax & 2ax - 1 & 2ax + b + 1 \\ b & b + 1 & -1 \\ 2(ax + b) & 2ax + 2b + 1 & 2ax + b \end{vmatrix}$

The value of $f(2)+f(3)$ is

A. 1

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

C. 2

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

Answer: A



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11. Suppose $f(x)$ is a function satisfying the following conditions:

(i) $f(0)=2, f(1)=1$

(ii) $f(x)$ has a minimum value at $x = \frac{5}{2}$

(iii) for all x $f'(x) = \begin{vmatrix} 2ax & 2ax - 1 & 2ax + b + 1 \\ b & b + 1 & -1 \\ 2(ax + b) & 2ax + 2b + 1 & 2ax + b \end{vmatrix}$

The number of solutions of the equation $f(x) + 1 = 0$ is

A. (A) 0

B. (B) 1

C. (C) 2

D. (D) infinite

Answer: A



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12. Suppose $f(x)$ is a function satisfying the following conditions:

(i) $f(0)=2, f(1)=1$

(ii) $f(x)$ has a minimum value at $x = \frac{5}{2}$

(iii) for all x $f'(x)=\begin{vmatrix} 2ax & 2ax-1 & 2ax+b+1 \\ b & b+1 & -1 \\ 2(ax+b) & 2ax+2b+1 & 2ax+b \end{vmatrix}$

The number of solutions of the equation $f(x)+1=0$ is

A. $\left(-\infty, \frac{7}{16} \right]$

B. $\left[\frac{3}{4}, \infty \right)$

C. $\left[\frac{7}{16}, \infty \right)$

D. $\left(-\infty, \frac{3}{4} \right]$

Answer: C



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13.

$$\begin{vmatrix} x & e^{x-1} & (x-1)^3 \\ x - \ln x & \cos(x-1) & (x-1)^2 \\ \tan x & \sin^2 x & \cos^2 x \end{vmatrix} = a_0 + a_1(x-1) + a_2(x-1)^2 \dots$$

The value of $\cos^{-1}(a_1)$ is:

A. (a) 0

B. (b) $\frac{\pi}{4}$

C. (c) $\frac{\pi}{2}$

D. (d) π

Answer: C



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14. Find $|A|$ if $A = \begin{vmatrix} 4x & 3x \\ 5x & 6x \end{vmatrix}$



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15. Expand $\begin{vmatrix} 8x & 3 \\ 2 & 2 \end{vmatrix}$



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16. Let $\Delta = \begin{vmatrix} -bc & b^2 + bc & c^2 + bc \\ a^2 + ac & -ac & c^2 + ac \\ a^2 + ab & b^2 + ab & -ab \end{vmatrix}$ and the equation

$px^3 + qx^2 + rx + s = 0$ has roots a,b,c where $a, b, c \in R^+$

if $\Delta = 27$ and $a^2 + b^2 + c^2 = 3$ then

A. $\leq 9r^3$

B. $\geq 27r^2$

C. $\leq 27r^2$

D. $\geq 81r^3$

Answer: B



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17. Expand $\begin{vmatrix} 7x & 4 \\ x & 1 \end{vmatrix}$



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18. Expand $\begin{vmatrix} 3 & 2 \\ 1 & 1 \end{vmatrix}$



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19. If $\Delta_n = \begin{vmatrix} a^2 + n & ab & ac \\ ab & b^2 + n & bc \\ ac & bc & c^2 + n \end{vmatrix}$, $n \in N$ and the equation

$x^3 - \lambda x^2 + 11x - 6 = 0$ has roots a, b, c where a, b, c are in AP.

The value of $\sum_{r=1}^{30} \left(\frac{27\Delta_r - \Delta_{3r}}{27r^2} \right)$ is

A. $(12)^3$

B. $(14)^3$

C. $(26)^3$

D. $(28)^3$

Answer: B



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20. Find $\frac{dy}{dx}$ if $x^3 - \lambda x^2 + 11x - 6 = y$



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21. If $\Delta_n = \begin{vmatrix} a^2 + n & ab & ac \\ ab & b^2 + n & bc \\ ac & bc & c^2 + n \end{vmatrix}$, $n \in N$ and the equation

$x^3 - \lambda x^2 + 11x - 6 = 0$ has roots a, b, c where a, b, c are in AP.

The value of $\sum_{r=1}^{30} \left(\frac{27\Delta_r - \Delta_{3r}}{27r^2} \right)$ is

A. 130

B. 190

C. 280

D. 340

Answer: C



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Exercise Single Integer Answer Type Questions

1. If $\begin{vmatrix} 3^2 + k & 4^2 & 3^2 + 3 + k \\ 4^2 + k & 5^2 & 4^2 + 4 + k \\ 5^2 + k & 6^2 & 5^2 + 5 + k \end{vmatrix} = 0$, then $\sqrt{2^k} \sqrt{\sqrt{2^k} \sqrt{\sqrt{2^k} \dots \infty}}$ is ____



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2. Let α, β and γ are three distinct roots of

$$\begin{vmatrix} x - 1 & -6 & 2 \\ -6 & x - 2 & -4 \\ 2 & -4 & x - 6 \end{vmatrix} = 0 \text{ the value of } \left(\frac{1}{\alpha} + \frac{1}{\beta} + \frac{1}{\gamma} \right)^{-1} \text{ is}$$



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3. Expand $\begin{vmatrix} 2 & 4 \\ -5 & -1 \end{vmatrix}$



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4. The value of

$\cos^2 \alpha + \cos^2 \beta + \cos^2 \gamma$ is ____.



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5. Prove that:

$$\begin{vmatrix} (b+c)^2 & a^2 & a^2 \\ b^2 & (c+a)^2 & b^2 \\ c^2 & c^2 & (a+b)^2 \end{vmatrix} = 2abc(a+b+c)^3$$



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6. If $0 \leq \theta \leq \pi$ and the system of equations

$$x = (\sin \theta)y + (\cos \theta)z$$

$$y = z + (\cos \theta)x$$

$$z = (\sin \theta)x + y$$

has a non-trivial solution then $\frac{8\theta}{\pi}$ is equal to



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7. Calculate the value of the determinant

$$\begin{vmatrix} 1 & 1 & 1 & 1 \\ 1 & 2 & 3 & 4 \\ 1 & 3 & 6 & 10 \\ 1 & 4 & 10 & 20 \end{vmatrix}$$



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8. If a, b, c and d are the roots of the equation

$x^4 + 2x^3 + 4x^2 + 8x + 16 = 0$ the value of the determinant

$$\begin{vmatrix} 1+a & 1 & 1 & 1 \\ 1 & 1+b & 1 & 1 \\ 1 & 1 & 1+c & 1 \\ 1 & 1 & 1 & 1+d \end{vmatrix} \text{ is}$$



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9. If $a \neq 0, b \neq 0, c \neq 0$ and $\begin{vmatrix} 1+a & 1 & 1 \\ 1+b & 1+2b & 1 \\ 1+c & 1+c & 1+3c \end{vmatrix} = 0$

the value of $|a^{-1} + b^{-1} + c^{-1}|$ is equal to



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10. If the system of equations

$$ax+hy+g=0 \dots(i)$$

$$hx+by+f=0 \dots(ii)$$

$$\text{and } ax^2 + 2hxy + by^2 + 2gx + 2fy + c + t = 0 \dots(iii)$$

has a unique solution and $\frac{abc + 2fgh - af^2 - bg^2 - ch^2}{h^2 - ab} = 8$, find the

value of 't'.



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Determinants Exercise 5

1. Find the value of x if $A = \begin{vmatrix} 3x & 2 \\ 5x & 1 \end{vmatrix}$ if $|A|= 5$



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2. Find $f'(x)$ if $f(x) = \log(\cos e^x)$



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3. Expand $\begin{vmatrix} 2 & 2x \\ 6 & x \end{vmatrix}$



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4. Find $|A|$ If $A = \begin{vmatrix} 7x & 3 \\ 5 & 6 \end{vmatrix}$



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5. If $|\text{adj}(A)| = 11$ and A is a square matrix of order 2 then find the value of $|A|$



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Exercise Statement I And II Type Questions

1. If $\Delta(r) = \begin{vmatrix} r & r+1 \\ r+3 & r+4 \end{vmatrix}$ then expand it



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2. Expand $\begin{vmatrix} \cos x & -\sin x \\ \sin x & \cos x \end{vmatrix}$



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3. Statement 1: The value of determinant

$$\begin{vmatrix} \sin \pi & \cos\left(x + \frac{\pi}{4}\right) & \tan\left(-\frac{\pi}{4}\right) \\ \sin\left(x - \frac{\pi}{4}\right) & -\cos\left(\frac{\pi}{2}\right) & \ln\left(\frac{x}{y}\right) \\ \cot\left(\frac{\pi}{4} + x\right) & \ln\left(\frac{y}{x}\right) & \tan(\pi) \end{vmatrix} \text{ is zero}$$

Statement 2: The value of skew-symmetric determinant of odd order equals zero.



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4. Statement-1 $f(x) = \begin{vmatrix} (1+x)^{11} & (1+x)^{12} & (1+x)^{13} \\ (1+x)^{21} & (1+x)^{22} & (1+x)^{23} \\ (1+x)^{31} & (1+x)^{32} & (1+x)^{33} \end{vmatrix}$

the cofactor of x in $f(x)=0$

Statement -2 If $P(x)=a_0 + a_1x + a_2x^2 + a_3x^3 + \dots + a_nx^n$ then

$a_1 = P'(0)$, where dash denotes the differential coefficient.



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5. Statement 1: If system of equations $2x + 3y = a$ and $bx + 4y = 5$ has infinite solutions, then $a = \frac{15}{4}$, $b = \frac{8}{5}$

Statement 2: Straight lines $a_1x + b_1y + c_1 = 0$ and $a_2x + b_2y + c_2 = 0$ are parallel if $\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$



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6. Statement -1 The value of the determinant $\begin{vmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 0 \end{vmatrix} \neq 0$

Statement -2 Neither of two rows or columns of $\begin{vmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 0 \end{vmatrix}$ is identical.



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7. The digits A,B,C are such that the three digit numbers A88, 6B8, 86 C are divisible by 72 the determinant

$$\begin{vmatrix} A & 6 & 8 \\ 8 & B & 6 \\ 8 & 8 & C \end{vmatrix}$$
 is divisible by



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Exercise Subjective Type Questions

1. Prove that $\begin{vmatrix} b+c & c & b \\ c & c+a & a \\ b & a & a+b \end{vmatrix} = 4abc$



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2. Prove: $\begin{vmatrix} a-b-c & 2a & 2a \\ 2b & b-c-a & 2b \\ 2c & 2c & c-a-b \end{vmatrix} = (a+b+c)^3$



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3. Find the value of determinant

$$\begin{vmatrix} \sqrt{(13)} + \sqrt{3} & 2\sqrt{5} & \sqrt{5} \\ \sqrt{(15)} + \sqrt{(26)} & 5 & \sqrt{(10)} \\ 3 + \sqrt{(65)} & \sqrt{(15)} & 5 \end{vmatrix}$$



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4. Find the value of the determinant

$$\begin{vmatrix} bc & ca & ab \\ p & q & r \\ 1 & 1 & 1 \end{vmatrix}, \text{ where } a, b, \text{ and } c \text{ are}$$

respectively, the pth, qth, and rth terms of a harmonic progression.



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5. Without expanding the determinant at any stage prove that

$$\begin{vmatrix} -5 & 3 + 5i & \frac{3}{2} - 4i \\ 3 - 5i & 8 & 4 + 5i \\ \frac{3}{2} + 4i & 4 - 5i & 9 \end{vmatrix} \text{ has a purely real value.}$$



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6. Prove without expansion that

$$|ah + bggab + chbf + ba fhb + bcaf + bbg + fc| = a|ah + bgahbf + bahb|$$



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7. In a $\triangle ABC$, if

$$\begin{vmatrix} 1 & 1 & 1 \\ 1 + \sin A & 1 + \sin B & 1 + \sin C \\ \sin A + \sin^2 A & \sin B + \sin^2 B & \sin C + \sin^2 C \end{vmatrix} = 0, \text{ then prove that}$$

$\triangle ABC$ is an isosceles triangle.



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8. The value of $\begin{vmatrix} \beta\gamma & \beta\gamma' + \beta'\gamma & \beta'\gamma' \\ \gamma\alpha & \gamma\alpha' + \gamma'\alpha & \gamma'\alpha' \\ \alpha\beta & \alpha\beta' + \alpha'\beta & \alpha'\beta' \end{vmatrix}$ is



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9. If $y = \frac{u}{v}$, where u & v are functions of 'x' show that $v^3 \frac{d^2y}{dx^2} =$

$$\begin{vmatrix} u & v & 0 \\ u' & v' & v \\ u' & v' & 2v' \end{vmatrix}$$


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10. Show that the determinant $\Delta(x)$ given by $\Delta(x) =$

$$\begin{vmatrix} \sin(x + \alpha) & \cos(x + \alpha) & a + x \sin \alpha \\ \sin(x + \beta) & \cos(x + \beta) & b + x \sin \beta \\ \sin(x + \gamma) & \cos(x + \gamma) & c + x \sin \gamma \end{vmatrix}$$

is independent of x .



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11. Evaluate $\begin{vmatrix} .^x C_1 & .^x C_2 & .^x C_3 \\ .^y C_1 & .^y C_2 & .^y C_3 \\ .^z C_1 & .^z C_2 & .^z C_3 \end{vmatrix}$



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12. (i) Find maximum value of

$$f(x) = \begin{vmatrix} 1 + \sin^2 x & \cos^2 x & 4 \sin 2x \\ \sin^2 x & 1 + \cos^2 x & 4 \sin 2x \\ \sin^2 x & \cos^2 x & 1 + 4 \sin 2x \end{vmatrix}.$$

(ii) Let A,B and C be the angles of triangle such that $A \geq B \geq C$.

Find the minimum value of Δ where

$$\Delta = \begin{vmatrix} \sin^2 A & \sin A \cos A & \cos^2 A \\ \sin^2 B & \sin B \cos B & \cos^2 B \\ \sin^2 C & \sin C \cos C & \cos^2 C \end{vmatrix}.$$



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13. If $f(x) = \begin{vmatrix} x^2 - 4x + 6 & 2x^2 + 4x + 10 & 3x^2 - 2x + 16 \\ x - 2 & 2x + 2 & 3x - 1 \\ 1 & 2 & 3 \end{vmatrix}$ then find

the value of $\int_{-3}^3 \frac{x^2 \sin x}{1 + x^6} f(x) dx$.



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14. If $|A| = 2$ and $A = \begin{vmatrix} 2x & 6 \\ 5x & 1 \end{vmatrix}$ then find the value of x



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15. Show that in general there are three values of t for which the following system of equations has a non-trivial solution $(a-t)x+by+cz=0$, $bx+(c-t)y+az=0$ and $cx+ay+(b-t)z=0$.

Express the product of these values of t in the form of a determinant.



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16. Find $\frac{dy}{dx}$ if $y = 13x - y^2$



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17. If x, y, z are not all zero & if $ax + by + cz = 0, bx + cy + az = 0 \& cx + ay + bz = 0$, then prove that $x:y:z = 1:1:1$ OR $1:\omega:\omega^2$ OR $1:\omega^2:\omega$, where ω is one of the complex cube root of unity.



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Determinants Exercise 7

1. If $Y=sX$ and $Z=tX$ all the variables being functions of x then prove that

$$\begin{vmatrix} X & Y & Z \\ X_1 & Y_1 & Z_1 \\ X_2 & Y_2 & Z_2 \end{vmatrix} = X^3 \begin{vmatrix} s_1 & t_1 \\ s_2 & t_2 \end{vmatrix}$$

where suffixes denote the order of differentiation with respect to x .



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2. If $f, g,$ and h are differentiable functions of x and $(\delta) =$

$$\begin{vmatrix} f & g & h \\ (xf)' & (xg)' & (xh)' \\ (x^2f)'' & (x^2g)'' & (x^2h)'' \\ f & g & h \\ f' & g' & h \\ (x^3f)''' & (x^3g)''' & (x^3h)''' \end{vmatrix} \quad \text{prove that } \delta' =$$



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3. If $|a_1| > |a_2| + |a_3|$, $|b_2| > |b_1| + |b_3|$ and

$|c_2| > |c_1| + |c_2|$ then show that $\begin{vmatrix} a_1 & a_2 & a_3 \\ b_1 & b_2 & b_3 \\ c_1 & c_2 & c_3 \end{vmatrix} \neq 0$.



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Exercise Questions Asked In Previous 13 Years Exam

- 1.** If $a^2 + b^2 + c^2 = -2$ and $f(x) = |1 + a^2x(1 + b^2)x(1 + c^2)x(1 + a^2)x| + b^2x(1 + c^2)x(1 + a^2)x(1 + b^2)x$, then $f(x)$ is a polynomial of degree
a. 3 b. 1 c. 2 d. 3

A. 3

B. 2

C. 1

D. 0

Answer: B



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2. The value of $|\alpha|$ for which the system of equation $\alpha x + y + z = \alpha - 1$
 $x + \alpha y + z = \alpha - 1$ $x + y + \alpha z = \alpha - 1$ has no solutions, is _____.

- A. not -2
- B. 1
- C. -2
- D. Either -2 or 1

Answer: C



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3. if $a_1, a_2, \dots, a_n, \dots$ form a G.P. and $a_1 > 0$, for all $I \geq 1$

$$\begin{vmatrix} \log a_n, & \log a_n + \log a_{n+2}, & \log a_{n+2} \\ \log a_{n+3}, & \log a_{n+3} + \log a_{n+5}, & \log a_{n+5} \\ \log a_{n+6}, & \log a_{n+6} + \log a_{n+8}, & \log a_{n+8} \end{vmatrix}$$

A. 1

B. 0

C. 4

D. 2

Answer: B



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4. If $D = \begin{vmatrix} 1 & 1 & 1 \\ 1 & 1+x & 1 \\ 1 & 1 & 1+y \end{vmatrix}$ for $x \neq 0, y \neq 0$ then D is

A. A. divisible by neither x nor y

B. B. divisible by both x and y

C. C. divisible by x but not y

D. D. divisible by y but not x

Answer: B

5. Consider the system of equations

$$x - 2y + 3z = -1$$

$$-x + y - 2z = k$$

$$x - 3y + 4z = 1$$

Statement -1 The system of equation has no solutions for $k \neq 3$.

statement -2 The determinant $\begin{vmatrix} 1 & 3 & -1 \\ -1 & -2 & k \\ 1 & 4 & 1 \end{vmatrix} \neq 0$, for $k \neq 3$.

A. (a) Statement -1 is true Statement -2 is true and Statement -2 is

correct explanation for Statement -1.

B. (b) Statement -1 is true Statement -2 is true and Statement -2 is not a

correct explanation for Statement -1.

C. (c) Statement -1 is true Statement -2 is false.

D. (d) Statement-1 is false, Statement -2 is true.

Answer: A



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6. Let a, b, c , be any real number. Suppose that there are real numbers x, y, z not all zero such that $x = cy + bz$, $y = az + cx$ and $z = bx + ay$. Then $a^2 + b^2 + c^2 + 2abc$ is equal to

A. -1

B. 0

C. 1

D. 2

Answer: C



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7. Let a, b, c be such that $b(a+c) \neq 0$. If

$$\begin{vmatrix} a & a+1 & a-1 \\ -b & b+1 & b-1 \\ c & c-1 & c+1 \end{vmatrix} + \begin{vmatrix} a+1 & b+1 & c-1 \\ a-1 & b-1 & c+1 \\ (-1)^{n+2}a & (-1)^{n+1}b & (-1)^nc \end{vmatrix} = 0,$$

Then the value of 'n' is:

- A. any integer
- B. zero
- C. an even integer
- D. any odd integer

Answer: D



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8. If $f(\theta) = \begin{vmatrix} 1 & \tan \theta & 1 \\ -\tan \theta & 1 & \tan \theta \\ -1 & -\tan \theta & 1 \end{vmatrix}$ then the set $\left\{ f(\theta) : 0 \leq \theta < \frac{\pi}{2} \right\}$

is

A. $(-\infty, -1) \cup (1, \infty)$

B. $[2, \infty)$

C. $(-\infty, 0] \cup [2, \infty)$

D. $(-\infty, -1] \cup [1, \infty)$

Answer: B



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9. The number of values of k for which the linear equations

$$4x + ky + 2z = 0$$

$$kx + 4y + z = 0$$

$$2x + 2y + z = 0$$

possess a non-zero solution is

A. zero

B. 3

C. 2

D. 1

Answer: C



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10. If the trivial solution is the only solution of the system of equations $x - ky + z = 0$, $kx + 3y - kz = 0$ and $3x + y - z = 0$. Then, set of all values of k is :

- A. $\{2, -3\}$
- B. $\mathbb{R} - \{2, -3\}$
- C. $\mathbb{R} - \{2\}$
- D. $\mathbb{R} - \{-3\}$

Answer: B



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11. The number of values of k , for which the system of equations $(k+1)x + 8y = 4k$, $kx + (k+3)y = 3k - 1$ has no solution, is (1) 1 (2) 2 (3) 3 (4) infinite

- A. 1
- B. 2

C. 3

D. infinite

Answer: A



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12. if $\alpha, \beta, \neq 0$ and $f(n) = \alpha^n + \beta^n$

and
$$\begin{vmatrix} 3 & 1 + f(1) & 1 + f(2) \\ 1 + f(1) & 1 + f(2) & 1 + f(3) \\ 1 + f(2) & 1 + f(3) & 1 + f(4) \end{vmatrix}$$

$= k(1 - \alpha)^2(1 - \beta)^2(\alpha - \beta)^2$ then k is equal to

A. 1

B. -1

C. $\alpha\beta$

D. $1/\alpha\beta$

Answer: A



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13. The set of all values of λ for which the system of linear equations

$$2x_1 - 2x_2 + x_3 = \lambda x_1$$

$$2x_1 - 3x_2 + 2x_3 = \lambda x_2$$

$$-x_1 + 2x_2 = \lambda x_3$$

has a non-trivial solution,

- A. contains two elements
- B. contains more than two elements
- C. is an empty set
- D. is a singleton

Answer: A

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14. Which of the following values of α satisfying the equation

$$|(1+\alpha)^2(1+2\alpha)^2(1+3\alpha)^2(2+\alpha)^2(2+2\alpha)^2(2+3\alpha)^2(3+\alpha)^2(3+2\alpha)|$$

- 4 b. 9 c. - 9 d. 4

A. -4

B. 9

C. -9

D. 4

Answer: B::C



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15. The system of linear equations $x + \lambda y - z = 0$, $\lambda x - y - z = 0$, $x + y - \lambda z = 0$ has a non-trivial solution for : (1) infinitely many values of λ . (2) exactly one value of λ . (3) exactly two values of λ . (4) exactly three values of λ .

A. exactly one-value of λ

B. exactly two values of λ

C. exactly three values of λ

D. infinitely many values of λ

Answer: C



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16. The total number of distinct $x \in R$ for which

$$\begin{vmatrix} x & x^2 & 1 + x^3 \\ 2x & 4x^2 & 1 + 8x^3 \\ 3x & 9x^2 & 1 + 27x^3 \end{vmatrix} = 10 \quad \text{is } \underline{\hspace{2cm}}$$



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17. Let $\alpha, \lambda, \mu \in R$. Consider the system of linear equations

$$\alpha x + 2y = \lambda$$

$$3x - 2y = \mu$$

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

- A. If $\alpha = -3$, then the system has infinitely many solutions for all values of λ and μ

B. If $a \neq -3$, then the system has a unique solution for all values of λ and μ

C. If $\lambda + \mu = 0$, then the system has infinitely many solutions for $a = -3$

D. If $\lambda + \mu \neq 0$ then the system has no solution for $a = -3$

Answer: B::C::D



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18. If S is the set of distinct values of ' b ' for which the following system of linear equations

$$x + y + z = 1$$

$$x + ay + z = 1$$

$$ax + by + z = 0$$

has no solution then S is

A. an infinite set

B. a finite set containing two or more elements

C. a singleton

D. an empty set

Answer: C



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