



## MATHS

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### DETERMINANT

Single Correct Answer

1. If  $\begin{vmatrix} 1 & \cos \alpha & \cos \beta \\ \cos \alpha & 1 & \cos \gamma \\ \cos \beta & \cos \gamma & 1 \end{vmatrix} = \begin{vmatrix} 0 & \cos \alpha & \cos \beta \\ \cos \alpha & 0 & \cos \gamma \\ \cos \beta & \cos \gamma & 0 \end{vmatrix}$  then the value of  $\cos^2 \alpha + \cos^2 \beta + \cos^2 \gamma$  is : (a) 1 (b)  $\frac{1}{2}$  (c)  $\frac{3}{8}$  (d)  $\frac{9}{4}$

A. 1

B. 2

C. 3/2

D. 1/2

**Answer: A**



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2. the value of determinant  $\begin{vmatrix} 1 + \alpha & 1 & 1 \\ 1 & 1 + \beta & 1 \\ 1 & 1 & 1 + \gamma \end{vmatrix}$  is

A.  $\alpha\beta\gamma$

B.  $1 + \frac{1}{\alpha} + \frac{1}{\beta} + \frac{1}{\gamma}$

C. 0

D. none of these

**Answer: C**



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3. If  $\omega \neq 1$  is a cube root of unity and  $x + y + z \neq 0$ , then prove that

$$\begin{vmatrix} \frac{x}{1+\omega} & \frac{y}{\omega+\omega^2} & \frac{z}{\omega^2+1} \\ \frac{y}{\omega+\omega^2} & \frac{z}{\omega^2+1} & \frac{x}{1+\omega} \\ \frac{z}{\omega^2+1} & \frac{x}{1+\omega} & \frac{y}{\omega+\omega^2} \end{vmatrix} = 0 \text{ if } x = y = z$$

A.  $x^2 + y^2 + z^2 = 0$

B.  $x + y\omega + z\omega^2 = 0$  or  $x = y = z$

C.  $x \neq y \neq z \neq 0$

D.  $x=2y=3z$

**Answer: B**



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4. If  $a = \cos\left(\frac{4\pi}{3}\right) + i \sin\left(\frac{4\pi}{3}\right)$  then  $((1+a)/2)^{3n}$  is

A. purely real

B. purely imaginary

C. 0

D. none of these

**Answer: B**



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5. If  $\alpha$  is a root of  $x^4 = 1$  with negative principal argument then the

principal argument of  $\Delta(\alpha) = \begin{vmatrix} 1 & 1 & 1 \\ \alpha^n & \alpha^{n+1} & \alpha^{n+3} \\ \frac{1}{\alpha^{n+1}} & \frac{1}{\alpha^n} & 0 \end{vmatrix}$  is

A. A.  $\frac{5\pi}{14}$

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

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

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

**Answer: B**



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6. If  $\Delta_1 = \begin{vmatrix} x & b & b \\ a & x & b \\ a & a & x \end{vmatrix}$  and  $\Delta_2 = \begin{vmatrix} x & b \\ a & x \end{vmatrix}$  are the given determinants,

then  $\Delta_1 = 3(\Delta_2)^2$    b.  $\frac{d}{dx}(\Delta_1) = 3\Delta_2$    c.  $\frac{d}{dx}(\Delta_1) = 3(\Delta_2)^2$    d.

$$\Delta_1 = 3(\Delta_2)^{3/2}$$

A.  $\Delta_1 = 3(\Delta_2)^2$

B.  $\frac{d}{dx}(\Delta_1) = 3\Delta_2$

C.  $\frac{d}{dx}(\Delta_1) = 3(\Delta_2)^2$

D.  $\Delta_1 = 3\Delta_2^{3/2}$

**Answer: B**



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7. If  $a^2 + b^2 + c^2 + ab + bc + ca \leq 0$  for all,  $a, b, c \in R$ , then the value of the determinant

$$\begin{vmatrix} (a+b+2)^2 & a^2+b^2 & 1 \\ 1 & (b+c+2)^2 & b^2+c^2 \\ c^2+a^2 & 1 & (c+a+2)^2 \end{vmatrix}, \text{ is equal to}$$

A. A. 65

B. B.  $a^2 + b^2 + c^2 + 31$

C. C.  $4(a^2 + b^2 + c^2)$

D. D. 0

**Answer: A**



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8. Product of roots of equation  $\begin{vmatrix} 1 + 2x & 1 & 1 - x \\ 2 - x & 2 + x & 3 + x \\ x & 1 + x & 1 - x^2 \end{vmatrix} = 0$  is

A.  $1/2$

B.  $3/4$

C.  $4/3$

D.  $1/4$

**Answer: A**

9. If  $x \neq 0, y \neq 0, z \neq 0$  and  $|1 + x| + |1 + y| + |1 + z| + |1 + 2y| + |1 + z| + |3z| = 0$ , then  $x^{-1} + y^{-1} + z^{-1}$  is equal to

- A. 0
- B. 1
- C. 3
- D. 6

**Answer: C**

10. If  $Y = SX, Z = tX$  all the variables being differentiable functions of  $x$  and lower suffixes denote the derivative with respect to  $x$  and

$$\begin{vmatrix} X & Y & Z \\ X_1 & Y_1 & Z_1 \\ X_2 & Y_2 & Z_2 \end{vmatrix} = \begin{vmatrix} S_1 & t_1 \\ S_2 & t_2 \end{vmatrix} X^n, \text{ then } n =$$

A. A. 1

B. B. 2

C. C. 3

D. D. 4

**Answer: C**



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11. If  $w \neq 1$  is a cube root of unity and

$$\Delta = \begin{vmatrix} x + w^2 & w & 1 \\ w & w^2 & 1 + x \\ 1 & x + w & w^2 \end{vmatrix} = 0, \text{ then value of } x \text{ is}$$

A. 0

B. 2

C. -1



D. None of these

**Answer: A**



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12. If  $A = [a_{ij}]$  is a  $2 \times 2$  matrix such that  $a_{ij} = i + 2j$ , then A will be

A. 1

B. -1

C. 0

D. 2

**Answer: C**



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13. If  $\alpha, \beta, \gamma$  are the roots of  $x^3 + px^2 + q = 0$ , where  $q = 0$ , then

$$\Delta = \begin{bmatrix} \frac{1}{\alpha} & \frac{1}{\beta} & \frac{1}{\gamma} \\ \frac{1}{\beta} & \frac{1}{\gamma} & \frac{1}{\alpha} \\ \frac{1}{\gamma} & \frac{1}{\alpha} & \frac{1}{\beta} \end{bmatrix} \text{ equals}$$

A.  $\alpha\beta\gamma$

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

C. 0

D. None of these

**Answer: C**



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14. If  $a, b, c$  are different, then the value of  $x$  satisfying

$$\begin{vmatrix} 0 & x^2 - a & x^3 - b \\ x^2 + a & 0 & x^2 + c \\ x^4 + b & x - c & 0 \end{vmatrix} = 0 \text{ is a. } c \text{ b. } a \text{ c. } b \text{ d. } 0$$

A.  $(a)x$

B. (b)  $-x$

C. (c)  $-1$

D. (d)  $1$

**Answer: C**



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15. Let  $x > 0$ ,  $y > 0$ ,  $z > 0$  are respectively the  $2^{nd}$ ,  $3^{rd}$ ,  $4^{th}$  terms of a

$$G. P. \text{ and } \Delta = \begin{vmatrix} x^k & x^{k+1} & x^{k+2} \\ y^k & y^{k+1} & y^{k+2} \\ z^k & z^{k+1} & z^{k+2} \end{vmatrix} = (r - 1)^2 \left( 1 - \frac{1}{r^2} \right) \text{ (where } r \text{ is the}$$

common ratio), then

A.  $k = -1$

B.  $k = 1$

C.  $k = 0$

D. None of these

**Answer: A**



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16. If  $a, b, c, d > 0$ ,  $x \in R$  and  $(a^2 + b^2 + c^2)x^2 - 2(ab + bc + cd)x + b^2 + c^2 + d^2 \leq 0$ , then

$$\begin{vmatrix} 33 & 14 & \log a \\ 65 & 27 & \log b \\ 97 & 40 & \log c \end{vmatrix} =$$

A. A. 1

B. B.  $-1$

C. C. 0

D. D. none of these

**Answer: C**



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17.

Show

that

$$\left| \begin{matrix} {}^x C_r & {}^x C_{r+1} & {}^x C_{r+2} \\ {}^y C_r & {}^y C_{r+1} & {}^y C_{r+2} \\ {}^z C_r & {}^z C_{r+1} & {}^z C_{r+2} \end{matrix} \right| = \left| \begin{matrix} {}^x C_r^{x+1} & {}^x C_{r+1}^{x+2} & {}^x C_{r+2}^{y+1} \\ {}^y C_r^y & {}^y C_{r+1}^y & {}^y C_{r+2}^y \\ {}^z C_r^z & {}^z C_{r+1}^z & {}^z C_{r+2}^z \end{matrix} \right|$$

A. 0

B.  $2^n$ C.  ${}^{x+y+z} C_r$ D.  ${}^{x+y+z} C_{r+2}$ 

Answer: A


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18. 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. 3

B. 4

C. 5

D. 6

**Answer: C**



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19. If either of the two  $P$ ,  $Q$  and  $R$  are equal and  $P + Q + R = 180^\circ$ ,

then the value of  $\begin{vmatrix} 1 & 1 + \sin P & \sin P(1 + \sin P) \\ 1 & 1 + \sin Q & \sin Q(1 + \sin Q) \\ 1 & 1 + \sin R & \sin R(1 + \sin R) \end{vmatrix}$  is

(a) 0 (b) 1 (c)  $\sin(P + Q + R)$  (d)  $\sin Q \cdot \sin R$

A. 0

B. 1

C.  $\sin(P + Q + R)$

D.  $\sin P \sin Q \sin R$

**Answer: A**



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20. In a triangle  $ABC$ , if  $a, b, c$  are the sides opposite to angles  $A, B, C$

respectively, then the value of  $\begin{vmatrix} b \cos C & a & c \cos B \\ c \cos A & b & a \cos C \\ a \cos B & c & b \cos A \end{vmatrix}$  is

A. 1

B.  $-1$

C. 0

D.  $a \cos A + b \cos B + c \cos C$

**Answer: C**



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If  $a = 1 + 2 + 4 + \dots$  to  $n$  terms

21.  $b = 1 + 3 + 9 + \dots$  to  $n$  terms

$c = 1 + 5 + 25 + \dots$  to  $n$  terms

then  $\begin{vmatrix} a & 2b & 4c \\ 2 & 2 & 2 \\ 2^n & 3^n & 5^n \end{vmatrix} =$

A.  $(30)^n$

B.  $(10)^n$

C. 0

D.  $2^n + 3^n + 5^n$

**Answer: C**



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22. If  $a_1, a_2, a_3, 54, a_6, a_7, a_8, a_9$  are in H.P., and  $D = \begin{vmatrix} a_1 & a_2 & a_3 \\ 5 & 4 & a_6 \\ a_7 & a_8 & a_9 \end{vmatrix}$ , then

the value of  $[D]$  *iswhere*  $[.]$  represents the greatest integer function

A. 4

B. 2

C. 6

D. 7



Answer: B



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23. 
$$\begin{vmatrix} \frac{1}{c} & \frac{1}{c} & -\frac{a+b}{c^2} \\ -\frac{b+c}{a^2} & \frac{1}{a} & \frac{1}{a} \\ \frac{-b(b+c)}{a^2c} & \frac{a+2b+c}{ac} & \frac{-b(a+b)}{ac^2} \end{vmatrix}$$
 is

(a) dependent on  $a, b, c$  (b) dependent on  $a$  (c) dependent on  $b$  (d) independent on  $a, b$  and  $c$

A. (a) dependent on  $a, b, c$

B. (b) dependent on  $a$

C. (c) dependent on  $b$

D. (d) independent on  $a, b$  and  $c$

Answer: A



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24. The equation

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

has (a) no real solution (b) 4 real solutions (c) two real and two non-real solutions (d) infinite number of solutions, real or non-real

A. has no real solution

B. has 4 real solutions

C. has two real and two non-real solutions

D. has infinite number of solutions, real or non-real

**Answer: D**

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25. Let  $\Delta_1 = \begin{vmatrix} ap^2 & 2ap & 1 \\ aq^2 & 2aq & 1 \\ ar^2 & 2ar & 1 \end{vmatrix}$  and  $\Delta_2 = \begin{vmatrix} apq & a(p+q) & 1 \\ aqr & a(q+r) & 1 \\ arp & a(r+p) & 1 \end{vmatrix}$  then

(a)  $\Delta_1 = \Delta_2$  (b)  $\Delta_2 = 2\Delta_1$  (c)  $\Delta_1 = 2\Delta_2$  (d)  $\Delta_1 + 2\Delta_2 = 0$

A.  $\Delta_1 = \Delta_2$

B.  $\Delta_2 = 2\Delta_1$

C.  $\Delta_1 = 2\Delta_2$

D.  $\Delta_1 + 2\Delta_2 = 0$

**Answer: D**



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26. Area of triangle whose vertices are  $(a, a^2)$ ,  $(b, b^2)$ ,  $(c, c^2)$  is  $\frac{1}{2}$  . and area of another triangle whose vertices are  $(p, p^2)$ ,  $(q, q^2)$  and  $(r, r^2)$  is

4, then the value of  $\begin{vmatrix} (1+ap)^2 & (1+bp)^2 & (1+cp)^2 \\ (1+aq)^2 & (1+bq)^2 & (1+cq)^2 \\ (1+ar)^2 & (1+br)^2 & (1+cr)^2 \end{vmatrix}$  is (A) 2 (B) 4 (C) 8

(D) 16

A. 2

B. 4

C. 8

**Answer: D****Watch Video Solution**

27. Prove that 
$$\begin{vmatrix} \beta\gamma & \beta\gamma' + \beta'\gamma & \beta'\gamma' \\ \gamma\alpha & \gamma\alpha' + \gamma'\alpha & \gamma'\alpha' \\ \alpha\beta & \alpha\beta' + \alpha'\beta & \alpha'\beta' \end{vmatrix}$$

$$= (\alpha\beta' - \alpha'\beta)(\beta\gamma' - \beta'\gamma)(\gamma\alpha' - \gamma'\alpha).$$

A.  $(\alpha\beta' - \alpha'\beta)(\beta\gamma' - \beta'\gamma)(\gamma\alpha' - \gamma'\alpha)$

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

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

D. None of these

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

28. If  $\begin{vmatrix} a & b & 1 \\ b & c & 1 \\ c & a & 1 \end{vmatrix} = 2010$  and if  $\begin{vmatrix} c-a & c-b & c^2 \\ a-b & a-c & a^2 \\ b-c & b-a & b^2 \end{vmatrix} = p$ , then the number of positive divisors of  $p$  is

- A. (a) 36
- B. (b) 49
- C. (c) 64
- D. (d) 81

**Answer: D**

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29. Let  $\begin{vmatrix} a & l & m \\ l & b & n \\ m & n & c \end{vmatrix} \begin{vmatrix} bc - n^2 & mn - lc & ln - bm \\ mn - lc & ac - m^2 & ml - an \\ ln - bm & lm - an & ab - l^2 \end{vmatrix} = 64$ . If the value of  $\begin{vmatrix} 2a + 3l & 3l + 5m & 5m + 4a \\ 2l + 3b & 3b + 5n & 5n + 4l \\ 2m + 3n & 3n + 5c & 5c + 4m \end{vmatrix} = \lambda$  then  $\left[ \frac{\lambda}{2} \right]$  equals

A. 180

B. 240

C. 360

D. 480

**Answer: C**

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30. The value of  $\begin{vmatrix} x^2 + y^2 & ax + by & x + y \\ ax + by & a^2 + b^2 & a + b \\ x + y & a + b & 2 \end{vmatrix}$  depends on

A.  $a$

B.  $b$

C.  $x$

D. none of these

**Answer: D**

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31. If  $u = ax + by + cz$ ,  $v = ay + bz + cx$ ,  $w = az + bx + cy$ , then the

value of  $\begin{vmatrix} a & b & c \\ b & c & a \\ c & a & b \end{vmatrix} \times \begin{vmatrix} x & y & z \\ y & z & x \\ z & x & y \end{vmatrix}$  is

A.  $u^2 + v^2 + w^2 - 2uvw$

B.  $u^3 + v^3 + w^3 - 3uvw$

C. 0

D. none of these

**Answer: B**

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32. If the number of positive integral solutions of  $u + v + w = n$  be

denoted by  $P_n$  then the absolute value of  $\begin{vmatrix} P_n & P_{n+1} & P_{n+2} \\ P_{n+1} & P_{n+2} & P_{n+3} \\ P_{n+2} & P_{n+3} & P_{n+4} \end{vmatrix}$  is

A. -1

B. 2

C. 3

D. 4

Answer: A



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33. If  $f(x), h(x)$  are polynomials of degree 4 and  $\begin{vmatrix} f(x) & g(x) & h(x) \\ a & b & c \\ p & q & r \end{vmatrix} = mx^4 + nx^3 + rx^2 + sx + r$  be an identity in  $x$ , then  $\begin{vmatrix} f'''(0) - f''(0) & g'''(0) - g''(0) & h'''(0) - h''(0) \\ a & b & c \\ p & q & r \end{vmatrix}$  is

A.  $2(3n - r)$

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

C.  $3(n - 2r)$



D. none of these

**Answer: A**



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34. If  $f(x) = \begin{vmatrix} x-2 & (x-1)^2 & x^3 \\ (x-1) & x^2 & (x+1)^3 \\ x & (x+1)^2 & (x+2)^3 \end{vmatrix}$  then coefficient of  $x$  in  $f(x)$  is (a)  $-4$  (b)  $-2$  (c)  $-6$  (d)  $0$

A.  $-4$

B.  $-2$

C.  $-6$

D.  $0$

**Answer: B**



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35. If  $f(x) = \begin{vmatrix} \sin x & \cos x & \tan x \\ x^3 & x^2 & x \\ 2x & 1 & x \end{vmatrix}$ , then  $\lim_{x \rightarrow 0} \frac{f(x)}{x^2} =$

A. (a) 0

B. (b) 3

C. (c) 2

D. (d) 1

**Answer: D**



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36. If the system of linear equations

$x + 2ay + az = 0$ ,  $x + 3by + bz = 0$  and  $x + 4cy + cz = 0$  has a non-

zero solution, then  $a, b, c$

A. A.  $P$ .

B. B.  $G$ .  $P$ .

C. C.  $H$ .  $P$ .

D. D. satisfies  $a + 2b + 3c = 0$

**Answer: C**



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37. Find all values of  $\lambda$  for which the  
 $(\lambda - 1)x + (3\lambda + 1)y + 2\lambda z = 0$ ,  $(\lambda - 1)x + (4\lambda - 2)y + (\lambda + 3)z = 0$ , 2  
possess non-trivial solution and find the ratios  $x:y:z$ , where  $\lambda$  has the  
smallest of these value.

A. 3:2:1

B. 3:3:2

C. 1:3:1

D. 1:1:1

**Answer: D**



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**38.** The system of homogenous equations

$$tx + (t + 1)y + (t - 1)z = 0, \quad (t + 1)x + ty + (t + 2)z = 0,$$

$(t - 1)x + (t + 2)y + tz = 0$  has a non trivial solution for

- A. exactly three real values of  $t$
- B. exactly two real values of  $t$
- C. exactly one real values of  $t$
- D. infinite number of values of  $t$

**Answer: C**



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**39.** If  $a, b, c$  are non-zero, then the system of equations

$$(\alpha + a)x + \alpha y + \alpha z = 0, \quad \alpha x + (\alpha + b)y + \alpha z = 0,$$

$\alpha x + \alpha y + (\alpha + c)z = 0$  has a non-trivial solution if

- A.  $2\alpha = a + b + c$

B.  $\alpha^{-1} = a + b + c$

C.  $\alpha + a + b + c = 1$

D.  $\alpha^{-1} = -(a^{-1} + b^{-1} + c^{-1})$

**Answer: D**



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**40.** The values of  $\theta$ ,  $\lambda$  for which the following equations

$$\sin \theta x - \cos \theta y + (\lambda + 1)z = 0 \quad , \quad \cos \theta x + \sin \theta y - \lambda z = 0 \quad ,$$

$$\lambda x + (\lambda + 1)y + \cos \theta z = 0$$

have non trivial solution, is

A.  $\theta = n\pi, \lambda \in R - \{0\}$

B.  $\theta = 2n\pi, \lambda$  is any rational number

C.  $\theta = (2n + 1)\pi, \lambda \in R^+, n \in I$

D.  $\theta = (2n + 1)\frac{\pi}{2}, \lambda \in R, n \in I$

**Answer: D**



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41. If the system of equation

$(x - 2y + z = a)$ ,  $(2x + y - 2z = b)$ , and  $(x + 3y - 3z = c)$

have at least one solution, then the relationship between  $a, b, c$  is

A.  $a + b + c = 0$

B.  $a - b + c = 0$

C.  $-a + b + c = 0$

D.  $a + b - c = 0$

**Answer: B**



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42. If  $A, B, C$  are the angles of a triangle, the system of equations

$$(\sin A)x + y + z = \cos A,$$

$$x + (\sin B)y + z = \cos B,$$

$$x + y + (\sin C)z = 1 - \cos C$$
 has

- A. No solution
- B. Unique solution
- C. Infinitely many solutions
- D. Finitely many solutions

**Answer: B**



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## Comprehension

1. A  $3 \times 3$  determinant has entries either 1 or  $-1$ .

Let  $S_3 =$  set of all determinants which contain determinants such that product of elements of any row or any column is  $-1$  For example

$\begin{vmatrix} 1 & -1 & 1 \\ 1 & 1 & -1 \\ -1 & 1 & 1 \end{vmatrix}$  is an element of the set  $S_3$ .

Number of elements of the set  $S_3 =$

A. 10

B. 16

C. 12

D. 18

**Answer: B**



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2. the value of determinant  $\begin{vmatrix} 1 + \alpha & 1 & 1 \\ 1 & 1 + \beta & 1 \\ 1 & 1 & 1 + \gamma \end{vmatrix}$  is

A.  $2^n$

B.  $2^{n-1}$

C.  $2^{2n}$



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

Answer: D



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### Multiple Correct Answer

1. If  $x \in R, a_i, b_i, c_i \in R$  for  $i = 1, 2, 3$  and

$$\begin{vmatrix} a_1 + b_1x & a_1x + b_1 & c_1 \\ a_2 + b_2x & a_2x + b_2 & c_2 \\ a_3 + b_3x & a_3x + b_3 & c_3 \end{vmatrix} = 0, \text{ then which of the following may be true ?}$$

A.  $x = 1$

B.  $x = -1$

C.  $\begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix} = 0$

D. none of these

Answer: A::B::C





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2. If  $a_i, i = 1, 2, \dots, 9$  are perfect odd squares, then  $\begin{vmatrix} a_1 & a_2 & a_3 \\ a_4 & a_5 & a_6 \\ a_7 & a_8 & a_9 \end{vmatrix}$  is

always a multiple of

A. 4

B. 7

C. 16

D. 64

Answer: A::C::D



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3. The value of the determinant  $\begin{vmatrix} \cos(\theta + \alpha) & -\sin(\theta + \alpha) & \cos 2\alpha \\ \sin \theta & \cos \theta & \sin \alpha \\ -\cos \theta & \sin \theta & \lambda \cos \alpha \end{vmatrix}$  is

A. independent of  $\theta$  for all  $\lambda \in R$

B. independent of  $\theta$  and  $\alpha$  when  $\lambda = 1$

C. independent of  $\theta$  and  $\alpha$  when  $\lambda = -1$

D. independent of  $\lambda$  for all  $\theta$

**Answer: A::C**



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4. A solution set of the equations  $x + 2y + z = 1$ ,  $x + 3y + 4z = k$ ,  
 $x + 5y + 10z = k^2$  is

A.  $(1 + 5\lambda, -3\lambda, \lambda)$

B.  $(5\lambda - 1, 1 - 3\lambda, \lambda)$

C.  $(1 + 6\lambda, -2\lambda, \lambda)$

D.  $(1 - 6\lambda, \lambda, \lambda)$

**Answer: A::B**



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5. Consider the system of equations :  $x \sin \theta - 2y \cos \theta - az = 0$ ,  
 $x + 2y + z = 0, -x + y + z = 0, \theta \in R$

- A. The given system will have infinite solutions for  $a = 2$
- B. The number of integer values of  $a$  is 3 for the system to have nontrivial solutions.
- C. For  $a = 1$  there exists  $\theta$  for which the system will have infinite solutions
- D. For  $a = 3$  there exists  $\theta$  for which the system will have unique solutions

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



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Illustration

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

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2. Prove that the determinant  $\Delta = \begin{vmatrix} x & \sin \theta & \cos \theta \\ -\sin \theta & -x & 1 \\ \cos \theta & 1 & x \end{vmatrix}$  is independent of  $\theta$ .

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3. The parameter on which the value of the determinant  $\begin{vmatrix} 1 & a & a^2 \\ \cos(p-d)x & \cos px & \cos(p+d)x \\ \sin(p-d)x & \sin px & \sin(p+d)x \end{vmatrix}$  does not depend is a  
b. p.c. d.d. x`

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4. Let  $a, b, c$  be positive and not all equal. Show that the value of the

determinant  $\begin{vmatrix} a & b & c \\ b & c & a \\ c & a & b \end{vmatrix}$  is negative.

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5. If  $a, b, c \in \mathbb{R}$ , then find the number of real roots of the equation

$$= |xc - b - cxa - ax| = 0$$

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6. If  $x + y + z = 0$  prove that  $\begin{vmatrix} ax & by & cz \\ cy & az & bx \\ bz & cx & ay \end{vmatrix} = xyz \begin{vmatrix} a & b & c \\ c & a & b \\ b & c & a \end{vmatrix}$

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

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8. Find minor and cofactor of elements of the determinant:  $\begin{vmatrix} 2 & -4 \\ 0 & 3 \end{vmatrix}$

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9. Find minor and cofactor of elements of the determinant:  $\begin{vmatrix} -1 & 2 \\ 1 & 0 \end{vmatrix}$

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10. Without expanding the determinants Prove that

$$\begin{vmatrix} 103 & 115 & 114 \\ 111 & 108 & 106 \\ 104 & 113 & 116 \end{vmatrix} + \begin{vmatrix} 113 & 116 & 104 \\ 108 & 106 & 111 \\ 115 & 114 & 103 \end{vmatrix} = 0$$

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11. Prove that  $\begin{vmatrix} ax & by & cz \\ x^2 & y^2 & z^2 \\ 1 & 1 & 1 \end{vmatrix} = \begin{vmatrix} a & b & c \\ x & y & z \\ yz & xz & xy \end{vmatrix}$



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12. for  $x, y, z > 0$  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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13. without expanding at any stage Prove that

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



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14. consider the fourth -degree polynomial equation

$$\begin{vmatrix} a_1 + b_1 x^2 & a_1 x^2 + b_1 & c_1 \\ a_2 + b_2 x^2 & a_2 x^2 + b_2 & c_2 \\ a_3 + b_3 x^2 & a_3 x^2 + b_3 & c_3 \end{vmatrix} = 0$$

Without expanding the determinant find all the roots of the equation.



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15. Let  $\Delta_r = \begin{vmatrix} r-1 & n & 6 \\ (r-1)^2 & 2n^2 & 4n-2 \\ (r-1)^3 & 3n^3 & 3n^2-3n \end{vmatrix}$ . Show that  $\sum_{r=1}^n \Delta_r$  is constant.

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16. Find the value of  $\begin{vmatrix} 41 & 1 & 5 \\ 79 & 7 & 9 \\ 29 & 5 & 3 \end{vmatrix}$

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17. Find the value of determinant

$$\left| \sqrt{(13)} + \sqrt{3}2\sqrt{5}\sqrt{5}\sqrt{(15)} + \sqrt{(26)5}\sqrt{(10)3} + \sqrt{(65)}\sqrt{(15)5} \right|$$

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18. Find 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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19. Prove that  $\begin{vmatrix} \sin \alpha & \cos \alpha & \sin(\alpha + \delta) \\ \sin \beta & \cos \beta & \sin(\beta + \delta) \\ \sin \gamma & \cos \gamma & \sin(\gamma + \delta) \end{vmatrix} = 0$

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20. Using properties of determinants, solve the following for  $x$ :

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

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21. By using properties of determinants, prove the following:

$$|x + 4 \quad 2x \quad 2x \quad 2 \times \quad + \quad 4 \quad 2x \quad 2x \quad 2 \times \quad + \quad 4| = (5x + 4)(4 - x)^2$$

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22. prove that

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

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23. if  $x_i = a_i b_i c_i, i = 1, 2, 3$  are three-digit positive integers such that

each  $x_i$  is a multiple of 19 then prove that  $\det \begin{Bmatrix} a_1 & a_2 & a_3 \\ b_1 & b_2 & b_3 \\ c_1 & c_2 & c_3 \end{Bmatrix}$  is

divisible by 19.

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24. If  $a$ ,  $b$  and  $c$  are real numbers, and  $\Delta = \begin{vmatrix} b & c & a \\ c & a & b \\ a & b & c \end{vmatrix} = 0$ . Show that either  $a + b + c = 0$  or  $a = b = c$ .



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25. Find the value of the determinant  $\begin{vmatrix} a & b & c \\ b & c & a \\ c & a & b \end{vmatrix}$ , where  $a$ ,  $b$ , and  $c$  are respectively, the  $p$ th,  $q$ th, and  $r$ th terms of a harmonic progression.



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26.

if  $a_1, a_2, a_3, \dots$  are in A.P, then find the value of the following determinant

$$\begin{vmatrix} a_p + a_{p+m} + a_{p+2m} & 2a_p + 3a_{p+m} + 4a_{p+2m} & 4a_p + 9a_{p+m} + 16a_{p+2m} \\ a_q + a_{q+m} + a_{q+2m} & 2a_q + 3a_{q+m} + 4a_{q+2m} & 4a_q + 9a_{q+m} + 16a_{q+2m} \\ a_r + a_{r+m} + a_{r+2m} & 2a_r + 3a_{r+m} + 4a_{r+2m} & 4a_r + 9a_{r+m} + 16a_{r+2m} \end{vmatrix}$$



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27.

Prove

that

$$|(1, \beta\gamma + \alpha\delta, \beta^2\gamma^2 + \alpha^2, \delta^2), (1, \gamma\alpha + \beta\delta, \gamma^2\alpha^2 + \beta^2\delta^2), (1, \alpha\beta + \gamma\delta, \alpha^2 + \beta^2, \gamma^2 + \delta^2)| = (\alpha\delta - \beta\gamma)^2$$


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28.

Prove

that

$$|a, b+c, a^2, b, c+a, b^2, c, a+b, c^2| = -(a+b+c)(a-b)(b-c)(c-a)$$

a)


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29.

Prove

that

$$|x^2x^2 - (y-z)^2zy^2y^2 - (z-x)^2zxz^2z^2 - (x-y)^2xy| = (x-y)(y-z)(z-x)$$


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30. 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

$$abc(ab+bc+ac) = a+b+c$$

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31. Prove that  $\begin{vmatrix} a^2 + 1 & ab & ac \\ ab & b^2 + 1 & bc \\ ac & bc & c^2 + 1 \end{vmatrix} = 1 + a^2 + b^2 + c^2$

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32. prove that  $\begin{vmatrix} (b+c)^2 & bc & ac \\ ba & (c+a)^2 & cb \\ ca & cb & (a+b)^2 \end{vmatrix}$   
 $\begin{vmatrix} (b+c)^2 & a^2 & a^2 \\ b^2 & (c+a)^2 & b^2 \\ c^2 & c^2 & (a+b)^2 \end{vmatrix} = 2abc(a+b+c)^3$

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33. Let  $a, b, c$  be real numbers with  $a^2 + b^2 + c^2 = 1$ . Show that the

equation 
$$\begin{vmatrix} ax - by - c & bx + ay & cx + a \\ bx + ay & -ax + by - c & cy + b \\ cx + a & cy + b & -ax - by + c \end{vmatrix} = 0$$
 represents

a straight line.

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34. 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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35. Find the area of a triangle whose vertices are

$A(3, 2)$ ,  $B(11, 8)$  and  $C(8, 12)$ .

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36. If the lines  $a_1x + b_1y + 1 = 0$ ,  $a_2x + b_2y + 1 = 0$  and  $a_3x + b_3y + 1 = 0$  are concurrent, show that the points  $(a_1, b_1)$ ,  $(a_2, b_2)$  and  $(a_3, b_3)$  are collinear.

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37. The number of values of  $a$  for which the lines  $2x + y - 1 = 0$ ,  $ax + 3y - 3 = 0$ , and  $3x + 2y - 2 = 0$  are concurrent is (a) 0 (b) 1 (c) 2 (d) infinite

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38. If the lines  $ax + y + 1 = 0$ ,  $x + by + 1 = 0$  and  $x + y + c = 0$  ( $a, b, c$  being distinct and different from 1) are concurrent, then prove that 
$$\frac{1}{1-a} + \frac{1}{1-b} + \frac{1}{1-c} = 1.$$

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39. Find the value of  $\lambda$  if  $2x^2 + 7xy + 3y^2 + 8x + 14y + \lambda = 0$  represents a pair of straight lines.

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40. show that the determinant

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

is always non- negative.

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41. Factorize the following

$$|3a + b + ca^3 + b^3 + c^3a + b + ca^2 + b^2 + c^2a^4 + b^4 + c^4a^2 + b^2 + c^2a^3 +$$

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42. prove that

$$\begin{vmatrix} (a-x)^2 & (a-y)^2 & (a-z)^2 \\ (b-x)^2 & (b-y)^2 & (b-z)^2 \\ (c-x)^2 & (c-y)^2 & (c-z)^2 \end{vmatrix} \\ \begin{vmatrix} (1+ax)^2 & (1+bx)^2 & (1+cx)^2 \\ (1+ay)^2 & (1+by)^2 & (1+cy)^2 \\ (1+az)^2 & (1+bx)^2 & (1+cz)^2 \end{vmatrix} \\ = 2(b-c)(c-a)(a-b) \times (y-z)(z-x)(x-y)$$



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43. If  $\alpha, \beta, \gamma$  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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44. If

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

then find the value of

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

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

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46. 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 values of  $f(0)$  and  $f'(\pi/2)$ .

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47. If  $f(x) = \left| x^n \cdot 2 \cos x - \frac{\cos(n\pi)}{2} - 4 \sin x - \frac{\sin(n\pi)}{2} - 8 \right|$  then find the value of  $\frac{d^n}{dx^n} (f(x)) \Big|_{x=0} \in \mathbb{Z}$ .

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

then the value of  $f(500)$  \_\_\_\_\_

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49. Let  $\alpha$  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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50. if  $\Delta(x) = \begin{vmatrix} a_1 + x & b_1 + x & c_1 + x \\ a_2 + x & b_2 + x & c_2 + x \\ a_3 + x & b_3 + x & c_3 + x \end{vmatrix}$  then show that  $\Delta(x) = 0$

and that  $\Delta(x) = \Delta(0) + sx$ . where  $s$  denotes the sum of all the

cofactors of all the elements in  $\Delta(0)$

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51. If  $\Delta(x) = \begin{vmatrix} 1 & x^2 & x^2 \\ 6 & 4x & 3 \\ 9 & x & -7 \end{vmatrix}$  then find the value of  $\int_0^1 \Delta(x) dx$

without expanding  $\Delta(x)$ .

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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

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53. If a system of three linear equations  $x + 4ay + a = 0$ ,  $x + 3by + b = 0$ , and  $x + 2cy + c = 0$  is consistent,

then prove that  $a, b, c$  are in H.P.

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54. Solve by Cramers rule  $x + y + z = 6$   $x - y + z = 2$   
 $3x + 2y - 4z = -5$

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55. For what values of  $p$  and  $q$  the system of equations  
 $2x + py + 6z = 8$ ,  $x + 2y + qz = 5$ ,  $x + y + 3z = 4$  has i no solution ii  
a unique solution iii in finitely many solutions.

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56. If  $2ax - 2y + 3z = 0$ ,  $x + ay + 2z = 0$ , and,  $2x + az = 0$  have a  
nontrivial solution, find the value of  $a$ .

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57. For what values of  $k$ , the following system of equations possesses a nontrivial solution over the set of rationals:  
 $x + ky + 3z = 0$ ,  $3x + ky - 2z = 0$ ,  $2x + 3y - 4z = 0$ . Also find the solution for this value of  $k$ .

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### Example

1. Prove that:

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

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2. If  $a, b$  and  $c$  are non-zero real number then 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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3. Prove that

$$|ax - by - cz \quad ayz + bxcx + azay + bxbx - cz - axbz + cyca + azbz + cycz|$$



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4. If  $f(x)$  is a polynomial of degree  $< 3$ , prove that

$$|1af(a)/(x-a) \quad 1bf(b)/(x-b) \quad 1cf(c)/(x-c)| \div |1aa^2 \quad 1^2 \quad 1^2| = \frac{f'(x)}{(x-a)(x-b)(x-c)}$$



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5. Let  $\Delta = \begin{vmatrix} 2a_1b_1 & a_1b_2 + a_2b_1 & a_1b_3 + a_3b_1 \\ a_1b_2 + a_2b_1 & 2a_2b_2 & a_2b_3 + a_3b_2 \\ a_1b_3 + a_3b_1 & a_3b_2 + a_2b_3 & 2a_3b_3 \end{vmatrix}$ . Expressing as

the product of two determinants, show that  $\Delta = 0$



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6. Find the value of  $\begin{vmatrix} \cos\left(\frac{2\pi}{63}\right) & \cos\left(\frac{3\pi}{70}\right) & \cos\left(\frac{4\pi}{77}\right) \\ \cos\left(\frac{\pi}{72}\right) & \cos\left(\frac{2\pi}{80}\right) & \cos\left(\frac{3\pi}{88}\right) \\ 1 & \cos\left(\frac{\pi}{90}\right) & \cos\left(\frac{2\pi}{99}\right) \end{vmatrix}$

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7. Let  $f(t) = \begin{vmatrix} \cos t & t & 1 \\ 2 \sin t & t & 2t \\ \sin t & t & t \end{vmatrix}$ . Then find  $\lim_{t \rightarrow 0} \frac{f(t)}{t^2}$

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8. if  $x_1^2 + 2y_1^2 + 3z_1^2 = x_2^2 + 2y_2^2 + 3z_2^2 = x_3^2 + 2y_3^2 + 3z_3^2 = 2$  and  $x_2x_3 + 2y_2y_3 + 3z_2z_3 = x_3x_1 + 2y_3y_1 + 3z_3z_1 = x_1x_2 + 2y_1y_2 + 3z_1z_2 =$

Then find the value of  $\begin{vmatrix} x_1 & y_1 & z_1 \\ x_2 & y_2 & z_2 \\ x_3 & y_3 & z_3 \end{vmatrix}$

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9. Let  $\alpha_1, \alpha_2$  and  $\beta_1, \beta_2$  be the roots of the equation  $ax^2 + bx + c = 0$  and  $px^2 + qx + r = 0$  respectively. If the system of equations

$\alpha_1 y + \alpha_2 z = 0$  and  $\beta_1 y + \beta_2 z = 0$  has a non trivial solution then prove

that  $\frac{b^2}{q^2} = \frac{ac}{pr}$

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10. If  $bc + qr = ca + rp = ab + pq = -1$  and  $(abc, pqr \neq 0)$  then

$\begin{vmatrix} ap & a & p \\ bq & b & q \\ cr & c & r \end{vmatrix}$  is (A) 1 (B) 2 (C) 0 (D) 3

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### Concept Application Exercise 12.1

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

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2. If A,B,C are the angles of a non right angled triangle ABC. Then find the

value of: 
$$\begin{vmatrix} \tan A & 1 & 1 \\ 1 & \tan B & 1 \\ 1 & 1 & \tan C \end{vmatrix}$$

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3. If  $e^{i\theta} = \cos \theta + is \int h \eta$ , find the value of

$$\left| 1e^{i\pi/3} e^{i\pi/4} e^{-i\pi/3} 1e^{i2\pi/3} e^{-i\pi/4} e^{-i2\pi/3} 1 \right|$$

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4. Find the number of real root of the equation

$$|0x - ax - bx + a0x - cx + bx + c0| = 0, a \neq b \neq c \text{ and } b(a + c) > ac$$

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5. If  $\alpha, \beta, \gamma$  are the roots of  $ax^3 + bx^2 + cx + d = 0$  and

$$\begin{vmatrix} \alpha & \beta & \gamma \\ \beta & \gamma & \alpha \\ \gamma & \alpha & \beta \end{vmatrix} = 0, \alpha \neq \beta \neq \gamma$$
 then find the equation whose roots are

$\alpha + \beta - \gamma, \beta + \gamma - \alpha,$  and  $\gamma + \alpha - \beta.$

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6. A triangle has vertices  $A_i(x_i, y_i)$  for  $i=1,2,3$ . If the orthocenter of triangle is  $(0,0)$  then prove that

$$\begin{vmatrix} x_2 - x_3 & y_2 - y_3 & y_1(y_2 - y_3) + x_1(x_2 - x_3) \\ x_3 - x_1 & y_3 - y_1 & y_2(y_3 - y_1) + x_2(x_3 - x_1) \\ x_1 - x_2 & y_1 - y_2 & y_3(y_1 - y_2) + x_3(x_1 - x_2) \end{vmatrix} = 0$$

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7. if  $\omega \neq 1$  is cube root of unity and  $x+y+z \neq 0$  then

$$\begin{vmatrix} \frac{x}{1+\omega} & \frac{y}{\omega+\omega^2} & \frac{z}{\omega^2+1} \\ \frac{y}{\omega+\omega^2} & \frac{z}{\omega^2+1} & \frac{x}{1+\omega} \\ \frac{z}{\omega^2+1} & \frac{x}{1+\omega} & \frac{y}{\omega+\omega^2} \end{vmatrix} = 0 \text{ if}$$

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## Concept Application Exercise 12 2

1. Prove that the value of determinant  $\begin{vmatrix} 1 & \omega & \omega^2 \\ \omega & \omega^2 & 1 \\ \omega^2 & 1 & \omega \end{vmatrix} = 0$

where  $\omega$  is complex cube root of unity .

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2. Prove that  $\begin{vmatrix} a & a^2 & bc \\ b & b^2 & ac \\ c & c^2 & ab \end{vmatrix} = \begin{vmatrix} 1 & 1 & 1 \\ a^2 & b^2 & c^2 \\ a^3 & b^3 & c^3 \end{vmatrix}$

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3. if  $\Delta = \begin{vmatrix} abc & b^2c & c^2b \\ abc & c^2a & ca^2 \\ abc & a^2b & b^2a \end{vmatrix} = 0$ , ( $a, b, c \in R$  and are all

different and non-zero ) the prove that  $a + b + c = 0$

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4. if  $a_r = (\cos 2r\pi + I \sin 2r\pi)^{1/9}$  then prove that

$$\{(a_1, a_2, a_3), (a_4, a_5, a_6), (a_7, a_8, a_9)\} = 0$$



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5. Given  $A = \begin{vmatrix} a & b & 2c \\ d & e & 2f \\ l & m & 2n \end{vmatrix}$ ,  $B = \begin{vmatrix} f & 2d & e \\ 2n & 4l & 2m \\ c & 2a & b \end{vmatrix}$ , then the value of  $B/A$

is \_\_\_\_\_.



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### Concept Application Exercise 12.3

1. Prove that the value of the following determinant is zero:

$$\begin{vmatrix} a_1 & la_1 + mb_1 & b_1 \\ a_2 & la_2 + mb_2 & b_2 \\ a_3 & la_3 + mb_3 & b_3 \end{vmatrix}$$



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2. using properties of determinants evaluate

$$\begin{vmatrix} 18 & 40 & 89 \\ 40 & 89 & 198 \\ 89 & 198 & 440 \end{vmatrix}$$



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



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4. Show that

$$|11 + p1 + p + q23 + 2p1 + 3p + 2q36 + 3p106p + 3q| = 1.$$



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5. Solve the equation  $\begin{vmatrix} a-x & c & b \\ c & b-x & a \\ b & a & c-x \end{vmatrix} = 0$  where  $a + b + c \neq 0$ .

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6. Show that:

$$|3a - a + b - a + c - b + a3b - b + c - c + a - c + b3c| = 3(a + b + c)$$

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7. Using properties of determinants Prove that

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

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8. Solve:  $\begin{vmatrix} x^2 - 1 & x^2 + 2x + 1 & 2x^2 + 3x + 1 \\ 2x^2 + x - 1 & 2x^2 + 5x - 3 & 2x^2 + 4x - 3 \\ 6x^2 - x - 2 & 6x^2 - 7x + 2 & 12x^2 - 5x - 2 \end{vmatrix} = 0$ .



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9. Show that

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

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10. Show that if  $x_1, x_2, x_3 \neq 0$

$$\begin{vmatrix} x_1 + a_1b_1 & a_1b_2 & a_1b_3 \\ a_2b_1 & x_2 + a_2b_2 & a_2b_3 \\ a_3b_1 & a_3b_2 & x_3 + a_3b_3 \end{vmatrix} \\ = x_1x_2x_3 \left( 1 + \frac{a_1b_1}{x_1} + \frac{a_2b_2}{x_2} + \frac{a_3b_3}{x_3} \right)$$

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11. If  $A, B$  and  $C$  are the angles of a triangle, show that

$$-1 + \cos B \cos C + \cos B \cos B \cos C + \cos A - 1 + \cos A \cos A - 1 + \cos$$

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12. If  $\begin{vmatrix} a^2 & b^2 & c^2 \\ (a+1)^2 & (b+1)^2 & (c+1)^2 \\ (a-1)^2 & (b-1)^2 & (c-1)^2 \end{vmatrix} = k(a-b)(b-c)(c-a)$  then the

value of k is a. 4 b. -2 c. -4 d. 2



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13. Prove that  $\Delta = \begin{vmatrix} 1 & 1 & 1 \\ a & b & c \\ bc+a^2 & ac+b^2 & ab+c^2 \end{vmatrix}$

$$= 2(a-b)(b-c)(c-a)$$



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14. 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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15. If  $r = |2^r 2 \cdot 3^r - 14 \cdot 5^r - 1 \alpha \beta \gamma 2^n - 13^n - 15^n - 1|$ , then find the value of  $r$ .

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16. Prove that

$$|1 + a + b + c + d| = abcd \left( a + \frac{1}{a} + \frac{1}{b} + \frac{1}{c} + \frac{1}{d} \right).$$

Hence find the value of the determinant if  $a, b, c, d$  are the roots of the equation  $px^4 + qx^3 + rx^2 + sx + t = 0$ .

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17. 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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18. Prove the identities: 
$$\begin{vmatrix} b^2 + c^2 & ab & ac \\ ab & c^2 + a^2 & bc \\ ca & bc & a^2 + b^2 \end{vmatrix} = 4a^2b^2c^2$$

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19. 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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### Concept Application Exercise 12.4

1. If  $x_1, x_2, x_3$  as well as  $y_1, y_2, y_3$  are in G.P. with same common ratio, then prove that the points  $(x_1, y_1), (x_2, y_2),$  and  $(x_3, y_3)$  are collinear.

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2. If lines  $px + qy + r = 0$ ,  $qx + ry + p = 0$  and  $rx + py + q = 0$  are concurrent, then prove that  $p + q + r = 0$  (where,  $p, q, r$  are distinct).

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3. 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

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

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4. It is known that the equation of hyperbola and that of its pair of asymptotes differ by constant  $k$ . If equation of hyperbola is  $x^2 + 4xy + 3y^2 - 4x + 2y + 1 = 0$  then find the equation of its pair of asymptotes.

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## Concept Application Exercise 12.5

1. Prove that

$$|(b+x)(c+x)(v+x)(a+x)(a+x)(b+x)(b+y)(c+y)(c+x)(a+t)|$$

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$$2. \Delta = \begin{vmatrix} 1 + a^2 + a^4 & 1 + ab + a^2b^2 & 1 + ac + a^2c^2 \\ 1 + ab + a^2b^2 & 1 + b^2 + b^4 & 1 + bc + b^2c^2 \\ 1 + ac + a^2c^2 & 1 + bc + b^2c^2 & 1 + c^2 + c^4 \end{vmatrix} \text{ is equal to}$$

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3. Prove that

$$|2\alpha + \beta + \gamma + \delta\alpha\beta + \gamma\delta\alpha + \beta + \gamma + \delta| 2(\alpha + \beta)(\gamma + \delta)\alpha\beta(\gamma + \delta) + \gamma\delta(\alpha$$

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4. For all values of  $A, B, C$  and  $P, Q, R$  show that  
 $|\cos(A - P)\cos(A - Q)\cos(A - R)\cos(B - P)\cos(B - Q)\cos(B - R)\cos(C - P)\cos(C - Q)\cos(C - R)| = \cos^3 A \cos^3 B \cos^3 C$

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5. Show that:  $|b^2 + c^2 abacbac^2 + a^2bccacba^2 + b^2| = 4a^2b^2c^2$

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6. Express  $\Delta = \begin{vmatrix} 2bc - a^2 & c^2 & b^2 \\ c^2 & 2ca - b^2 & a^2 \\ b^2 & a^2 & 2ab - c^2 \end{vmatrix}$  as square of a  
 determinant of hence evaluate if.

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Concept Application Exercise 12.6

1. Let  $f(x) = \begin{vmatrix} \cos(x + x^2) & \sin(x + x^2) & -\cos(x + x^2) \\ \sin(x - x^2) & \cos(x - x^2) & \sin(x - x^2) \\ \sin 2x & 0 & \sin(2x^2) \end{vmatrix}$ . Find the value of  $f'(0)$ .



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2. If  $f(x)$ ,  $g(x)$  and  $h(x)$  are three polynomial of degree 2, then prove that

$\phi(x) = \begin{vmatrix} f(x) & g(x) & h(x) \\ f'(x) & g'(x) & h'(x) \\ f''(x) & g''(x) & h''(x) \end{vmatrix}$  is a constant polynomial.



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3. 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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4. If  $f(x) = \begin{vmatrix} \cos(x + \alpha) & \cos(x + \beta) & \cos(x + \gamma) \\ \sin(x + \alpha) & \sin(x + \beta) & \sin(x + \gamma) \\ \sin(\beta - \gamma) & \sin(\gamma - \alpha) & \sin(\alpha - \beta) \end{vmatrix}$  and

$f(0) = 2$  then find the value of  $\sum_{r=1}^{30} |f(r)|$ .

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5.  $f(x) = \begin{vmatrix} \cos x & x & 1 \\ 2 \sin x & x^2 & 2x \\ \tan x & x & 1 \end{vmatrix}$  then find the value of

$$\lim_{x \rightarrow 0} \frac{f(x)}{x}$$

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## Concept Application Exercise 12.7

1. Find the following system of equations is consistent,

$$(a + 1)^3 x + (a + 2)^3 y = (a + 3)^3 \quad (a + 1)x + (a + 2)y = a + 3 \quad +=1,$$

then find the value of  $a$ .

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2. Solve the system of the equations:  $ax + by + cz = d$ ,  
 $a^2x + b^2y + c^2z = d^2$ ,  $a^3x + b^3y + c^3z = d^3$ .

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3. consider the system of equations : Itbr.  $3x - y + 4z = 3$

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

$$6x + 5y + \lambda z = -3$$

Prove that system of equation has at least one solution for all real values of  $\lambda$ .also prove that infinite solutions of the system of equations satisfy

$$\frac{7x - 4}{-5} = \frac{7y + 9}{13} = z$$

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4. If the equation  
 $2x + 3y + 1 = 0$ ,  $3x + y - 2 = 0$ , and  $ax + 2y - b = 0$  are

consistent, then prove that  $a - b = 2$ .

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5. if  $x, y$  and  $z$  are not all zero and connected by the equations

$$a_1x + b_1y + c_1z = 0, a_2x + b_2y + c_2z = 0 \quad \text{and}$$

$$(p_1 + \lambda q_1)x + (p_2 + \lambda q_2)y + (p_3 + \lambda q_3)z = 0 \text{ show that}$$

$$\lambda = - \begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ p_1 & p_2 & p_3 \end{vmatrix} \div \begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ q_1 & q_2 & q_3 \end{vmatrix}$$

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### Single Correct Answer Type

1. if  $\theta \in R$  then maximum value of  $\Delta = \begin{vmatrix} 1 & 1 & 1 \\ 1 & 1 + \sin \theta & 1 \\ 1 & 1 & 1 + \cos \theta \end{vmatrix}$  is

A.  $\sqrt{3}/2$ )

B.  $1/2$

C.  $1/\sqrt{2}$

D. None of these

**Answer: B**



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2. If  $p + q + r = a + b + c = 0$ , then the determinant  $\begin{vmatrix} pa & qb & rc \\ qc & ra & pb \\ rb & pc & qa \end{vmatrix}$  equals

A. 0

B.  $pa + qb + rc$

C. 1

D. none of these

**Answer: A**



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3. If  $\alpha, \beta, \gamma$  are the roots of  $px^3 + qx^2 + r = 0$ , then the value of the

determinant  $\begin{vmatrix} \alpha\beta & \beta\gamma & \gamma\alpha \\ \beta\gamma & \gamma\alpha & \alpha\beta \\ \gamma\alpha & \alpha\beta & \beta\gamma \end{vmatrix}$  is p b. q c. 0 d. r

A. p

B. q

C. 0

D. r

**Answer: C**



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4. If  $f(x) = a + bx + cx^2$  and  $\alpha, \beta, \gamma$  are the roots of the equation

$x^3 = 1$ , then  $|abc bcacab|$  is equal to  $f(\alpha) + f(\beta) + f(\gamma)$

$f(\alpha)f(\beta) + f(\beta)f(\gamma) + f(\gamma)f(\alpha) - f(\alpha)f(\beta)f(\gamma)$

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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5. If  $[x]$  denotes the greatest integer less than or equal to the real number under consideration, and  $-1 \leq x < 0$ ,  $0 \leq y < 1$ ,  $1 \leq a < 2$ , then the value of the determinant  $|\begin{bmatrix} [x] + 1 & [y] & [z] \\ [x] & [y] + 1 & [z] \\ [x] & [y] & [z] + 1 \end{bmatrix}|$  is  $[x]$  b.  $[y]$  c.  $[z]$  d. none of these

A.  $[x]$

B.  $[y]$

C.  $[z]$

D. none of these

**Answer: C**



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6. if  $a = \cos \theta + i \sin \theta$ ,  $b = \cos 2\theta - i \sin 2\theta$ ,  $c = \cos 3\theta + i \sin 3\theta$  and if

$$\begin{vmatrix} a & b & c \\ b & c & a \\ c & a & b \end{vmatrix} = 0 \text{ then}$$

A.  $0 = 2k\pi, k \in \mathbb{Z}$

B.  $0 = (2k + 1)\pi, k \in \mathbb{Z}$

C.  $0 = (4k + 1)\pi, k \in \mathbb{Z}$

D. none of these

**Answer: A**



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7. If  $\begin{vmatrix} x^n & x^{n+2} & x^{n+3} \\ y^n & y^{n+2} & y^{n+3} \\ z^n & z^{n+2} & z^{n+3} \end{vmatrix} = (x - y)(y - z)(z - x) \left( \frac{1}{x} + \frac{1}{y} + \frac{1}{z} \right)$ , then

$n$  equals a. 1 b. -1 c. 2 d. -2

A. 1

B. -1

C. 2

D. -2

**Answer: B**

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8. If  $f(x) = \begin{vmatrix} 1 & x & x+1 \\ 2x & x(x-1) & (x+1)x \\ 3x(x-1) & x(x-1)(x-2) & (x+1)x(x-1) \end{vmatrix}$  then  
the value of  $f(500)$  \_\_\_\_\_

A. 1

B. 0

C. -1

D. 2



**Answer: C**



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9. If a determinant of order  $3 \times 3$  is formed by using the numbers 1 or -1 then minimum value of determinant is :

A. -2

B. -4

C. 0

D. -8

**Answer: B**



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10. 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

D. -4

**Answer: D**



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11. If  $a, b, c$  are different, then the value of  $\begin{vmatrix} 0 & x^2 - a & x^3 - b \\ x^2 + a & 0 & x^2 + c \\ x^4 + b & x - c & 0 \end{vmatrix}$  is a.

b b. c c. b d. 0

A. a

B. c

C. b

D. 0

**Answer: D**



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12. if the value of the determinant  $\begin{vmatrix} a & 1 & 1 \\ 1 & b & 1 \\ 1 & 1 & c \end{vmatrix}$  is positive then  
( $a, b, c < 0$ )

A.  $abc > 1$

B.  $abc > -8$

C.  $abc > -8$

D.  $abc > -2$

**Answer: B**



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13. if  $A_1, B_1, C_1, \dots$  are respectively the cofactors of the elements  $a_1, b_1, c_1, \dots$  of the determinant

$$\Delta = \begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix}, \Delta \neq 0 \text{ then the value of } \begin{vmatrix} B_2 & C_2 \\ B_3 & C_3 \end{vmatrix} \text{ is equal to}$$

A.  $a_1^2 \Delta$

B.  $a_1 \Delta$

C.  $a_1 \Delta^2$

D.  $a_1^2 \Delta^2$

**Answer: B**



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14. If  $a, b, c, d, e, \text{ and } f$  are in G.P. then the value of  $|a^2 d^2 x b^2 e^2 y c^2 f^2 z|$  depends on  $x$  and  $y$  b.  $x$  and  $z$  c.  $y$  and  $z$  d. independent of  $x, y, \text{ and } z$

A.  $x$  and  $y$

B. x and z

C. y and z

D. independent of x,y and z

**Answer: D**



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15. Let  $x < 1$ , then value of  $\begin{vmatrix} x^2 + 2 & 2x + 1 & 1 \\ 2x + 1 & x + 2 & 1 \\ 3 & 3 & 1 \end{vmatrix}$  is a. none-negative b.

none-positive c. negative d. positive

A. non-negative

B. non- positive

C. begative

D. positive

**Answer: C**



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16. The value of  $\begin{vmatrix} -1 & 2 & 1 \\ 3 + 2\sqrt{2} & 2 + 2\sqrt{2} & 1 \\ 3 - 2\sqrt{2} & 2 - 2\sqrt{2} & 1 \end{vmatrix}$  is equal to

- A. 0
- B.  $-16\sqrt{2}$
- C.  $-8\sqrt{2}$
- D. none of these

**Answer: B**

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17. 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

$\sum_{i=1}^n D_i = 1$  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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18. if  $w$  is a complex cube root to unity then value of

$$\Delta = \begin{vmatrix} a_1 + b_1 w & a_1 w^2 + b_1 & c_1 + b_1 \bar{w} \\ a_2 + b_2 w & a_2 w^2 + b_2 & c_2 + b_2 \bar{w} \\ a_3 + b_3 w & a_3 w^2 + b_3 & c_3 + b_3 \bar{w} \end{vmatrix} \text{ is}$$

A. 0

B. -1

C. 2

D. none of these

**Answer: A**



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19. If  $a + b + c = 0$ , one root of  $|a - x \quad c \quad b \quad c \quad b - x \quad a \quad b \quad a \quad c - x| = 0$  is  $x = 1$

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

A.  $x = 1$

B.  $x = 2$

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

D.  $x = 0$

Answer: D



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20. If  $x, y, z$  are in A.P., then the values of the determinant

$$\begin{vmatrix} a + 2 & a + 3 & a + 2y \\ a + 3 & a + 4 & a + 2y \\ a + 4 & a + 5 & a + 2z \end{vmatrix}, \text{ is}$$

A. 1



B. 0

C. 2a

D. a

**Answer: B**



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21. If  $a_1, a_2, a_3, \dots$  are in G.P. then the value of determinant

$$\begin{vmatrix} \log(a_n) & \log(a_{n+1}) & \log(a_{n+2}) \\ \log(a_{n+3}) & \log(a_{n+4}) & \log(a_{n+5}) \\ \log(a_{n+6}) & \log(a_{n+7}) & \log(a_{n+8}) \end{vmatrix} \text{ equals (A) 0 (B) 1 (C) 2 (D) 3}$$

A. 1

B. 0

C. 2a

D. a

**Answer: B**





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22. Value of  $|x + yzzy + zxyyz + x|$ , where  $x, y, z$  are nonzero real number, is equal to  $xyz$  b.  $2xyz$  c.  $3xyz$  d.  $4xyz$

A.  $xyz$

B.  $2xyz$

C.  $3xyz$

D.  $4xyz$

Answer: D



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23. Which of the following is not the root of the equation

$$|x - 6 - 12 - 3 \times - 3 - 32 \times + 2| = 0? \text{ 2 b. 0 c. 1 d. } -3$$

A. 2

B. 0

C. 1

D. -3

**Answer: B**



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24. The value of the determinant  $\begin{vmatrix} kak^2 + a^2 & 1kbbk^2 + b^2 & 1kck^2 + c^2 \\ 1 & k & 1 \end{vmatrix}$  is  
 $k(a+b)(b+c)(c+a)$     $kabc(a^2 + b^2 + c^2)$     $k(a-b)(b-c)(c-a)$   
 $k(a+b-c)(b+c-a)(c+a-b)$

A.  $k(a+b)(b+c)(c+a)$

B.  $kabc(a^2 + b^2 + c^2)$

C.  $k(a-b)(b-c)(c-a)$

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

**Answer: C**

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$$25. \text{ If } \begin{vmatrix} 1 & 1 & 1 \\ a & b & c \\ a^3 & b^3 & c^3 \end{vmatrix} = (a-b)(b-c)(c-a)(a+b+c)$$

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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26. If  $f'(x) = \begin{vmatrix} mx & mx - p & mx + p \\ n & n + p & n - p \\ mx + 2n & mx + 2n + p & mx + 2n - p \end{vmatrix}$ , then

$y = f(x)$  represents a. a straight line parallel to x-axis b. a straight line parallel to y-axis c. parabola d. a straight line with negative slope

A. a straight line parallel to x-axis

B. a straight line parallel to y-axis

C. parabola

D. a straight line with negative slope

**Answer: B**

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27. 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

**Answer: B**



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28. If  $\begin{vmatrix} x^n & x^{n+2} & x^{2n} \\ 1 & x^a & a \\ x^{n+5} & x^{a+6} & x^{2n+5} \end{vmatrix} = 0, \forall x \in R, \text{ when } n \in N, \text{ then value of}$

$a$  is  $n$  b.  $n - 1$  c.  $n + 1$  d. none of these

A.  $n$

B.  $n-1$

C.  $n+1$

D. none of these

**Answer: C**



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29. for the equation 
$$\begin{vmatrix} 1 & x & x^2 \\ x^2 & 1 & x \\ x & x^2 & 1 \end{vmatrix} = 0$$

- A. There are exactly two distinct roots
- B. there is one pair of equation real roots
- C. There are three pairs of equal roots
- D. Modulus of each root is 2

Answer: C

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30. If  $a^2 + b^2 + c^2 = -2$  and  $f(x) = |1 + a^2x(1 + b^2)x(1 + c^2)x(1 + a^2)x| + |1 + b^2x(1 + c^2)x(1 + a^2)x(1 + b^2)x|$ , 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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31. The value of the determinant  $\begin{vmatrix} 1 & 1 & 1 \\ .^m C_1 & .^{m+1} C_1 & .^{m+2} C_1 \\ .^m C_2 & .^{m+1} C_2 & .^{m+2} C_2 \end{vmatrix}$  is equal to

A. 1

B. -1

C. 0

D. none of these

**Answer: A**



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32. the value of the determinant

$$\begin{vmatrix} {}^n C_{r-1} & {}^n C_r & (r+1)^{n+2} C_{r+1} \\ {}^n C_r & {}^n C_{r+1} & (r+2)^{n+2} C_{r+2} \\ {}^n C_{r+1} & {}^n C_{r+2} & (r+3)^{n+2} C_{r+3} \end{vmatrix} \text{ is}$$

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

B. 0

C.  ${}^{n+3} C_{r+3}$

D.  ${}^n C_{r-1} + {}^n C_r + {}^n C_{r+1}$

**Answer: B**



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33. if  $f(x) = \begin{vmatrix} x & a & a \\ a & x & a \\ a & a & x \end{vmatrix} = 0$  then

A.  $f(x) = 0$  and  $f(x) = 0$  has one common root

B.  $f(x) = 0$  and  $f(x) = 0$  has one common root

C. sum of roots of  $f(x) = 0$  is  $-3a$

D. none of these

**Answer: B**



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

then the value of  $f(500)$  \_\_\_\_\_

A. 1

B. 2

C.  $-1$

D.  $-2$

**Answer: C**



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$$35. \quad \text{If } f(x) = \begin{vmatrix} 1 & x & x+1 \\ 2x & x(x-1) & (x+1)x \\ 3x(x-1) & x(x-1)(x-2) & (x+1)x(x-1) \end{vmatrix}$$

then the value of  $f(500)$  \_\_\_\_\_

- A.  $-1$
- B.  $-2$
- C.  $-3$
- D. none of these

**Answer: C**

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$$36. \quad \text{If } f(x) = \begin{vmatrix} 1 & x & x+1 \\ 2x & x(x-1) & (x+1)x \\ 3x(x-1) & x(x-1)(x-2) & (x+1)x(x-1) \end{vmatrix}$$

then the value of  $f(500)$  \_\_\_\_\_

- 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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37. if  $\begin{vmatrix} b+c & c+a & a+b \\ a+b & b+c & c+a \\ c+a & a+b & b+c \end{vmatrix} = k \begin{vmatrix} a & b & c \\ c & a & b \\ b & c & a \end{vmatrix}$  then the value of

k is

A. 1

B. 2

C. 3

D. 4

**Answer: B**



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38. suppose  $D = \begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix}$  and

$$D' = \begin{vmatrix} a_1 + pb_1 & b_1 + qc_1 & c_1 + ra_1 \\ a_2 + pb_2 & b_2 + qc_2 & c_2 + ra_2 \\ a_3 + pb_3 & b_3 + qc_3 & c_3 + ra_3 \end{vmatrix}. \text{ Then}$$

A.  $D' = D$

B.  $D' = D(1 - pqr)$

C.  $D' = D(1 + p + q + r)$

D.  $D' = D(1 + pqr)$

Answer: D

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39. The value of the determinant  $\begin{vmatrix} \log_a\left(\frac{x}{y}\right) & \log_a\left(\frac{y}{z}\right) & \log_a\left(\frac{z}{x}\right) \\ \log_b\left(\frac{y}{z}\right) & \log_b\left(\frac{z}{x}\right) & \log_b\left(\frac{x}{y}\right) \\ \log_c\left(\frac{z}{x}\right) & \log_c\left(\frac{x}{y}\right) & \log_c\left(\frac{y}{z}\right) \end{vmatrix}$

A. 1

B. -1

C. 0

D.  $\frac{1}{6} \log_a xyz$

**Answer: C**



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**40.** If  $a > 0, b > 0, c > 0$  are respectively the  $p$ th,  $q$ th,  $r$ th terms of a G.P., then the value of the determinant

$$\begin{vmatrix} \log a & p & 1 \\ \log b & q & 1 \\ \log c & r & 1 \end{vmatrix}, \text{ is}$$

A. 0

B.  $\log(abc)$

C.  $-(p + q + r)$

D. none of these

**Answer: A**



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41. If  $a > 0$  and discriminant of  $ax^2 + 2bx + c$  is negative, then

$$\Delta = \begin{vmatrix} a & b & ax + b \\ b & c & bx + c \\ ax + b & bx + c & 0 \end{vmatrix} \text{ is}$$

a.  $+ve$

b.  $(ac - b)^2(ax^2 + 2bx + c)$

c.  $-ve$

d. 0

A.  $+ve$

B.  $(ac - b)^2(ax^2 + 2bx + c)$

C.  $-ve$

D. 0

Answer: C



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42. The number of distinct real roots of  $\begin{vmatrix} \sin x & \cos x & \cos x \\ \cos x & \sin x & \cos x \\ \cos x & \cos x & \sin x \end{vmatrix} = 0$  in the interval  $-\frac{\pi}{4} \leq x \leq \frac{\pi}{4}$  is

A. 0

B. 2

C. 1

D. 3

Answer: C

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

then the value of  $f(500)$  \_\_\_\_\_

A. 4

B. 6



C. 8

D. 7

**Answer: D**



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44. the value of  $\sum_{r=2}^n (-2)^r \begin{vmatrix} {}^{n-2}C_{r-2} & {}^{n-2}C_{r-1} & {}^{n-2}C_r \\ -3 & 1 & 1 \\ 2 & -1 & 0 \end{vmatrix} (n > 2)$

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

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

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

D. none of these

**Answer: A**



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45. if  $\Delta = \begin{vmatrix} 3 & 4 & 5 & x \\ 4 & 5 & 6 & y \\ 5 & 6 & 7 & z \\ x & y & z & 0 \end{vmatrix} = 0$  then

A.  $x, y, z$  are in A.P.

B.  $x, y, z$  are in G.P

C.  $x, y, z$  are in H.P

D. none of these

**Answer: A**



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46. Roots of the equations  $\begin{vmatrix} x & m & n & 1 \\ a & x & n & 1 \\ a & b & x & 1 \\ a & b & c & 1 \end{vmatrix} = 0$  are

A. independent of  $m$  and  $n$

B. independent of  $a, b$  and  $c$

C. depend on  $m, n$  and  $a, b, c$

D. independent of  $m, n$  and  $a, b, c$

Answer: A



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47. If  $x, y, z$  are different from zero and

Delta =  $\begin{vmatrix} a & b-y & c-z \\ a-x & b & c-z \\ a-x & b-y & c \end{vmatrix} = 0$ , then the value of the expression

$\frac{a}{x} + \frac{b}{y} + \frac{c}{z}$  is a. 0 b. -1 c. 1 d. 2

A. 0

B. -1

C. 1

D. 2

Answer: D



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48. about to only mathematics

A. 0

B. 3

C. 6

D. 12

Answer: B



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49. In triangle ABC, if

$$\left| \begin{array}{ccc} 1 & 1 & 1 \\ \cot\left(\frac{A}{2}\right) & \cot\left(\frac{B}{2}\right) & \cot\left(\frac{C}{2}\right) \\ \tan\left(\frac{B}{2}\right) + \tan\left(\frac{C}{2}\right) & \tan\left(\frac{C}{2}\right) + \tan\left(\frac{A}{2}\right) & \tan\left(\frac{A}{2}\right) + \tan\left(\frac{B}{2}\right) \end{array} \right| = 0$$

then the triangle must be (A) Equilateral (B) Isosceles (C) Right Angle (D)

none of these

A. equilateral

B. isosceles

C. obtuse angled

D. none of these

**Answer: B**



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50. 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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51. The determinant  $\begin{vmatrix} y^2 & -xy & x^2 \\ a & b & c \\ a' & b' & c' \end{vmatrix}$  is equal to

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

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

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

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

Answer: D



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52. Let  $\vec{a}_r = x_r \hat{i} + y_r \hat{j} + z_r \hat{k}$ ,  $r = 1, 2, 3$  three mutually perpendicular

unit vectors then the value of  $\begin{vmatrix} x_1 & x_2 & x_3 \\ y_1 & y_2 & y_3 \\ z_1 & z_2 & z_3 \end{vmatrix}$  is equal to

A. zero

B.  $\pm 1$

C.  $\pm 2$

D. none of these

**Answer: B**



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**53. Let**

$$\begin{vmatrix} y^5 z^6 (z^3 - y^3) & x^4 z^6 (x^3 - z^3) & x^4 y^5 (y^3 - x^3) \\ y^2 z^3 (y^6 - z^6) & x z^3 (z^6 - x^6) & x y^2 (x^6 - y^6) \\ y^2 (z^3 - y^3) & x z^3 (x^3 - z^3) & x y^2 (y^3 - x^3) \end{vmatrix} \quad \text{and} \quad \Delta_2 = \begin{vmatrix} x \\ x^4 \\ x^7 \end{vmatrix}$$

.Then  $\Delta_1 \Delta_2$  is equal to

A.  $\Delta_2^6$

B.  $\Delta_2^4$

C.  $\Delta_2^3$

D.  $\Delta_2^2$

Answer: C



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54. the value of the determinant

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

- A. dependant on  $a_i, i = 1, 2, 3, 4$
- B. dependant on  $b_i, i = 1, 2, 3, 4$
- C. dependant on  $a_{ij}, b_i, i = 1, 2, 3, 4$
- D. 0

Answer: D



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55. if  $\Delta(x) = \begin{vmatrix} \tan x & \tan(x+h) & \tan(x+2h) \\ \tan(x+2h) & \tan x & \tan(x+h) \\ \tan(x+h) & \tan(x+2h) & \tan x \end{vmatrix}$ , then

The value of  $\lim_{h \rightarrow 0} \left( \frac{\Delta(\pi/3)}{(\sqrt{3})h^2} \right)$  is

A. 144

B. 216

C. 64

D. 36

**Answer: A**



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56. 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.  $x$  only

B.  $x_1$  only

C.  $x_2$  only

D. none of these

**Answer: D**

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

, then the value of  $\lambda$  is 8 b. 27 c. 1 d. -1

A. 8

B. 27

C. 1

D. -1

**Answer: C**

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58. Let  $\begin{vmatrix} x & 2 & x \\ x^2 & x & 6 \\ x & x & 6 \end{vmatrix} = Ax^4 + Bx^3 + Cx^2 + Dx + E$ . Then the value of

$5A + 4B + 3C + 2D + E$  is equal to a. zero b.  $-16$  c.  $11$  d.  $-11$

A. zero

B.  $-16$

C.  $16$

D.  $-11$

**Answer: D**



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59. If  $\Delta_1 = \begin{vmatrix} x & b & b \\ a & x & b \\ a & a & x \end{vmatrix}$  and  $\Delta_2 = \begin{vmatrix} x & b \\ a & x \end{vmatrix}$  are the given

determinants then

A.  $\Delta_1 = 3(\Delta_2)^2$

B.  $\frac{d}{dx}(\Delta_1) = 3\Delta_2$

$$C. \frac{d}{dx}(\Delta_1) = 3(\Delta_2)^2$$

$$D. \Delta_1 = 3\Delta_2^{3/2}$$

**Answer: B**



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$$60. \text{ If } f(x) = \begin{vmatrix} 1 & x & x+1 \\ 2x & x(x-1) & (x+1)x \\ 3x(x-1) & x(x-1)(x-2) & (x+1)x(x-1) \end{vmatrix}$$

then the value of  $f(500)$  \_\_\_\_\_

A.  $m^9$

B.  $m^2$

C.  $m^3$

D. 0

**Answer: D**



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61. 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

$$\int_0^{\pi/2} \{f(x) + f'(x)\} dx \text{ is}$$

- A.  $\pi$
- B.  $\pi/2$
- C.  $2\pi$
- D.  $3\pi/2$

**Answer: A**



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62.  $a, b, c$  are distinct real numbers not equal to one. If  $ax + y + z = 0$ ,  $x + by + z = 0$ , and  $x + y + cz = 0$  have nontrivial solution, then the value of  $\frac{1}{1-a} + \frac{1}{1-b} + \frac{1}{1-c}$  is equal to a. 1 b.  $-1$  c. zero d. none of these

A.  $-1$

B.  $1$

C. zero

D. none of these

**Answer: B**



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

A.  $\lambda \neq 8$

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

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

D. none of these

**Answer: A**



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**64.** If  $\alpha, \beta, \gamma$  are the angles of a triangle and system of equations

$$\cos(\alpha - \beta)x + \cos(\beta - \gamma)y + \cos(\gamma - \alpha)z = 0$$

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

$\sin(\alpha + \beta)x + \sin(\beta + \gamma)y + \sin(\gamma + \alpha)z = 0$  has non-trivial solutions,

then triangle is necessarily a. equilateral b. isosceles c. right angled d.

acute angled

A. equilateral

B. isosceles

C. right angled

D. acute angled

**Answer: B**



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65.

Given

$a = x/(y - z)$ ,  $b = y/(z - x)$ , and  $c = z/(x - y)$ , where  $x, y$  and  $z$  are not all zero, then the value of  $ab + bc + ca$  is a. 0 b. 1 c. -1 d. none of these

A. 0

B. 1

C. -1

D. none of these

Answer: C



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66. If  $pqr \neq 0$  and the system of equation  $(p + a)x + by + cz = 0$   
 $ax + (q + b)y + cz = 0$   $ac + by + (r + c)z = 0$  has nontrivial solution,  
then value of  $\frac{a}{p} + \frac{b}{q} + \frac{c}{r}$  is -1 b. 0 c. 0 d.  $\neg - 2$



A. -1

B. 0

C. 1

D. 2

**Answer: A**



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67. 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. either -2 or 1

B. -2

C. 1

D. not-2

**Answer: B**



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68. 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. for no value of  $\lambda$  and  $\theta$
- B. for all values of  $\lambda$  and  $\theta$
- C. for all values of  $\lambda$  and only two values of  $\theta$
- D. for only one value of  $\lambda$  and all values of  $\theta$

**Answer: A**



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

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

D. none of these

**Answer: C**



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**70.** If  $a, b, c$  are in G.P. with common ratio  $r_1$  and  $\alpha, \beta, \gamma$  are in G.P. with common ratio  $r_2$  and equations  $ax + \alpha y + z = 0, bx + \beta y + z = 0, cx + \gamma y + z = 0$  have only zero solution, then which of the following is not true?

A.  $r_1 \neq 1$

B.  $r_2 \neq 1$

C.  $r_1 \neq r_2$

D. none of these

**Answer: D**



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71. if the system of equations

$$(a - t)x + by + cz = 0$$

$$bx + (c - t)y + az = 0$$

$$cx + ay + (b - t)z = 0$$

has non-trivial solutions then product of all possible values of t is

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

B.  $a + b + c$

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

D. 1

**Answer: A**



72. Let  $\lambda$  and  $\alpha$  be real. Then the numbers of intergral values  $\lambda$  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. 0

B. 1

C. 2

D. 3

**Answer: D**

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.  $\begin{vmatrix} 1/a & a^2 & bc \\ 1/b & b^2 & ac \\ 1/c & c^2 & ab \end{vmatrix}$

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. If  $f(\alpha, \beta) = \begin{vmatrix} \cos \alpha & -\sin \alpha & 1 \\ \sin \alpha & \cos \alpha & 1 \\ \cos(\alpha + \beta) & -\sin(\alpha + \beta) & 1 \end{vmatrix}$ , then

A.  $f(300, 200) = f(400, 200)$

B.  $f(200, 400) = f(200, 600)$

C.  $f(100,200)=f(200,200)$

D. none of these

**Answer: A::C**

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3. if  $f(\theta) = \begin{vmatrix} \sin \theta & \cos \theta & \sin \theta \\ \cos \theta & \sin \theta & \cos \theta \\ \cos \theta & \sin \theta & \sin \theta \end{vmatrix}$  then

A.  $f(\theta) = 0$  has exactly 2 real solutions in  $[0, \pi]$

B.  $f(\theta) = 0$  has exactly 3 real solutions in  $[0, \pi]$

C. range of function  $\frac{f(\theta)}{1 - \sin 2\theta}$  is  $[-\sqrt{2}, \sqrt{2}]$

D. range of function  $\frac{f(\theta)}{\sin 2\theta - 1}$  is  $[-3, 3]$  is  $[-3, 3]$

**Answer: A::C**

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4. If  $f(x) = \begin{vmatrix} a & -1 & 0 \\ ax & a & -1 \\ ax^2 & ax & a \end{vmatrix}$ , then  $f(2x) - f(x)$  is divisible by

A.  $x$

B.  $a$

C.  $2a + 3x$

D.  $x^2$

Answer: A::B::C



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

A.  $a$

B.  $b$

C.  $c, d, e$

D. none of these



Answer: A::B::C



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6. 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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7. the determinant  $\Delta = \begin{vmatrix} a^2 + x & ab & ac \\ ab & b^2 + x & bc \\ ac & bc & c^2 + x \end{vmatrix}$  is divisible by

A.  $x$

B.  $x^2$

C.  $x^3$

D. none of these

**Answer: A:B**



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

a.  $a + b$

b.  $a + 2b$

c.  $2a + 3b$

d.  $a^2$

A.  $a + b$

B.  $a + 2b$

C.  $2a + 3b$

D.  $a^2$

**Answer: A**



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9. the roots of the equations  $\begin{vmatrix} \cdot^x C_r & \cdot^{n-1} C_r & \cdot^n C_r \\ \cdot^{x+1} C_r & \cdot^n C_r & \cdot^{n+1} C_r \\ \cdot^{x+2} C_r & \cdot^{n+1} C_r & \cdot^{n+2} C_r \end{vmatrix} = 0$

A.  $x = n$

B.  $x = n + 1$

C.  $x = n - 1$

D.  $x = n - 2$

**Answer: A::C**



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10. 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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11. Let  $f(n) = \begin{vmatrix} n & n+1 & n+2 \\ {}^n P_n & {}^{n+1} P_{n+1} & {}^{n+2} P_{n+2} \\ {}^n C_n & {}^{n+1} C_{n+1} & {}^{n+2} C_{n+2} \end{vmatrix}$  where the symbols

have their usual meanings .then  $f(n)$  is divisible by

A.  $n^2 + n + 1$

B.  $(n + 1)!$

C.  $n!$

D. none of these

**Answer: A::C**



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12. 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.  $a, b, c$  are in A.P

B.  $a, b, c$  are in G.P.

C.  $\alpha$  is a root of the equation  $ax^2 + bx + c = 0$

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

**Answer: B::D**



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13. if  $\begin{vmatrix} \sin x & \sin y & \sin z \\ \cos x & \cos y & \cos z \\ \cos^3 x & \cos^3 y & \cos^3 z \end{vmatrix} = 0$  then which of the following is / are possible ?

A.  $x = y$

B.  $y = z$

C.  $x = z$

D.  $x + y + z = \pi/2$

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

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14. If  $\begin{vmatrix} x^2 + x & x + 1 & x - 2 \\ 2x^2 + 3x - 1 & 3x & 3x - 3 \\ x^2 + 2x + 3 & 2x - 1 & 2x - 1 \end{vmatrix} = xA + B$  then find A

and B

A.  $\begin{vmatrix} 1 & 1 & 1 \\ -1 & -3 & 3 \\ 4 & 0 & 0 \end{vmatrix}$

$$\begin{array}{l} \text{B. } \begin{vmatrix} 0 & 1 & 2 \\ 1 & -2 & 3 \\ -4 & 0 & 0 \end{vmatrix} \\ \text{C. } \begin{vmatrix} 1 & 1 & -2 \\ -3 & -2 & 3 \\ 4 & 0 & 1 \end{vmatrix} \\ \text{D. } \begin{vmatrix} 0 & 1 & -2 \\ -1 & -3 & 3 \\ 4 & 0 & 0 \end{vmatrix} \end{array}$$

Answer: A::D

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15. if  $\begin{vmatrix} 1 & 1 & 1 \\ a & b & c \\ bc & ca & ab \end{vmatrix} = \begin{vmatrix} 1 & 1 & 1 \\ a & b & c \\ a^3 & b^3 & c^3 \end{vmatrix}$  where  $a, b, c$  are distinct

positive reals then the possible values of  $abc$  is / are

- A.  $\frac{1}{18}$
- B.  $\frac{1}{63}$
- C.  $\frac{1}{27}$
- D.  $\frac{1}{9}$

Answer: A::B

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16. 
$$\begin{vmatrix} \cdot^x C_r & \cdot^x C_{r+1} & \cdot^x C_{r+2} \\ \cdot^y C_r & \cdot^y C_{r+1} & \cdot^y C_{r+2} \\ \cdot^z C_r & \cdot^z C_{r+1} & \cdot^z C_{r+2} \end{vmatrix}$$
 is equal to

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17. If 
$$\begin{vmatrix} \sin \theta \cos \phi & \sin \theta \sin \phi & \cos \theta \\ \cos \theta \cos \phi & \cos \theta \sin \phi & -\sin \theta \\ -\sin \theta \sin \phi & \sin \theta \cos \phi & \theta \end{vmatrix}$$
 then

A.  $\Delta$  is independent of theta

B.  $\Delta$  is independent of  $\phi$

C.  $\Delta$  is a constant

D. 
$$\left[ \frac{d\Delta}{d}(\theta) \right]_{\theta=\pi/2} = 0$$

Answer: B::D



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18. If  $f(\theta) = \left| \sin^2 A \cot A \sin^2 B \cot B \sin^2 C \cot C \right|$ , then  $\tan A + \tan B + \tan C \cot A \cot B \cot C \sin^2 A + \sin^2 B + \sin^2 C$  is

- A.  $\tan A + \tan B + \tan C$
- B.  $\cot A \cot B \cot C$
- C.  $\sin^2 A + \sin^2 B + \sin^2 C$
- D. 0

Answer: D

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19. if determinant  $\begin{vmatrix} \cos(\theta + \phi) & -\sin(\theta + \phi) & \cos 2\phi \\ \sin \theta & \cos \theta & \sin \phi \\ -\cos \theta & \sin \theta & \cos \phi \end{vmatrix}$  is

- A. non-negative
- B. independent of theta

C. independent of  $\phi$

D. none of these

**Answer: A:B**



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20. If  $g(x) = \begin{vmatrix} a^{-x} & e^{x \log_e a} & x^2 \\ a^{-3x} & e^{3x \log_e a} & x^4 \\ a^{-5x} & e^{5x \log_e a} & 1 \end{vmatrix}$  then

A. graphs of  $g(x)$  is symmetrical about the origin

B. graphs of  $g(x)$  is symmetrical about the y-axis

C.  $\frac{d^4 g(x)}{dx^4} \Big|_{x=0} = 0$

D.  $f(x) = g(x) \times \log. \left( \frac{a-x}{a+x} \right)$  is an odd function

**Answer: A:C**



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21.

If

$$(x) = \left| \begin{bmatrix} x^2 + 4x - 32x + 413 \\ 2x^2 + 5x - 94x + 526 \\ 8x^2 - 6x + 116x \end{bmatrix} \right|$$

then  $a = 3$   $b = 0$   $c = 0$   $d = \text{none of these}$

A.  $a = 3$

B.  $b = 0$

C.  $c = 0$

D. None of these

**Answer: B::C****Watch Video Solution**

22. if 
$$\begin{vmatrix} yz - x^2 & zx - y^2 & xy - z^2 \\ xz - y^2 & xy - z^2 & yz - x^2 \\ xy - z^2 & yz - x^2 & zx - y^2 \end{vmatrix} = \begin{vmatrix} r^2 & u^2 & u^2 \\ u^2 & r^2 & u^2 \\ u^2 & u^2 & r^2 \end{vmatrix}$$
 then

A.  $r^2 = x + y + z$

B.  $r^2 = x^2 = y^2 + z^2$

C.  $u^2 = yz + zx + xy$

$$D. u^2 = xyz$$

Answer: B::C



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23. which of the following is / are true for

$$\Delta = \begin{vmatrix} a^2 & 1 & a + c \\ 0 & b^2 + 1 & b + c \\ 0 & b + c & c^2 + 1 \end{vmatrix} ?$$

A.  $\Delta \geq 0$  for real values of a,b,c

B.  $\Delta \leq 0$  for real values of a,b,c

$$C. \Delta = \begin{vmatrix} bc - 1 & 0 & 0 \\ 1 & ac & -a \\ -b & -a & ab \end{vmatrix}$$

D.  $\Delta = 0$  if  $bc = 1$  where a,b,c are non-zero

Answer: A::C::D



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24. The values of  $k \in R$  for which the system of equations  $x + ky + 3z = 0$ ,  $kx + 2y + 2z = 0$ ,  $2x + 3y + 4z = 0$  admits of nontrivial solution is 2 b.  $5/2$  c. 3 d.  $5/4$

A. 2

B.  $5/2$

C. 3

D.  $5/4$

**Answer: A::B**



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25. The system of equations  $-2x + y + z = a$   $x - 2y + z = b$   $x + y - 2z = c$  has

A. no solution if  $a + b + c \neq 0$

B. unique solution if  $a + b + c = 0$

C. infinite number of solutions if  $a + b + c = 0$

D. None of these

**Answer: A::C**



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26. Let  $\alpha, \beta$  and  $\gamma$  be the roots of the equations  $x^3 + ax^2 + bx + c = 0, (a \neq 0)$ . If the system of equations

$$\alpha x + \beta y + \gamma z = 0$$

$\beta x + \gamma y + \alpha z = 0$  and  $\gamma x = \alpha y + \beta z = 0$  has non-trivial solution then

A.  $a^2 = 3b$

B.  $a^3 = 27c$

C.  $b^3 = 27c^2$

D.  $\alpha + \beta + \gamma = 0$

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



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## Linked Comprehension Type

1. Consider the function  $f(x) = \begin{vmatrix} a^2 + x & ab & ac \\ ab & b^2 + x & bc \\ ac & bc & c^2 + x \end{vmatrix}$

In which of the following interval  $f(x)$  is strictly increasing

- A.  $f(x) = 0$  and  $f'(x) = 0$  have one positive common root
- B.  $f(x) = 0$  and  $f'(x) = 0$  have one negative common root
- C.  $f(x) = 0$  and  $f'(x) = 0$  have no common root
- D. None of these

**Answer: D**

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2. Consider the function  $f(x) = \begin{vmatrix} a^2 + x & ab & ac \\ ab & b^2 + x & bc \\ ac & bc & c^2 + x \end{vmatrix}$

In which of the following interval  $f(x)$  is strictly increasing

- A.  $f(x)$  has one +ve point of maxima.
- B.  $f(x)$  has one -ve point of minima
- C.  $f(x)=0$  has three distinct roots
- D. Local minimum value of  $f(x)$  is zero

**Answer: D**

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3. Consider the function  $f(x) = \begin{vmatrix} a^2 + x & ab & ac \\ ab & b^2 + x & bc \\ ac & bc & c^2 + x \end{vmatrix}$

In which of the following interval  $f(x)$  is strictly increasing

- A.  $(-\infty, \infty)$
- B.  $(-\infty, 0)$



C.  $(0, \infty)$

D. None of these

**Answer: C**



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4. 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.  $r^2/p^2$

B.  $r^3/p^3$

C.  $-s/p$

D. none of these

**Answer: B**



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5. 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.  $\leq 9r^2/p^2$

B.  $\geq 27s^2/p^2$

C.  $\leq 27s^3/p^3$

D. none of these

**Answer: B**



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6. 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.  $3p + 2q = 0$

B.  $4p + 3q = 0$

C.  $3p + q = 0$

D. none of these

**Answer: C**

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7. if  $x > m, y > n, z > r$  ( $x, y, z > 0$ ) such that  $\begin{vmatrix} x & n & r \\ m & y & r \\ m & n & z \end{vmatrix} = 0$

the value of  $\frac{m}{x-m} + \frac{n}{y-n} + \frac{z}{z-r}$  is

A. 1

B. -1

C. 2

D. -2

Answer: C



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8. if  $x > m, y > n, z > r (x, y, z > 0)$  such that  $\begin{vmatrix} x & n & r \\ m & y & r \\ m & n & z \end{vmatrix} = 0$   
the value of  $\frac{m}{x-m} + \frac{n}{y-n} + \frac{z}{z-r}$  is

A. -2

B. -4

C. 0

D. -1

Answer: D



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9. if  $x > m, y > n, z > r (x, y, z > 0)$  such that  $\begin{vmatrix} x & n & r \\ m & y & r \\ m & n & z \end{vmatrix} = 0$

the value  $\frac{xyz}{(x - m)(y - n)(z - r)}$  is

A. 27

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

C.  $\frac{64}{27}$

D. None of these

**Answer: B**



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

the value of  $f(500)$  \_\_\_\_\_

A.  $\frac{g(a) - f(b)}{b - a}$

B.  $\frac{g(-a) - g(-b)}{b - a}$

C.  $\frac{g(a) - g(b)}{b - a}$

D. none of these

**Answer: C**



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

the value of  $f(500)$  \_\_\_\_\_

A.  $\frac{bg(a) - ag(b)}{(b - a)}$

B.  $\frac{bf(a) - af(-b)}{(b - a)}$

C.  $\frac{bf(-a) - ag(b)}{(b - a)}$

D. none of these

**Answer: D**



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

the value of  $f(500)$  \_\_\_\_\_

A.  $f(-a) = g(a)$

B.  $f(-a) = g(-a)$

C.  $f(-b) = g(b)$

D. none of these

**Answer: B**



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

$f(0) = 2, f(1) = 1$   $f$  has a minimum value at  $x = \frac{5}{2}$  For all

$x, f'(x) = |2ax^2 - 12ax + b + 1 + 1 - 12(ax + b)2ax + 2b + 12ax +$

where  $a, b$  are some constants. Determine the constants  $a, b$ , and the function  $f(x)$

A.  $1/4$

B.  $1/2$

C.  $-1$

D.  $3$

**Answer: B**



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

$f(0) = 2, f(1) = 1$   $f$  has a minimum value at  $x = \frac{5}{2}$  For all

$x, f'(x) = |2ax^2 - 12ax + b + 1| + 1 - 12(ax + b)2ax + 2b + 12ax +$

where  $a, b$  are some constants. Determine the constants  $a, b$ , and the

function  $f(x)$

A. both roots positive



B. both roots negative

C. roots of opposite sign

D. imaginary roots

**Answer: D**



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

$f(0) = 2, f(1) = 1$   $f$  has a minimum value at  $x = \frac{5}{2}$  For all  $x, f'(x) = |2ax^2 - 12ax + b + 1 + 1 - 12(ax + b)2ax + 2b + 12ax +$

where  $a, b$  are some constants. Determine the constants  $a, b$ , and the function  $f(x)$

A.  $[7/16, \infty)$

B.  $(-\infty, 15/16]$

C.  $[3/4, \infty)$

D. none of these

Answer: A



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16. Consider the polynomial function

$$f(x) = \begin{vmatrix} (1+x)^a & (1+2x)^b & 1 \\ 1 & (1+x)^a & (1+2x)^b \\ (1+2x)^b & 1 & (1+x)^a \end{vmatrix} \quad a, b \text{ being positive}$$

integers. The constant term in  $f(x)$  is

A. 2

B. 1

C. -1

D. 0

Answer: D



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17. Find  $A^T$ , if  $A = \begin{bmatrix} 7 & -1 & 0 \\ -5 & 3 & 6 \end{bmatrix}$

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18. Find  $A^T$ , if  $A = \begin{bmatrix} -8 & 9 & 0 \\ 6 & 0 & 0 \end{bmatrix}$

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19. Find  $A^T$ , if  $A = \begin{bmatrix} 7 & -1 & 0 \\ -2 & 7 & 1 \end{bmatrix}$

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20. Given that the system of equations  $x = cy + bz$ ,  $y = az + cx$ ,  $z = bx + ay$  has nonzero solutions and at least one of the  $a, b, c$  is a proper fraction.

$abc$  is

A.  $> -1$

B.  $> 1$

C.  $< 2$

D.  $< 3$

**Answer: A**

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21. Find  $A^T$ , if  $A = \begin{bmatrix} -1 & 5 & 0 \\ -9 & 0 & 1 \end{bmatrix}$

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22. Find the area of triangle whose vertices are :A(7,-1),B(0,3),C(1,0)

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23. Consider the system of equations

$$x + y + z = 6$$

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

$$x + 2y + \lambda z = \mu$$

The system has no solution if (a)  $\lambda \neq 3$  (b)  $\lambda = 3, \mu = 10$  (c)

$\lambda = 3, \mu \neq 10$  (d) none of these

A.  $\lambda \neq 3$

B.  $\lambda = 3, \mu = 10$

C.  $\lambda = 3, \mu \neq 10$

D. none of these

**Answer: C**



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**Matrix Match Type**

1. Find the area of triangle whose vertices are :A(2,-3),B(-2,0),C(0,5)



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2. Find the area of triangle whose vertices are :A(1,-1),B(0,-9),C(3,-3)



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3. Find the area of triangle whose vertices are :A(1,0),B(7,1),C(0,3)



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4. Find the area of triangle whose vertices are :A(1,0),B(2,0),C(0,1)



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5. Find the area of triangle whose vertices are :A(1,-1),B(-2,0),C(0,-4)



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## Numerical Value Type

1. Find the area of triangle whose vertices are :A(0,5),B(-2,3),C(1,-4)



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2. The sum of values of  $p$  for which the equations  $x+y+z=1$ ,  $x+2y+4z=p$  and  $x+4y+10z=p^2$  have a solution is \_\_\_\_\_



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3. Find the value of determinant :  $\begin{vmatrix} 2+i & -i \\ 1 & -i \end{vmatrix}$



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4. Find the value of determinant :  $\begin{vmatrix} 10 & -1 \\ -1 & 7 \end{vmatrix}$

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

the value of  $f(500)$  \_\_\_\_\_

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6. If  $\begin{vmatrix} x & x+y & x+y+z \\ 2x & 3x+2y & 4x+3y+2z \\ 3x & 6x+3y & 10x+6y+3z \end{vmatrix} = 64$  then the real value of  $x$  is

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7. Find the value of determinant :  $\begin{vmatrix} 6 & 7 \\ -1 & 2 \end{vmatrix}$

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8. Find the value of determinant :  $\begin{vmatrix} 5i & -3i \\ 4i & -i \end{vmatrix}$

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9. Find the value of determinant :  $\begin{vmatrix} 1 + i & -i \\ i & -i \end{vmatrix}$

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10. Find the value of determinant :  $\begin{vmatrix} 0 & i \\ 3i - 7 & 9 \end{vmatrix}$

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11. Let  $a+b+c = s$  and  $\begin{vmatrix} s + c & a & b \\ c & s + a & b \\ c & a & s + b \end{vmatrix} = 432$  then the value of  $s$  is \_\_\_\_\_

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12. Let  $a, b, c, \in R$  not all are equal and  $\Delta_1 = \begin{vmatrix} a & b & c \\ b & c & a \\ c & a & b \end{vmatrix}$

$$\Delta_2 = \begin{vmatrix} a+2b & b+3c & c+4a \\ b+2c & c+3a & a+4b \\ c+2a & a+3b & b+4c \end{vmatrix} \text{ then } \frac{\Delta_2}{\Delta_1} = \text{---}$$

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13. Three distinct points  $P(3u^2, 2u^3)$ ;  $Q(3v^2, 2v^3)$  and  $R(3w^2, 2w^3)$  are collinear then

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14. if  $\Delta_r = \begin{vmatrix} r & 612 & 915 \\ 101r^2 & 2r & 3r \\ r & \frac{1}{r} & \frac{1}{r^2} \end{vmatrix}$  then the value of

$$\lim_{n \rightarrow \infty} \cdot \frac{1}{n^3} (\sum_{r=1}^n \Delta_r \text{ is } \text{---})$$

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15. if  $x=31, y=32$  and  $z=33$  then the value of

$$\begin{vmatrix} (x^2 + 1)^2 & (xy + 1)^2 & (xz + 1)^2 \\ (xy + 1)^2 & (y^2 + 1)^2 & (yz + 1)^2 \\ (xz + 1)^2 & (yz + 1)^2 & (z^2 + 1)^2 \end{vmatrix} \text{ is } \underline{\hspace{2cm}}$$

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16. Find the value of determinant :  $\begin{vmatrix} a & b \\ a & -b \end{vmatrix}$

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17. Find the value of determinant :  $\begin{vmatrix} -3 & 9 \\ 7 & -1 \end{vmatrix}$

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18. Find the value of determinant :  $\begin{vmatrix} i & -i \\ 4 & -i \end{vmatrix}$

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19. Let  $\omega$  be the complex number  $\cos\left(\frac{2\pi}{3}\right) + i \sin\left(\frac{2\pi}{3}\right)$ . Then the number of distinct complex numbers  $z$  satisfying

$$\Delta = \begin{vmatrix} z+1 & \omega & \omega^2 \\ \omega & z+\omega^2 & 1 \\ \omega^2 & 1 & z+\omega \end{vmatrix} = 0$$
 is

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

$$\begin{vmatrix} x & x^2 & 1+x^3 \\ 2x & 4x^2 & 1+8x^3 \\ 3x & 9x^2 & 1+27x^3 \end{vmatrix} = 10$$
 is (A) 0 (B) 1 (C) 2 (D) 3

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21. For a real number  $\alpha$ , if the system  $[1\ \alpha\ \alpha^2\ \alpha\ 1\ \alpha\ \alpha^2\ \alpha\ 1][xyz] = [1\ -11]$  of linear equations, has infinitely many solutions, then  $1 + \alpha + \alpha^2 =$

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22. Let  $P$  be a matrix of order  $3 \times 3$  such that all the entries in  $P$  are from the set  $\{-1,0,1\}$ . Then, the maximum possible value of the determinant of  $P$  is \_\_\_\_\_



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### Archives Single Correct Answer Type

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

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

then the value of  $n$  is

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

**Answer: 3**



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**2. Consider the system of linear equations:**

$$x_1 + 2x_2 + x_3 = 3$$

$$2x_1 + 3x_2 + x_3 = 3$$

$$3x_1 + 5x_2 + 2x_3 = 1$$

The system has

- A. no solution
- B. infinite number of solutions
- C. exactly three solutions.
- D. a unique solution

**Answer: 1**



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3. 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 : (1) 3 (2) 2 (3) 1 (4) zero

A. zero

B. 3

C. 2

D. 1

**Answer: 3**



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4. Find the value of determinant :  $\begin{vmatrix} 5 & 4 \\ 3 & -1 \end{vmatrix}$



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5. Find the value of determinant :  $\begin{vmatrix} 8 & 3 \\ 5 & -1 \end{vmatrix}$



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6. The set of the all values of  $\lambda$  for which the system of linear equations

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

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

$$-x_1 + 2x_2 = \lambda x_3 \text{ has a non-trivial solution,}$$

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

Answer: 3



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7. 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  $\lambda$  . (2) exactly one value of  $\lambda$  . (3) exactly two values of  $\lambda$  . (4) exactly three values of  $\lambda$  .

- A. Exactly one value of  $\lambda$
- B. Exactly two values of  $\lambda$
- C. Exactly three values of  $\lambda$
- D. Infinitely many values of  $\lambda$

**Answer: 3**

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8. Find the value of determinant :  $\begin{vmatrix} 2i & i \\ 7 & -i \end{vmatrix}$

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9. Let  $\omega$  be a complex number such that  $2\omega + 1 = z$  where  $z = \sqrt{-3}$ .

If  $|1111 - \omega^2 - 1\omega^2 1\omega^2 \omega^7| = 3k$ , then  $k$  is equal to : -1 (2) 1 (3) -z (4)

$z$

A. 1

B.  $-z$

C.  $z$

D. -1

**Answer: 2**



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10. If the system of linear equations  $x+ky+3z=0$ ;  $3x+ky-2z=0$ ;  $2x+4y-3z=0$  has a non-zero solution  $(x,y,z)$  then  $\frac{xz}{y^2}$  is equal to

A. 30

B. -10

C. 10

D. -30

**Answer: 3**



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11. If  $\begin{vmatrix} x - 4 & 2x & 2x \\ 2x & x - 4 & 2x \\ 2x & 2x & x - 4 \end{vmatrix} = (A + Bx)(x - A)^2$  then the ordered

pair (A,B) is equal to

A. (4, 5)

B. (-4, -5)

C. (-4, 3)

D. (-4, 5)

**Answer: 4**



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1. Which of the following values of  $\alpha$  satisfying the equation

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

– 4 b. 9 c. – 9 d. 4

A. – 4

B. 9

C. – 9

D. 4

**Answer: 2,3**



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2. 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  $\lambda$  and  $\mu$
- B. If  $\alpha \neq -3$  then the system has a unique solution for all values of  $\lambda$  and  $\mu$
- C. If  $\lambda + \mu = 0$  then the system has infinitely many solutions for  $\alpha = -3$
- D. if  $\lambda + \mu \neq 0$  then the system has no solution for  $\alpha = -3$

**Answer: 2,3,4**



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