



## MATHS

### BOOKS - CHHAYA PUBLICATION MATHS (BENGALI ENGLISH)

#### DETERMINANT

##### Example

1. Evaluate  $\begin{vmatrix} 4 & 3 \\ 7 & 8 \end{vmatrix}$



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2.  $\begin{vmatrix} a & b & c \\ b & c & a \\ c & a & b \end{vmatrix}$



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$$3. \begin{vmatrix} 1 & 3 & 5 \\ 2 & 4 & 3 \\ 4 & 6 & 7 \end{vmatrix}$$



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$$4. \text{ Solve: } \begin{vmatrix} 1 & -3 & 5 \\ -2 & 4 & 3 \\ 4 & 5 & 6 \end{vmatrix}$$



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$$5. \begin{vmatrix} 4 & -7 \\ -3 & 2 \end{vmatrix}$$



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



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



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$$8. \begin{vmatrix} 2 & 0 & -1 \\ -3 & 5 & 2 \\ 4 & -3 & 6 \end{vmatrix}$$



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



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$$10. \text{ Evaluate : } \begin{vmatrix} 2 & 1 & -3 \\ 3 & -2 & 4 \\ 5 & 3 & 2 \end{vmatrix}$$



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11. Find the value of 
$$\begin{vmatrix} 0 & 2 & -3 \\ 1 & 2 & 4 \\ -2 & 3 & 2 \end{vmatrix} \times \begin{vmatrix} 2 & 0 & -3 \\ 3 & 1 & 0 \\ 0 & 4 & -2 \end{vmatrix}$$



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12. Find the adjoint and reciprocal determinants of 
$$\begin{vmatrix} 4 & 1 & 2 \\ 7 & 3 & 5 \\ 5 & 1 & 3 \end{vmatrix}$$



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13. Find the adjoint and reciprocal determinants of 
$$\begin{vmatrix} -4 & 1 & 2 \\ 2 & -1 & 0 \\ -3 & 1 & 3 \end{vmatrix}$$



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14. Using determinant find the area of the triangle formed by joining the point  $(-3,-5)$ ,  $(5,2)$  and  $(-9,-3)$ .



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15. Solve by cramer's rule :  $2x-z=1$ ,  $2x+4y-z=1$ ,  $x-8y-3z=-2$ .



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16. Solve by cramer's rule :  $3x+y+z =10$ ,  $x+y-z=0$ ,  $5x-9y=1$



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17. Solve by cramer's rule :

$$x+y+z=1$$

$$x+2y+3z=4$$

$$x+3y+5z=7$$



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**18.** Solve the following system of homogeneous equations.

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



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**19.** Solve the following system of homogeneous equations:

$$x+y-z=0, x-2y+z=0, 3x+6y-5z=0$$



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$$20. \begin{vmatrix} x - 1 & 1 \\ x^3 & x^2 + x + 1 \end{vmatrix}$$



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$$21. \begin{vmatrix} \log_3 512 & \log_4 3 \\ \log_3 8 & \log_4 9 \end{vmatrix}$$



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$$22. \begin{vmatrix} 1 & -3 & 2 \\ 4 & -1 & 2 \\ 3 & 5 & 2 \end{vmatrix}$$



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$$23. \begin{vmatrix} 0 & a & -b \\ -a & 0 & c \\ b & -c & 0 \end{vmatrix}$$



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$$24. \begin{vmatrix} a & h & g \\ h & b & f \\ g & f & c \end{vmatrix}$$



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$$25. \begin{vmatrix} x + 1 & -3 & 4 \\ -5 & x + 2 & 2 \\ 4 & 1 & x - 6 \end{vmatrix}$$



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$$26. \begin{vmatrix} -1 & 6 & -2 \\ 2 & 1 & 1 \\ 4 & 1 & -3 \end{vmatrix}$$



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$$27. \begin{vmatrix} a & b & c \\ a + 2x & b + 2y & c + 2z \\ x & y & z \end{vmatrix}$$



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$$28. \begin{vmatrix} \cos \alpha \cos \beta & \cos \alpha \sin \beta & -\sin \alpha \\ -\sin \beta & \cos \beta & 0 \\ \sin \alpha \cos \beta & \sin \alpha \sin \beta & \cos \alpha \end{vmatrix}$$



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$$29. \begin{vmatrix} 12 & 7 & 0 \\ 5 & 8 & 3 \\ 6 & 7 & 0 \end{vmatrix}$$



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$$30. \begin{vmatrix} 5 & 2 & 3 \\ 7 & 3 & 4 \\ 9 & 4 & 5 \end{vmatrix} = 0$$



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$$31. \begin{vmatrix} 0 & a & -b \\ -a & 0 & c \\ b & -c & 0 \end{vmatrix} = 0$$



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$$32. \begin{vmatrix} 1 & a & bc \\ 1 & b & ca \\ 1 & c & ab \end{vmatrix} = \begin{vmatrix} 1 & a & a^2 \\ 1 & b & b^2 \\ 1 & c & c^2 \end{vmatrix}$$



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$$33. \begin{vmatrix} a+b & 2a+b & 3a+b \\ 2a+b & 3a+b & 4a+b \\ 4a+b & 5a+b & 6a+b \end{vmatrix} = 0$$



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34. Without expanding, prove that  $\begin{bmatrix} 41 & 1 & 5 \\ 79 & 7 & 9 \\ 29 & 5 & 3 \end{bmatrix} = 0$



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35.  $\begin{vmatrix} 1 & a & b + c \\ 1 & b & c + a \\ 1 & c & a + b \end{vmatrix} = 0$



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36.  $\begin{vmatrix} 1 & bc & a(b + c) \\ 1 & ca & b(c + a) \\ 1 & ab & c(a + b) \end{vmatrix} = 0$



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$$37. \begin{vmatrix} 1 & 3 & 5 \\ 2 & 6 & 10 \\ 31 & 11 & 38 \end{vmatrix} = 0$$



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$$38. \begin{vmatrix} 0 & x & y \\ -x & 0 & z \\ -y & -z & 0 \end{vmatrix} = 0$$



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39. Prove that ,

$$\begin{vmatrix} 1 + a_1 & 1 & 1 \\ 1 & 1 + a_2 & 1 \\ 1 & 1 & 1 + a_3 \end{vmatrix} = a_1 a_2 a_3 \left( 1 + \frac{1}{a_1} + \frac{1}{a_2} + \frac{1}{a_3} \right)$$



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$$40. \text{ Evaluate: } \begin{vmatrix} 1 & \omega^3 & \omega^2 \\ \omega^3 & 1 & \omega \\ \omega^2 & \omega & 1 \end{vmatrix}, \text{ where } \omega \text{ is an imaginary cube root of unity .}$$



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$$41. \begin{vmatrix} a+x & y & z \\ x & a+y & z \\ x & y & a+z \end{vmatrix} = a^2(a+x+y+z)$$



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$$42. \begin{vmatrix} 0 & ab^2 & ac^2 \\ a^2b & 0 & bc^2 \\ a^2c & cb^2 & 0 \end{vmatrix} = 2a^3b^3c^3$$



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$$43. \begin{vmatrix} x+y & x & x \\ 5x+4y & 4x & 2x \\ 10x+8y & 8x & 3x \end{vmatrix} = x^3$$



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$$44. \begin{vmatrix} a & b & c \\ a-b & b-c & c-a \\ b+c & c+a & a+b \end{vmatrix} = a^3 + b^3 + c^3 - 3abc$$



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$$45. \begin{vmatrix} 1 & a & a^2 - bc \\ 1 & b & b^2 - ca \\ 1 & c & c^2 - ab \end{vmatrix} = 0$$



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$$46. \begin{vmatrix} y+z & z & y \\ z & z+x & x \\ y & x & x+y \end{vmatrix} = 4xyz$$



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$$47. \text{ if } x^3 = 1, \text{ prove: } \begin{vmatrix} a & b & c \\ b & c & a \\ c & a & b \end{vmatrix} = (a + bx + cx^2) \begin{vmatrix} 1 & b & c \\ x^2 & c & a \\ x & a & b \end{vmatrix}$$



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48. prove that,  $\begin{vmatrix} 2a & a-b-c & 2a \\ 2b & 2b & b-c-a \\ c-a-b & 2c & 2c \end{vmatrix} = (a+b+c)^3$

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49. prove that ,

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

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50. prove that ,  $\begin{vmatrix} \sin A & \cos A & \sin(A+\theta) \\ \sin B & \cos B & \sin(B+\theta) \\ \sin C & \cos C & \sin(C+\theta) \end{vmatrix} = 0$

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51. prove that,

$$\begin{vmatrix} 1 & \cos x - \sin x & \cos x + \sin x \\ 1 & \cos y - \sin y & \cos y + \sin y \\ 1 & \cos z - \sin z & \cos z + \sin z \end{vmatrix} = 2 \begin{vmatrix} 1 & \cos x & \sin x \\ 1 & \cos y & \sin y \\ 1 & \cos z & \sin z \end{vmatrix}$$



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52. solve :  $\begin{vmatrix} 2-x & 2 & 3 \\ 2 & 5-x & 6 \\ 3 & 4 & 10-x \end{vmatrix} = 0$



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53. prove that,  $\begin{vmatrix} -bc & b^2 + bc & c^2 + bc \\ a^2 + ac & -ac & c^2 + ac \\ a^2 + ab & b^2 + ab & -ab \end{vmatrix} = (ab + bc + ca)^3$



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54. Evaluate :  $\begin{vmatrix} a & b & 0 \\ c & 0 & a \\ 0 & c & b \end{vmatrix}$ . Express the square of this determinant as a third order determinant. What is the value of this determinant ?



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55. Using properties of determinants , prove that,

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

and                          hence                          show                          that,

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



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56. if  $x+y+z=0$  , then show that,  $\begin{vmatrix} 1 & 1 & 1 \\ x & y & z \\ x^3 & y^3 & z^3 \end{vmatrix} = 0$



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57. Without expanding prove that ,

$$\begin{vmatrix} 1 & ab & \frac{1}{a} + \frac{1}{b} \\ 1 & bc & \frac{1}{b} + \frac{1}{c} \\ 1 & ca & \frac{1}{c} + \frac{1}{a} \end{vmatrix} = 0$$



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58. prove that ,

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



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59. prove that,

$$\begin{vmatrix} 1 & \log_x y & \log_x z \\ \log_y x & 1 & \log_y z \\ \log_z x & \log_z y & 1 \end{vmatrix} = 0$$



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60. If A,B,C be angles of a triangle, then prove that,

$$\begin{vmatrix} -1 & \cos C & \cos B \\ \cos C & -1 & \cos A \\ \cos B & \cos A & -1 \end{vmatrix} = 0$$



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61. Evaluate : 
$$\begin{vmatrix} \cos^2 \theta & \cos \theta \sin \theta & -\sin \theta \\ \cos \theta \sin \theta & \sin^2 \theta & \cos \theta \\ \sin \theta & -\cos \theta & 0 \end{vmatrix}$$



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62. prove that,

$$\begin{vmatrix} \sin^2 \alpha & \sin \alpha \cos \alpha & \cos^2 \alpha \\ \sin^2 \beta & \sin \beta \cos \beta & \cos^2 \beta \\ \sin^2 \gamma & \sin \gamma \cos \gamma & \cos^2 \gamma \end{vmatrix} = -\sin(\alpha - \beta)\sin(\beta - \gamma)\sin(\gamma - \alpha)$$



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63. If omega is an imaginary cube root of unity , prove that,

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



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**64.** If  $2s = a+b+c$ , prove that,

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



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**65.** prove that,

$$\begin{vmatrix} x & b & c \\ a & y & c \\ a & b & z \end{vmatrix} = (x-a)(y-b)(z-c) \left( \frac{x}{x-a} + \frac{y}{y-b} + \frac{z}{z-c} - 2 \right)$$



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**66.** If  $\Delta_1 = \begin{vmatrix} a & b & c \\ x & y & z \\ p & q & r \end{vmatrix}$  and  $\Delta_2 = \begin{vmatrix} q & -b & y \\ -p & a & -x \\ r & -c & z \end{vmatrix}$  then without expanding

$\Delta_1$  and  $\Delta_2$ , prove that  $\Delta_1 + \Delta_2 = 0$



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67. Without expanding prove that ,

$$\begin{vmatrix} a + bx & c + dx & p + qx \\ ax + b & cx + d & px + q \\ u & v & w \end{vmatrix} = (1 - x^2) \begin{vmatrix} a & c & p \\ b & d & q \\ u & v & w \end{vmatrix}$$



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68. Evaluate :  $\begin{vmatrix} a & a+b & a+b+c \\ 2a & 3a+2b & 4a+3b+2c \\ 3a & 6a+3b & 10a+6b+3c \end{vmatrix}$



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69. Evaluate :  $D = \begin{vmatrix} 1 & a & a^2 \\ 1 & b & b^2 \\ 1 & c & c^2 \end{vmatrix}$



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70.

Prove

that,

$$\begin{vmatrix} \alpha & \beta & \gamma \\ \alpha^2 & \beta^2 & \gamma^2 \\ \beta + \gamma & \gamma + \alpha & \alpha + \beta \end{vmatrix} = (\alpha - \beta)(\beta - \gamma)(\gamma - \alpha)(\alpha + \beta + \gamma)$$



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71. Prove that :  $\begin{vmatrix} a & b & c \\ a^2 & b^2 & c^2 \\ bc & ca & ab \end{vmatrix} = (a - b)(b - c)(c - a)(ab + bc + ca)$



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72. For any scalar  $c$  prove that,

$$\begin{vmatrix} x & x^2 & 1 + cx^3 \\ y & y^2 & 1 + cy^3 \\ z & z^2 & 1 + cz^3 \end{vmatrix} = (1 + cxyz)(x - y)(y - z)(z - x)$$



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73. Evaluate : 
$$\begin{vmatrix} 10! & 11! & 12! \\ 11! & 12! & 13! \\ 12! & 13! & 14! \end{vmatrix}$$



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74. if  $a, b, c$ , are all distinct and  $\begin{vmatrix} a & a^3 & a^4 - 1 \\ b & b^3 & b^4 - 1 \\ c & c^3 & c^4 - 1 \end{vmatrix} = 0$ , show that

$$abc(ab+bc+ca)=a+b+c.$$



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75. Show that,

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



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**76.** If  $a, b, c$  are all positive and are  $p$ -th,  $q$ -th and  $r$ -th terms of a G.P., then

show that  $\begin{vmatrix} \log a & p & 1 \\ \log b & q & 1 \\ \log c & r & 1 \end{vmatrix} = 0$ .



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**77.** If  $a_1, a_2, \dots, a_n$  are in G.P. then evaluate.:

$$\begin{vmatrix} \log a_n, \log a_{n+1}, \log a_{n+2} \\ \log a_{n+3}, \log a_{n+4}, \log a_{n+5} \\ \log a_{n+6}, \log a_{n+7}, \log a_{n+8} \end{vmatrix} = 0$$



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**78.** If  $a^2 + b^2 + c^2 = -2$  and

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

then find the degree of the polynomial  $f(x)$ .



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79. Evaluate:  $f(x) = \begin{vmatrix} 1 & 1 & 1 \\ (e^x + e^{-x})^2 & (\pi^x + \pi^{-x})^2 & 2 \\ (e^x - e^{-x})^2 & (\pi^x - \pi^{-x})^2 & -2 \end{vmatrix}$



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80. solve :  $\begin{vmatrix} a+x & a-x & a-x \\ a-x & a+x & a-x \\ a-x & a-x & a+x \end{vmatrix} = 0$



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81. Solve :  $\begin{vmatrix} a+x & a-x & a-x \\ a-x & a+x & a-x \\ a-x & a-x & a+x \end{vmatrix} = 0$



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82. Evaluate  $\begin{vmatrix} 0 & c & b \\ c & 0 & a \\ b & a & 0 \end{vmatrix}$  and hence show that,

$$\begin{vmatrix} -a^2 & ab & ac \\ ab & -b^2 & bc \\ ca & bc & -c^2 \end{vmatrix} = 4a^2b^2c^2$$



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83. Using determinant find the area of the triangle whose vertices are (a  $\cos \alpha, b \sin \alpha$  ), (a  $\cos \beta, b \sin \beta$ ) and (a  $\cos \gamma, b \sin \gamma$ ).



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84. The coordinates of the vertices of a triangle are [m(m+1),m+1],[(m+1)(m+2),m+2] and [(m+2)(m+3), m+3], show that the area of the triangle is independent of m



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85. solve by cramer's rule :  $x+y+z=1$  ,  $ax+by+cz=k$ ,

$$a^2x + b^2y + c^2z = k^2 [a \neq b \neq c].$$



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86. Show that the following system of equations has no solutions:

$$3x+2y+3z=2, 5x+7y+5z=3, 4x+5y+4z=4$$



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87. Show that the following system of equations has infinite number of solutions:

$$2x-3y+4z=7, 3x-4y+5z=8, 4x-5y+6z=9$$



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**88.** Eliminate  $x$ ,  $y$  and  $z$  from the following equation:

$$\frac{bx}{y+z} = a, \frac{cy}{z+x} = b, \frac{az}{x+y} = c$$



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**89.** If  $A(x_1, y_1)$ ,  $B(x_2, y_2)$  and  $C(x_3, y_3)$  are vertices of an equilateral triangle whose each side is equal to a unit , then prove that,

$$\begin{vmatrix} x_1 & y_1 & 2 \\ x_2 & y_2 & 2 \\ x_3 & y_3 & 2 \end{vmatrix}^2 = 3a^4$$



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**90.** If the points  $(a_1, b_1)$ ,  $(a_2, b_2)$  and  $(a_1 + a_2, b_1 + b_2)$  are collinear ,show that  $a_1b_2 = a_2b_1$ .



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91. If the system of homogeneous equations  $(a-1)x + (a+2)y + az = 0$ ,  $(a+1)x + ay + (a+2)z = 0$  and  $ax + (a+1)y + (a-1)z = 0$  has a non-trivial solution, then find the value of  $a$ .



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92. 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  $ab+bc+ca = abc$ .



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93. Find the value  $\theta$  for which the homogeneous system of equations:  $(\sin 3\theta)x - y + z = 0$ ,  $(\cos 2\theta)x + 4y + 3z = 0$  and  $2x + 7y + 7z = 0$  has non-trivial solutions.



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## Exercise 2 A

1. Choose the correct option

The value of  $\begin{vmatrix} a & b & a \\ a & b & b \\ a & b & c \end{vmatrix}$  is....

A. -1

B. 1

C. 0

D. 2

Answer: C



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2. Choose the correct option

The expression  $x_1(y_2-y_3)+x_2(y_3-y_1)+x_3(y_1-y_2)$ , when written in the form of a determinant of 3rd order ,it will be



Next

3. If  $D = \begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix}$  and  $A_1, B_1, C_1$  etc. are the respective cofactors of the elements  $a_1, b_1, c_1$  etc. then  $D$  will be-

A.  $a_2C_2 + b_2C_2 + c_2C_2$

B.  $c_1C_1 + c_2C_2 + c_3C_3$

C.  $a_1A_1 + b_1B_1 + c_1C_1$

D.  $a_1B_1 + a_2B_2 + a_3B_3$

**Answer: B**



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4. state which of the statement is true ?

A. A determinant has got a definite value .

- B. The cofactor of an element in a given determinant is equal to the minor of that element .
- C. The value of the determinant changes if its rows and columns are interchanged.
- D. If first row and first column of a determinant are identical , then the value of determinant is zero .

**Answer: A**



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5. The value of the determinant formed by the elements of an identity matrix is always

A. 1

B. -1

C. 2

**Answer: A****Watch Video Solution**

6. if  $\begin{vmatrix} 3x & 7 \\ 2 & 4 \end{vmatrix} = 10$ , find the value of x.

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7. If  $A = \begin{vmatrix} 1 & 2 \\ 4 & 2 \end{vmatrix}$ , then show that  $|2A|=2|A|$ .

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8. Evaluate:  $\begin{vmatrix} a + ib & c + id \\ -c + id & a - ib \end{vmatrix}$

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9. If  $\begin{vmatrix} x-2 & -3 \\ 3x & 2x \end{vmatrix} = 3$ , find the value of x .



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10. Show that  $\begin{vmatrix} \cos 15^\circ, \sin 15^\circ \\ \sin 75^\circ, \cos 75^\circ \end{vmatrix} = 0$



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11. Find the value of x if ,

$$\begin{vmatrix} 2 & 4 \\ 5 & 1 \end{vmatrix} = \begin{vmatrix} 2x & 4 \\ 6 & x \end{vmatrix}$$



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12. Find the value of x if ,

$$\begin{vmatrix} 3 & x \\ x & 1 \end{vmatrix} = \begin{vmatrix} 3 & 2 \\ 4 & 1 \end{vmatrix}$$



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$$13. \begin{vmatrix} -1 & 1 & 1 \\ 2 & -2 & 2 \\ 3 & 3 & -3 \end{vmatrix}$$



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



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$$15. \begin{vmatrix} 1 & 4 & -3 \\ -4 & 1 & 2 \\ 3 & -2 & 1 \end{vmatrix}$$



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$$16. \begin{vmatrix} x & z & 0 \\ 0 & y & y \\ z & 0 & x \end{vmatrix}$$



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$$17. \begin{vmatrix} 1 & a & bc \\ 1 & b & ca \\ 1 & c & ab \end{vmatrix}$$



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$$18. \begin{vmatrix} 1 & 1 & 1 \\ 1 & 1+x & 1 \\ 1 & 1 & 1+y \end{vmatrix}$$



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$$19. \begin{vmatrix} 1+a & b & c \\ a & 1+b & c \\ a & b & 1+c \end{vmatrix}$$



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$$20. \begin{vmatrix} 1 & z & -y \\ -z & 1 & x \\ y & -x & 1 \end{vmatrix}$$



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$$21. \begin{vmatrix} -a & a & a \\ b & -b & b \\ c & c & -c \end{vmatrix}$$



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$$22. \begin{vmatrix} 0 & \sin \alpha & -\cos \beta \\ \cos \alpha & 0 & \sin \beta \\ \cos \alpha & -\sin \beta & 0 \end{vmatrix}$$



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$$23. \text{ write minor and cofactor ; } \begin{vmatrix} 5 & 2 \\ 0 & -1 \end{vmatrix}$$



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$$24. \text{ write minor and cofactor ; } \begin{vmatrix} -1 & 4 \\ 2 & 3 \end{vmatrix}$$



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25. write down the minor and cofactor

$$\begin{vmatrix} 1 & a & bc \\ 1 & b & ca \\ 1 & c & ab \end{vmatrix}$$



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26. write down the minor and cofactor

$$\begin{vmatrix} 0 & 2 & 6 \\ 1 & 5 & 0 \\ 3 & 7 & 1 \end{vmatrix}$$



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27. Evaluate the determinant

$$\begin{vmatrix} 2 & 3 & -5 \\ 7 & 1 & -2 \\ -3 & 4 & 1 \end{vmatrix} \text{ by expansion with sarrus rule.}$$



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28. 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

find the value of the determinant

$$\begin{vmatrix} [x] + 1 & [y] & [z] \\ [x] & [y] + 1 & [z] \\ [x] & [y] & [z] + 1 \end{vmatrix}$$



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29. Evaluate the determinant  $D = \begin{vmatrix} 1 & \sin \theta & 1 \\ -\sin \theta & 1 & \sin \theta \\ -1 & -\sin \theta & 1 \end{vmatrix}$ . Also prove that

$$2 \leq D \leq 4.$$



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30. Find the minors and the cofactors of each element of the first column

of the following determinant D and hence find its

value where  $D = \begin{vmatrix} 2 & 4 & 1 \\ 8 & 5 & 2 \\ -1 & 3 & 7 \end{vmatrix}$



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31. If  $A = \begin{bmatrix} 1 & 3 \\ 2 & 1 \end{bmatrix}$ , find the determinant of the matrix  $A^2 - 2A$ .



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32. If  $A = \begin{bmatrix} 1 & 0 & 1 \\ 0 & 1 & 2 \\ 0 & 0 & 4 \end{bmatrix}$ , then show that  $|3A| = 27|A|$ .



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33. If  $A = \begin{bmatrix} 2 & 5 \\ 2 & 1 \end{bmatrix}$  and  $B = \begin{bmatrix} 4 & -3 \\ 2 & 5 \end{bmatrix}$ , verify that  $|AB| = |A||B|$ .



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34. If  $f(\theta) = \begin{vmatrix} \cos^2 \theta & \cos \theta \sin \theta & -\sin \theta \\ \cos \theta \sin \theta & \sin^2 \theta & \cos \theta \\ \sin \theta & -\cos \theta & 0 \end{vmatrix}$ , then find the value of  $f\left(\frac{\pi}{6}\right)$ .



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35. Find the integral value of x if  $\begin{vmatrix} x^2 & x & 1 \\ 0 & 2 & 1 \\ 3 & 1 & 4 \end{vmatrix} = 28$



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36. prove that :  $\begin{vmatrix} 1 & a & b \\ -a & 1 & c \\ -b & -c & 1 \end{vmatrix} = 1 + a^2 + b^2 + c^2$



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## Exercise 2 B

1. If two rows (or two columns ) of a determinant are identical , then the value of the determinant is

A. 1

B. 2

C. -1

D. none of these

**Answer: D**



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2. The determinant  $\begin{vmatrix} a & b & a\alpha + b \\ b & c & a\alpha + c \\ a\alpha + b & b\alpha + c & 0 \end{vmatrix} = 0$  if  $a, b, c$  are in

A. A.P

B. G.P

C. H.P

D. none of these

**Answer: B**



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3. Given that  $x=9$  is a root of  $\begin{vmatrix} x & 3 & 7 \\ 2 & x & 2 \\ 7 & 6 & x \end{vmatrix} = 0$  then the other two roots are

- A.  $-2, 7$
- B.  $2, -7$
- C.  $2, 7$
- D.  $-2, -7$

**Answer: C**



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4. Let  $p\lambda^4 + q\lambda^3 + r\lambda^2 + s\lambda + t = \begin{vmatrix} \lambda^2 + 3\lambda & \lambda - 1 & \lambda - 3 \\ \lambda - 1 & -2\lambda & \lambda - 4 \\ \lambda - 3 & \lambda + 3 & 3\lambda \end{vmatrix}$  be an identity in  $\lambda$  where  $p, q, r, s$  and  $t$  are constants. Then the value of  $t$  is

- A.  $-3$
- B.  $3$

C. -6

D. 6

**Answer: A**



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5. The value of  $\theta$  lying between  $\theta=0$  and  $\theta = \frac{\pi}{2}$  and satisfying the equation

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

A.  $\frac{7\pi}{24}, \frac{11\pi}{24}$

B.  $\frac{\pi}{24}, \frac{3\pi}{4}$

C.  $\frac{\pi}{2}, \frac{3\pi}{2}$

D.  $\pi, 3\pi$

**Answer: A**



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6. Evaluate the determinants

$$\begin{vmatrix} 1 & a & a^2 \\ 1 & b & b^2 \\ 1 & c & c^2 \end{vmatrix}.$$



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7. Evaluate the determinants

$$\begin{vmatrix} x+4 & x & x \\ x & x+4 & x \\ x & x & x+4 \end{vmatrix}$$



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8. Let  $A = \begin{vmatrix} 1 & \sin \theta & 1 \\ -\sin \theta & 1 & \sin \theta \\ -1 & -\sin \theta & 1 \end{vmatrix}$ , where  $0 \leq \theta \leq 2\pi$ , then

A.  $|A|=0$

B.  $|A| \in (2, \infty)$

C.  $|a| \in (2, 4)$

D.  $|A| \in [2, 4]$

**Answer: D**



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**9.** Let A be a square matrix of order  $3 \times 3$ , then  $|KA|$  is equal to

A.  $K|A|$

B.  $K^2|A|$

C.  $K^3|A|$

D.  $3K|A|$

**Answer: C**



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**10.** 
$$\begin{vmatrix} \alpha & \beta & \gamma \\ \alpha^2 & \beta^2 & \gamma^2 \\ \beta + \gamma & \gamma + \alpha & \alpha + \beta \end{vmatrix}$$



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$$11. \begin{vmatrix} x & a & b \\ a & x & b \\ a & b & x \end{vmatrix}$$



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$$12. \begin{vmatrix} 2 & 3 & 4 \\ 3 & 4 & 5 \\ 4 & 5 & 6 \end{vmatrix} = 0$$



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$$13. \begin{vmatrix} a & b & c \\ x & y & z \\ p & q & r \end{vmatrix} = \begin{vmatrix} x & y & z \\ p & q & r \\ a & b & c \end{vmatrix} = \begin{vmatrix} y & b & q \\ x & a & p \\ z & c & r \end{vmatrix}$$



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$$14. \begin{vmatrix} 1 & \omega & \omega^2 \\ \omega & \omega^2 & 1 \\ \omega^2 & 1 & \omega \end{vmatrix} = 0 \text{ where } \omega \text{ is an imaginary cube root of unity.}$$



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$$15. \begin{vmatrix} b+c & a & 1 \\ c+a & b & 1 \\ a+b & c & 1 \end{vmatrix} = 0$$



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$$16. \begin{vmatrix} a-b & 1 & a \\ b-c & 1 & b \\ c-a & 1 & c \end{vmatrix} = \begin{vmatrix} a & 1 & b \\ b & 1 & c \\ c & 1 & a \end{vmatrix}$$



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$$17. \begin{vmatrix} a+1 & a+4 & a+2 \\ a+2 & a+5 & a+4 \\ a+3 & a+6 & a+6 \end{vmatrix} = 0$$



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$$18. \begin{vmatrix} 0 & a & b \\ -a & 0 & c \\ -b & -c & 0 \end{vmatrix}$$



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$$19. \begin{vmatrix} 9 & 9 & 12 \\ 1 & -3 & -4 \\ 1 & 9 & 12 \end{vmatrix} = 0$$



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$$20. \begin{vmatrix} a & a^2 & bc \\ b & b^2 & ca \\ c & c^2 & ab \end{vmatrix} = \begin{vmatrix} 1 & a^2 & a^3 \\ 1 & b^2 & b^3 \\ 1 & c^2 & c^3 \end{vmatrix}$$



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$$21. \begin{vmatrix} 441 & 442 & 443 \\ 445 & 446 & 447 \\ 449 & 450 & 451 \end{vmatrix} = 0$$



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22. Prove  $\begin{vmatrix} \cos(x-a) & \cos(x+a) & \cos x \\ \sin(x+a) & \sin(x-a) & \sin x \\ \cos a \tan x & \cos a \cot x & \cos ec2x \end{vmatrix} = 0$



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23.  $\begin{vmatrix} 101 & 103 & 105 \\ 104 & 105 & 106 \\ 107 & 108 & 109 \end{vmatrix} = 0$



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24.  $\begin{vmatrix} 5^2 & 5^3 & 5^4 \\ 5^3 & 5^4 & 5^5 \\ 5^4 & 5^6 & 5^7 \end{vmatrix} = 0$



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25.  $\begin{vmatrix} 1 & \alpha & \alpha^2 \\ 1 & \beta & \beta^2 \\ 1 & \gamma & \gamma^2 \end{vmatrix} = (\alpha - \beta)(\beta - \gamma)(\gamma - \alpha)$



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$$26. \begin{vmatrix} 1 & 1 & 1 \\ a & b & c \\ bc & ca & ab \end{vmatrix} = (a - b)(b - c)(c - a)$$



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$$27. \begin{vmatrix} 1 & \alpha & \alpha^3 \\ 1 & \beta & \beta^3 \\ 1 & \gamma & \gamma^3 \end{vmatrix} = (\alpha - \beta)(\beta - \gamma)(\gamma - \alpha)(\alpha + \beta + \gamma)$$



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$$28. \begin{vmatrix} a + b + 2c & a & b \\ c & b + c + 2a & b \\ c & a & c + a + 2b \end{vmatrix} = 2(a + b + c)^3$$



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$$29. \begin{vmatrix} 1 & 1 & 1 \\ a^2 & b^2 & c^2 \\ a^3 & b^3 & c^3 \end{vmatrix} = (b - c)(c - a)(a - b)(bc + ca + ab)$$



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$$30. \begin{vmatrix} a & b & c \\ a^2 & b^2 & c^2 \\ a^3 & b^3 & c^3 \end{vmatrix} = abc(a - b)(b - c)(c - a)$$



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$$31. \begin{vmatrix} a & b & c \\ a^2 & b^2 & c^2 \\ b + c & c + a & a + b \end{vmatrix} = (a - b)(b - c)(c - a)(a + b + c)$$



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$$32. \begin{vmatrix} 1 + x & 1 & 1 \\ 1 & 1 + y & 1 \\ 1 & 1 & 1 + z \end{vmatrix} = xy + yz + zx + xyz$$



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$$33. \begin{vmatrix} x + 4 & 2x & 2x \\ 2x & x + 4 & 2x \\ 2x & 2x & x + 4 \end{vmatrix} = (5x + 4)(x - 4)^2$$



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$$34. \begin{vmatrix} 1+a & 1 & 1 \\ 1 & 1+a & 1 \\ 1 & 1 & 1+a \end{vmatrix} = a^3 + 3a^2$$



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$$35. \begin{vmatrix} 1 & b+c & b^2+c^2 \\ 1 & c+a & c^2+a^2 \\ 1 & a+b & a^2+b^2 \end{vmatrix} = (b-c)(c-a)(a-b)$$



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$$36. \begin{vmatrix} a^2 & ab & ac \\ ab & b^2 & bc \\ ca & bc & c^2 \end{vmatrix} = ?$$



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37.

$$\begin{vmatrix} -1 & b & c \\ a & -1 & c \\ a & b & -1 \end{vmatrix} = (a+1)(b+1)(c+1) \left( \frac{a}{a+1} + \frac{b}{b+1} + \frac{c}{c+1} - 1 \right)$$



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$$38. \begin{vmatrix} x^2 + y^2 + 1 & x^2 + 2y^2 + 3 & x^2 + 3y^2 + 4 \\ y^2 + 2 & 2y^2 + 6 & 3y^2 + 8 \\ y^2 + 1 & 2y^2 + 3 & 3y^2 + 4 \end{vmatrix} = x^2y^2$$



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$$39. \begin{vmatrix} 3a & -a+b & -a+c \\ a-b & 3b & c-b \\ a-c & b-c & 3c \end{vmatrix} = 3(a+b+c)(ab+bc+ca)$$



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$$40. \begin{vmatrix} x & a & b \\ a & x & b \\ a & b & x \end{vmatrix} = (x-a)(x-b)(x+a+b)$$





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41. 
$$\begin{vmatrix} b+c & a-b & a \\ c+a & b-c & b \\ a+b & c-a & c \end{vmatrix} = 3abc - a^3 - b^3 - c^3$$



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42. Prove 
$$\begin{vmatrix} 1 & a^2 + bc & a^3 \\ 1 & b^2 + ca & b^3 \\ 1 & c^2 + ab & c^3 \end{vmatrix} = -(a-b)(b-c)(c-a)(a^2 + b^2 + c^2)$$



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43.

$$\begin{vmatrix} a^2 & a^2 - (b-c)^2 & bc \\ b^2 & b^2 - (c-a)^2 & ca \\ c^2 & c^2 - (a-b)^2 & ab \end{vmatrix} = (a-b)(b-c)(c-a)(a+b+c)(a^2 + b^2 + c^2)$$



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44. 
$$\begin{vmatrix} (a+1)(a+2) & a+2 & 1 \\ (a+2)(a+3) & a+3 & 1 \\ (a+3)(a+4) & a+4 & 1 \end{vmatrix} = -2$$

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45. Show that the following determinant is a perfect square :

$$\begin{vmatrix} 1 & a & a^2 \\ a^2 & 1 & a \\ a & a^2 & 1 \end{vmatrix}$$

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46. if  $x+y+z=0$  then prove that 
$$\begin{vmatrix} x & y & z \\ x^2 & y^2 & z^2 \\ y+z & z+x & x+y \end{vmatrix} = 0$$

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47. 
$$\begin{vmatrix} 1 & 1 & 1 \\ x & y & z \\ x^3 & y^3 & z^3 \end{vmatrix} = 0$$



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$$48. \begin{vmatrix} x & 4 & -2 \\ 4 & x & -2 \\ 4 & -2 & x \end{vmatrix} = 0$$



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$$49. \begin{vmatrix} x & a & a \\ a & x & b \\ b & b & x \end{vmatrix} = 0$$



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$$50. \begin{vmatrix} x + 1 & 2 & 3 \\ 1 & x + 1 & 3 \\ 3 & -6 & x + 1 \end{vmatrix} = 0$$



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$$51. \begin{vmatrix} a - x & b & c \\ b & c - x & a \\ c & a & b - x \end{vmatrix} = 0$$



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52. 
$$\begin{vmatrix} x & c+x & b+x \\ c+x & x & a+x \\ b+x & a+x & x \end{vmatrix} = 0$$



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53. 
$$\begin{vmatrix} 2-x & 2 & 3 \\ 2 & 5-x & 6 \\ 3 & 4 & 10-x \end{vmatrix} = 0$$



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54. solve: 
$$\begin{vmatrix} 3+x & 3-x & 3-x \\ 3-x & 3+x & 3-x \\ 3-x & 3-x & 3+x \end{vmatrix} = 0$$



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$$55. \begin{vmatrix} x - 2 & 2x - 3 & 3x - 4 \\ x - 4 & 2x - 9 & 3x - 16 \\ x - 8 & 2x - 27 & 3x - 64 \end{vmatrix} = 0$$

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$$56. \begin{vmatrix} 0 & x - a & x - b \\ x + a & 0 & x - c \\ x + b & x + c & 0 \end{vmatrix} = 0 [where \quad a \neq b \neq c]$$

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$$57. \text{Solve: } \begin{vmatrix} 3 & 5 & x \\ 7 & x & 7 \\ x & 5 & 3 \end{vmatrix} = 0$$

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$$58. \begin{vmatrix} x + a & b & c \\ a & x + b & c \\ a & b & x + c \end{vmatrix} = 0$$

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$$59. \begin{vmatrix} 3x - 8 & 3 & 3 \\ 3 & 3x - 8 & 3 \\ 3 & 3 & 3x - 8 \end{vmatrix} = 0$$



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$$60. \begin{vmatrix} 15 - 2x & 11 - 3x & 7 - x \\ 11 & 17 & 14 \\ 10 & 16 & 13 \end{vmatrix} = 0$$



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$$61. \begin{vmatrix} 1 & 1 & x \\ p + 3 & p + 1 & p + x \\ 3 & x + 1 & x + 1 \end{vmatrix} = 0$$



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$$62. \text{ If } x \text{ and } y \text{ are real and } x + iy = \begin{vmatrix} 6i & -3i & 1 \\ 4 & 3i & -1 \\ 20 & 3 & i \end{vmatrix} = 0, \text{ find } x \text{ and } y$$



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63. solve : 
$$\begin{vmatrix} x - 2 & 2 & 5 \\ x - 7 & 3 & 6 \\ 2x - 6 & 4 & 7 \end{vmatrix} = 0$$



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64. solve 
$$\begin{vmatrix} x - 2 & 3 & 3 \\ 3 & x + 4 & 5 \\ 3 & 5 & x + 4 \end{vmatrix} = 0$$



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65. show that  $x = 2$  is a root to the equation

$$\begin{vmatrix} x & -6 & -1 \\ 2 & -3x & x - 3 \\ -3 & 2x & 2 + x \end{vmatrix} = 0$$



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66. 
$$\begin{vmatrix} 1 + a^2 - b^2 & 2ab & -2b \\ 2ab & 1 - a^2 + b^2 & 2a \\ 2b & -2a & 1 - a^2 - b^2 \end{vmatrix} = (1 + a^2 + b^2)^3$$



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67. 
$$\begin{vmatrix} (b+c)^2 & a^2 & a^2 \\ b^2 & (c+a)^2 & b^2 \\ c^2 & c^2 & (a+b)^2 \end{vmatrix} = 2abc(a+b+c)^3$$



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68. Factorise: 
$$\begin{vmatrix} x & y & z \\ x^2 & y^2 & z^2 \\ yz & zx & xy \end{vmatrix}$$



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69. 
$$\begin{vmatrix} b+c & a & b \\ c+a & c & a \\ a+b & b & c \end{vmatrix}$$



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70. If  $\begin{vmatrix} x & x^2 & x^3 + 1 \\ y & y^2 & y^3 + 1 \\ z & z^2 & z^3 + 1 \end{vmatrix} = a$  and  $x \neq y \neq z$ , prove that,  $xyz=-1$ .



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71. Evaluate  $\begin{vmatrix} 0 & c & b \\ c & 0 & a \\ b & a & 0 \end{vmatrix}$ , hence show that .

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



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72. Express the square of  $\begin{vmatrix} a_1 & b_1 & 0 \\ a_2 & b_2 & 0 \\ a_3 & b_3 & 0 \end{vmatrix}$  as a third order

determinant ,what is the value of this determinant ?



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73. prove that  $\begin{vmatrix} a & b & 0 \\ 0 & a & b \\ b & 0 & a \end{vmatrix} = a^3 + b^3$ , hence , find the value of the following determinant :  $\begin{vmatrix} 2ab & a^2 & b^2 \\ a^2 & b^2 & 2ab \\ b^2 & 2ab & a^2 \end{vmatrix}$



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74. Prove that , the value of the determinant  $\begin{vmatrix} x+1 & x+2 & x+4 \\ x+3 & x+5 & x+8 \\ x+7 & x+10 & x+14 \end{vmatrix}$  is independent of x and find the value of the determinant.



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75.  $\begin{vmatrix} b+c & a-c & a-b \\ b-c & c+a & b-a \\ c-b & c-a & a+b \end{vmatrix} = 8abc$



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$$76. \begin{vmatrix} a^2 & bc & c^2 + ca \\ a^2 + ab & b^2 & ca \\ ab & b^2 + bc & c^2 \end{vmatrix} = 4a^2b^2c^2$$



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$$77. \begin{vmatrix} 2\cos\theta & 1 & 0 \\ 1 & 2\cos\theta & 1 \\ 0 & 1 & 2\cos\theta \end{vmatrix} = \frac{\sin 4\theta}{\sin \theta} [\theta \neq n\pi]$$



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$$78. \begin{vmatrix} a & b & ax + by \\ b & c & bx + cy \\ ax + by & bx + cy & 0 \end{vmatrix} = (b^2 - ac)(ax^2 + 2bxy + cy^2)$$



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$$79. \begin{vmatrix} 3x^2 & 3x & 1 \\ x^2 + 2x & 2x + 1 & 1 \\ 2x + 1 & x + 2 & 1 \end{vmatrix} = (x - 1)^3$$



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$$80. \begin{vmatrix} x+y+z & -z & -y \\ -z & x+y+z & -x \\ -y & -x & x+y+z \end{vmatrix} = 2(x+y)(y+z)(z+x)$$



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$$81. \begin{vmatrix} 1 & 1 & 1 \\ {}^n c_1 & {}^{n+1} c_1 & {}^{n+2} c_1 \\ {}^{n+1} c_2 & {}^{n+2} c_2 & {}^{n+3} c_2 \end{vmatrix} = 1$$



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$$82. \begin{vmatrix} x+y+z & -z & -y \\ -z & x+y+z & -x \\ -y & -x & x+y+z \end{vmatrix} = 2(x+y)(y+z)(z+x)$$



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$$83. \begin{vmatrix} \cos(x+y) & \sin(x+y) & -\cos(x+y) \\ \sin(x-y) & \cos(x-y) & \sin(x-y) \\ \sin 2x & 0 & \sin 2y \end{vmatrix} = \sin 2(x+y)$$



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84. prove that,  $\begin{vmatrix} 0 & \cos \alpha & -\sin \alpha \\ \sin \alpha & 0 & \cos \alpha \\ \cos \alpha & \sin \alpha & 0 \end{vmatrix}^2 = \begin{vmatrix} 1 & x & -x \\ x & 1 & x \\ -x & x & 1 \end{vmatrix}$  where  $x = \frac{\sin \alpha \cos \alpha}{\sin \alpha \cos \alpha}$



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85. If  $a, b, c$  are in A.P, show that,  $\begin{vmatrix} x+1 & x+2 & x+a \\ x+2 & x+3 & x+b \\ x+3 & x+4 & x+c \end{vmatrix} = 0$



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86. If  $A, B, C$ , are the angles of a triangles, show that,

$$\begin{vmatrix} \sin^2 A & \cot A & 1 \\ \sin^2 B & \cot B & 1 \\ \sin^2 C & \cot C & 1 \end{vmatrix} = 0$$



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**87.** without expanding prove that [22-24]

$$\begin{vmatrix} 7 & 12 & -3 \\ 9 & 14 & -1 \\ 8 & 13 & -2 \end{vmatrix} = 0$$



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**88.**  $\begin{vmatrix} 1 & bc & bc(b+c) \\ 1 & ca & ca(c+a) \\ 1 & ab & ab(a+b) \end{vmatrix} = 0$



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**89.**  $\begin{vmatrix} \log_x xyz & \log_x y & \log_x z \\ \log_y xyz & 1 & \log_y z \\ \log_z xyz & \log_z y & 1 \end{vmatrix} = 0$



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**90.**

$$\begin{vmatrix} a+ib & c+id \\ -c+id & a-ib \end{vmatrix} \times \begin{vmatrix} \alpha-i\beta & \gamma-i\delta \\ -\gamma-i\delta & \alpha+i\beta \end{vmatrix} = \begin{vmatrix} A-iB & C-iD \\ -C-iD & A+iB \end{vmatrix}$$

if

,show that the products of sums , each of four squares , can be expressed as the sum of four squares.



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**91.**

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



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**92.** Show that  $\begin{vmatrix} x-3 & x-4 & x-\alpha \\ x-2 & x-3 & x-\beta \\ x-1 & x-2 & x-\gamma \end{vmatrix} = 0$ , where  $\alpha, \beta, \gamma$  are in A.P



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**93.** If  $a, b, c$ , are real numbers such that

$$\begin{vmatrix} b+c & c+a & a+b \\ c+a & a+b & b+c \\ a+b & b+c & c+a \end{vmatrix} = 0, \text{ then show that either } a+b+c=0 \text{ or, } a=b=c.$$



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94. Show that , 
$$\begin{vmatrix} \frac{a^2+b^2}{c} & c & c \\ a & \frac{b^2+c^2}{a} & a \\ b & b & \frac{c^2+a^2}{b} \end{vmatrix} = 4abc$$



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95. prove that , 
$$\begin{vmatrix} 1 & 1+a & 1+a+b \\ 2 & 3+2a & 4+3a+2b \\ 3 & 6+3a & 10+6a+3b \end{vmatrix} = 1$$



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96. if  $f(x) = \begin{vmatrix} \sin x & \cos x & \tan x \\ x^3 & x^2 & x \\ 2x & 1 & 1 \end{vmatrix}$  then show that  $\lim_{x \rightarrow 0} \frac{f(x)}{x^2} = 1$



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97. If 5 is one root of the equation  $\begin{vmatrix} x & 3 & 7 \\ 2 & x & -2 \\ 7 & 8 & x \end{vmatrix} = 0$  then find the other two roots of the equation.

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98. If  $y = \sin px$  and  $y_n$  is the nth derivative of  $y$ , then find the

value of  $\begin{vmatrix} y & y_1 & y_2 \\ y_3 & y_4 & y_5 \\ y_6 & y_7 & y_8 \end{vmatrix}$

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99. If  $\begin{vmatrix} 1 + ax & 1 + bx & 1 + cx \\ 1 + a_1x & 1 + b_1x & 1 + c_1x \\ 1 + a_2x & 1 + b_2x & 1 + c_2x \end{vmatrix} = A_0 + A_1 + A_2x^2 + A_3x^3$ , then find the value of  $A_1$ .

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100. Evaluate:  $\begin{vmatrix} 1 & 1 & 1 \\ 1 & \omega^2 & \omega \\ 1 & \omega & \omega^2 \end{vmatrix}$  (where  $\omega$  is an imaginary cube root of unity ).



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101. If  $\begin{vmatrix} -a^2 & ab & ac \\ ab & -b^2 & bc \\ ac & bc & -c^2 \end{vmatrix} = \lambda a^2 b^2 c^2$ , then find the value of  $\lambda$



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102. If  $\begin{vmatrix} 10_{c_4} & 10_{c_5} & 11_{c_m} \\ 11_{c_6} & 11_{c_7} & 12_{c_{m+2}} \\ 12_{c_8} & 12_{c_9} & 13_{c_{m+4}} \end{vmatrix} = 0$  then find the value of m .



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103. If l,m and n are real numbers such that  $l^2 + m^2 + n^2 = 0$ ,

then show that  $\begin{vmatrix} 1 + l^2 & lm & \ln \\ lm & 1 + m^2 & mn \\ \ln & mn & 1 + n^2 \end{vmatrix} = 1$



104. If  $f(x) = \begin{vmatrix} 1 & x & x+1 \\ 2x & x(x-1) & x(x+1) \\ 3x(x-1) & x(x-1)(x-2) & x(x+1)(x-1) \end{vmatrix}$  then find  $f(200)$ .



105. If  $\omega \neq 1$  is a cube root of unity , then find the value of

$$\begin{vmatrix} 1 + 2\omega^{100} + \omega^{200} & \omega^2 & 1 \\ 1 & 1 + \omega^{100} + 2\omega^{200} & \omega \\ \omega & \omega^2 & 2 + \omega^{100} + \omega^{200} \end{vmatrix} = 0$$



106. If  $\alpha$  is a cube root of unity , then find the value of  $\begin{vmatrix} \alpha & \alpha^3 & \alpha^5 \\ \alpha^3 & \alpha^5 & \alpha \\ \alpha^5 & \alpha & \alpha^3 \end{vmatrix}$



**107.** If  $f(\alpha) = \begin{vmatrix} 1 & \alpha & \alpha^2 \\ \alpha & \alpha^2 & 1 \\ \alpha^2 & 1 & \alpha \end{vmatrix}$ , then find the value of  $f\left(3^{\frac{1}{3}}\right)$ .



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**108.** Without expanding prove that,  $\begin{vmatrix} b^2c^2 & bc & b+c \\ c^2a^2 & ca & c+a \\ a^2b^2 & ab & a+b \end{vmatrix} = 0$



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**109.** Show that,  $\begin{vmatrix} a^2 + 10 & ab & ac \\ ab & b^2 + 10 & bc \\ ca & bc & c^2 + 10 \end{vmatrix}$  is divisible by 100 .



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**110.** If  $D_1 = \begin{vmatrix} 1 & 1 & 1 \\ 1 & \omega & \omega^2 \\ 1 & \omega^2 & \omega \end{vmatrix}$  and  $D_2 = \begin{vmatrix} 1 & 1 & \omega \\ 1 & 1 & \omega^2 \\ \omega^2 & \omega & 1 \end{vmatrix}$  show that ,  
 $D_1 = \sqrt{3i}D_2$  where  $\omega = \frac{-1 + \sqrt{3i}}{2}$  and  $i = \sqrt{-1}$ .



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111. Using properties of determinants prove that,

$$\begin{vmatrix} x & x^2 & 1 + px^3 \\ y & y^2 & 1 + py^3 \\ z & z^2 & 1 + pz^3 \end{vmatrix} = (1 + pxyz)(x - y)(y - z)(z - x)$$



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## Exercise 2 C

1. The two equations  $a_1x + b_1y = k_1$  and  $a_2x + b_2y = k_2$  will have unique solutions for x and y when

A.  $\begin{vmatrix} a_1 & b_1 \\ a_2 & b_2 \end{vmatrix} \neq 0$

B.  $\begin{vmatrix} a_1 & k_1 \\ a_2 & k_2 \end{vmatrix} \neq 0$

C.  $\begin{vmatrix} k_1 & b_1 \\ k_2 & b_2 \end{vmatrix} \neq 0$

D.  $\begin{vmatrix} a_1 & b_1 \\ a_2 & b_2 \end{vmatrix} = 0$

Answer: A



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2. If  $a \in \mathbb{R}$  and the system of equations  $x+ay=0$ ,  $az+y=0$ ,  $ax+z=0$  has infinite number of solution then the value of  $a$  is

A. 1

B. 0

C. -1

D. no real value

**Answer: C**



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3. Given  $2x-y+2z=2$ ,  $x-2y+z=-4$  and  $x+y+\lambda z = 4$  then the value of  $\lambda$  such that the given system of equations has no solution is

A. -3

B. 0

C. 1

D. 3

**Answer: C**



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**4.** The value of k for which the system of equations  $x+ky-3z=0$  ,  $3x+ky-2z=0$ ,  $2x+3y-4z=0$  has a non -trivial solution is

A. - 5

B. 4

C.  $\frac{31}{10}$

D.  $\frac{21}{10}$

**Answer: D**



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5. Find the real values of  $\lambda$  for which the following system of linear equations has non-trivial solutions:

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

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



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6. Find the real values of  $k$  for which the following system of linear equations has non-trivial solution:

$$x-ky-z=0, kx-y-z=0, x+y-z=0.$$



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7. Find the real values of  $k$  for which the following system of linear equations has non-trivial solutions:

$$x-ky+z=0, kx+3y-kz=0, 3x+y-z=0$$



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**8.** Find the real values of  $a$  for which the system of equations

$$a^3x + (a+1)^3y + (a+2)^3z = 0, ax + (a+1)y + (a+2)z = 0$$

$x+y+z=0$  has a non-zero solution.



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



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**10.** 
$$\begin{vmatrix} 2 & 3 & 4 \\ 5 & 6 & 1 \\ 3 & 2 & 3 \end{vmatrix}$$



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**11. Using determinant :**

find the area of the triangle formed by joining the points  $(6,2)$ ,  $(-3,4)$  and  $(4,-3)$



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**12. Using determinant :**

Show that the points  $(a,b+c)$ ,  $(b,c+a)$  and  $(c,a+b)$  are collinear .



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**13. Using determinant :**

find the area of the triangle whose vertices are  $(at_1^2, 2at_1)$ ,  $(at_2^2, 2at_2)$  and  $(at_3^2, 2at_3)$



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**14. Using determinant :**

show that the area of the triangle whose vertices are  $(m,m-2)$ ,  $(m+2,m+2)$  and  $(m+3,m)$  , is independent of  $m$  .



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**15. Using determinant :**

Find the value of  $t$  for which the area of the triangle having vertices at  $(-1,t)$ ,  $(t-2,1)$  and  $(t-2,t)$  is  $\frac{121}{2}$  square unit .



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**16. Using determinant :**

show that the points  $(a+1,a)$  ,  $(a,a+1)$  and  $\left[ (a+1)^2, -a^2 \right]$  are collinear.



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**17. Using determinant :**

show that the area of the triangle with vertices at

$(a^2, a^3), (b^2, b^3)$  and  $(c^2, c^3)$  is

$\frac{1}{2}(a-b)(b-c)(c-a)(ab+bc+ca)$  square unit.



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**18. Eliminating x and y from the following equations, obtain the value of k:**

$$ax + hy + g = 0, hx + by + f = 0, gx + fy + c = k$$



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**19. Eliminate x,y and z from the following equations:**

$$\frac{x}{y+z} = a, \frac{y}{z+x} = b, \frac{z}{x+y} = c$$



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**20.** Show that the following system of equations has no solution :

$$x+2y+3z=1, 2x+3y+5z=1, 3x+4y+7z=1$$



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**21.** Show that the following system of equations has infinite number of solutions :

$$x+2y+3z=1, 3x+4y+5z=2, 5x+6y+7z=3$$



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**22.**  $a-b+c=6, 4a+2b+c=11, 9a-3b+c=6$



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**23.**  $2x-y=4, x-2y+1=0$



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$$24. x+y-z=-3, 2x+3y+z=2, 8y+3z=1$$



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$$25. 2x+3y+z=17, x-y+z=3, 3x+2y-2z=4$$



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$$26. x+3y=4, y+3z=7, z+4y=6$$



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$$27. x+2y-2z=5, 3x-y+z=8, x+y-z=4$$



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**28.**  $x+y+z=1$ ,  $ax+by+cz=k$ ,  $bcx+cay+abz=k^2$  [a,b,c are unequal ]



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**29.**  $\frac{1}{x} + \frac{1}{y} + \frac{1}{z} = 1$ ,  $\frac{2}{x} + \frac{5}{y} + \frac{3}{z} = 0$ ,  $\frac{1}{x} + \frac{2}{y} + \frac{4}{z} = 3$



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**30.**  $\frac{2}{x} + \frac{3}{y} - \frac{4}{z} = -3$ ,  $\frac{1}{x} + \frac{2}{y} + \frac{6}{z} = 2$ ,  $\frac{3}{x} - \frac{1}{y} + \frac{2}{z} = 5$



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**31.**

$$x + y + z = 3, a^2x + b^2y + c^2z = a^2 + b^2 + c^2, a^3x + b^3y + c^3z = a^3 + b^3 + c^3$$

[a,b,c are unequal and  $ab+bc+ca \neq 0$ ].



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$$32. 5x+3y=65, 2y-5z=-25, 3x+4z=57$$



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$$33. 3y+2x=5, x+2y=4$$



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$$34. 2x-y+z=6, x+2y+3z=3, 3x+y-z=4$$



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$$35. 2x+y+z=1, x-y+2z=-1, 3x+2y-z=4$$



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$$36. x+2y-3z=0, 3x+3y-z=5, x-2y+2z=1$$



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37. Use cramer's rule to solve the equations:

$a_2x + b_2y + c_2 = 0$ .  $a_3x + b_3y + c_3 = 0$ ,  $a_2b_3 - b_2a_3 \neq 0$  and hence , find the condition in the form of a determinant of third order so that the three equations  $a_i x + b_i y + c_i = 0$  ( $i=1,2,3$ ) are satisfied by the same values of x and y .



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### Sample Questions For Competitive Examination Multiple Correct Answers Type

1. Which of the following has/have value equal to zero ?

A. 
$$\begin{vmatrix} 8 & 2 & 7 \\ 12 & 3 & 5 \\ 16 & 4 & 3 \end{vmatrix}$$

B. 
$$\begin{vmatrix} \frac{1}{a} & a^2 & bc \\ \frac{1}{b} & b^2 & ca \\ \frac{1}{c} & c^2 & ab \end{vmatrix}$$

C. 
$$\begin{vmatrix} a+b & 2a+b & 3a+b \\ 2a+b & 3a+b & 4a+b \\ 4a+b & 5a+b & 6a+b \end{vmatrix}$$

D. 
$$\begin{vmatrix} 2 & 43 & 6 \\ 7 & 35 & 4 \\ 3 & 17 & 2 \end{vmatrix}$$

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



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2.  $\Delta = \begin{vmatrix} 1 & 1+ac & 1+bc \\ 1 & 1+ad & 1+bd \\ 1 & 1+ae & 1+be \end{vmatrix}$  is independent of

A. a

B. b

C. c,d,e

D. none of these

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



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

A.  $a=0$

B.  $b=0$

C.  $c=0$

D. d=141

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



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5. If  $\Delta = \begin{vmatrix} -x & a & b \\ b & -x & a \\ a & b & -x \end{vmatrix}$  then a factor of  $\Delta$  is -

A.  $a+b+x$

B.  $x^2 - (a - b)x + a^2 + b^2 + ab$

C.  $x^2 + (a + b)x + a^2 + b^2 - ab$

D.  $a + b - x$

**Answer: C::D**



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1. If  $A+B+C=\pi$  and  $\Delta = \begin{vmatrix} \sin^2 A & \cot A & 1 \\ \sin^2 B & \cot B & 1 \\ \sin^2 C & \cot C & 1 \end{vmatrix}$ , find  $\Delta + 5$ .



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2..

Let  $f(\theta) = \begin{vmatrix} \cos^2 \theta & \cos \theta \sin \theta & -\sin \theta \\ \sin \theta \cos \theta & \sin^2 \theta & \cos \theta \\ \sin \theta & -\cos \theta & 0 \end{vmatrix}$ , find  $f\left(\frac{\pi}{3}\right)$ .



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3. Find the number of values of  $\lambda$  for which the system of equations  $\lambda x + y + z = 1$ ,  $x + \lambda y + z = \lambda$  and  $x + y + \lambda z = \lambda^2$  has infinite number of solutions .



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4.

Let

$$f(x) = \begin{vmatrix} 2\cos^2 x & \sin 2x & -\sin x \\ \sin 2x & 2\sin^2 x & \cos x \\ \sin x & -\cos x & 0 \end{vmatrix}, \text{ then find } \frac{1}{\pi} \int_0^{\frac{\pi}{2}} [f(x) + f'(x)] dx.$$



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$$5. \text{ Let } f(x) = \begin{vmatrix} 1 + \sin^2 x & \cos^2 x & 4\sin 2x \\ \sin^2 x & 1 + \cos^2 x & 4\sin 2x \\ \sin^2 x & \cos^2 x & 1 + 4\sin 2x \end{vmatrix}$$

Find the maximum value of  $f(x)$



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### Sample Questions For Competitive Examination Matrix Match Type

$$1. \text{ Evaluate the determinants } \begin{vmatrix} \cos \theta & -\sin \theta \\ \sin \theta & \cos \theta \end{vmatrix}$$



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2. Evaluate the determinants

$$\begin{vmatrix} x^2 - x + 1 & x - 1 \\ x + 1 & x + 1 \end{vmatrix}$$



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### Sample Questions For Competitive Examination Comprehension Type

1. Let  $A(x_1, y_1)$ ,  $B(x_2, y_2)$ , and  $C(x_3, y_3)$  be three points. Area of the triangle with vertices A, B and C is given by  $\frac{1}{2} |\Delta|$

Where  $\Delta = \begin{vmatrix} x_1 & y_1 & 1 \\ x_2 & y_2 & 1 \\ x_3 & y_3 & 1 \end{vmatrix}$ .



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2. Points A,B,C are collinear if and only if

A.  $\Delta = 0$

B.  $\Delta > 0$

C.  $\Delta < 0$

D.  $\Delta \leq 0$

**Answer: D**



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3. If  $a=BC, b=CA, c=AB$  and  $2s=a+b+c$ , then  $\Delta^2$  equal to

A.  $abc$

B.  $s(s-a)(s-b)(s-c)$

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

D.  $4s(s-a)(s-b)(s-c)$

**Answer: C**



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4. If  $\Delta ABC$  is an equilateral triangle and  $a=BC$  is a rational number ,then

$\Delta$  must be

- A. an integer
- B. a rational number
- C. an irrational number
- D. an imaginary number

**Answer: C**



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5. Given that the system of equations  $x=cy+bz, y=az+cx, z=bx+ay$  has non-zero solutions and atleast one of  $a,b,c$  is a proper fraction.

$a^2 + b^2 + c^2$  is

- A.  $> 2$
- B.  $> 3$

C.  $< 3$

D.  $< 2$

**Answer: A**



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6. Given that the system of equations  $x=cy+bz, y=az+cx, z=bx+ay$  has non-zero solutions and atleast one of  $a,b,c$  is a proper fraction.

abc is-

A.  $> -1$

B.  $> 1$

C.  $< 2$

D.  $< 3$

**Answer: D**



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7. Given that the system of equations  $x=cy+bz$ ,  $y=az+cx$ ,  $z=bx+ay$  has non-zero solutions and atleast one of  $a,b,c$  is a proper fraction.

The system has solution ,such that-

A.  $x:y:z \equiv (1 - 2a^2) : (1 - 2b^2) : (1 - 2c^2)$

B.  $x:y:z \equiv \frac{1}{1 - 2a^2} : \frac{1}{1 - 2b^2} : \frac{1}{1 - 2c^2}$

C.  $x:y:z \equiv \frac{a}{1 - a^2} : \frac{b}{1 - b^2} : \frac{c}{1 - c^2}$

D.  $x:y:z \equiv \sqrt{1 - a^2} : \sqrt{1 - b^2} : \sqrt{1 - c^2}$

**Answer:**



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### Sample Questions For Competitive Examination Assertion Reason Type

1. If  $A = \begin{bmatrix} 1 & 2 \\ 4 & 2 \end{bmatrix}$ , then show that  $|2A| = 4|A|$ .



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2. Evaluate the determinants

$$\begin{vmatrix} ax & y & z \\ x & ay & z \\ x & y & az \end{vmatrix}$$



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