



India's Number 1 Education App

MATHS

BOOKS - DISHA PUBLICATION MATHS (HINGLISH)

DETERMINANTS

Jee Main 5 Years At A Glance

1. 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. (-4,3)

B. (-4,5)

C. (4,5)

D. (-4,-5)

Answer: B



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2. 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. 10
- B. - 30
- C. 30
- D. - 10

Answer: A



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3. The number of values of k for which the system of linear equations, $(k+2)x + 10y = k$; $kx + (k+3)y = k - 1$ has no solution, is

A. Infinitely many

B. 3

C. 1

D. 2

Answer: C



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4. If $A = \begin{vmatrix} 2 & -3 \\ -4 & 1 \end{vmatrix}$ then $\text{adj}(3A^2 + 12A)$ is equal to

A. $\begin{bmatrix} 72 & -63 \\ -84 & 51 \end{bmatrix}$

B. $\begin{bmatrix} 72 & -84 \\ -63 & 51 \end{bmatrix}$

C. $\begin{bmatrix} 51 & 63 \\ 84 & 72 \end{bmatrix}$

D. $\begin{bmatrix} 51 & 84 \\ 63 & 72 \end{bmatrix}$

Answer: C



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5. Let k be an integer such that the triangle with vertices $(k, -3k)$, $(5, k)$ and $(-k, 2)$ has area $28sq$ units. Then the orthocentre of this triangle is at the point : (1) $\left(1, -\frac{3}{4}\right)$ (2) $\left(2, \frac{1}{2}\right)$ (3) $\left(2, -\frac{1}{2}\right)$ (4) $\left(1, \frac{3}{4}\right)$

A. $\left(2, \frac{1}{2}\right)$

B. $\left(2, -\frac{1}{2}\right)$

C. $\left(1, \frac{3}{4}\right)$

D. $\left(1, \frac{3}{4}\right)$

Answer: A



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6. Let ω be a complex number such that $2\omega + 1 = z$ where $z = \sqrt{-3}$. If $|(1, 1, 1), (1, -\omega^2 - 1, \omega^2), (1, \omega^2, \omega^7)| = 3k$, then k is equal to

A. 1

B. $-z$

C. z

D. -1

Answer: B



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7. If S is the set of distinct values of ' b ' for which the following system of linear equations $x + y + z = 1$ $x + ay + z = 1$ $ax + by + z = 0$ has no solution, then S is :
a finite set containing two or more elements (2) a singleton
an empty set (4) an infinite set

A. a singleton

B. an empty set

C. an infinite set

D. a finite set containing two or more elements

Answer: A



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8. If $s = \left\{ x \in [0, 2\pi] : \begin{vmatrix} 0 & \cos x & -\sin x \\ \sin x & 0 & \cos x \\ \cos x & \sin x & 0 \end{vmatrix} = \right\}$ then $\sum_{x \in s} \tan\left(\frac{\pi}{3} + x\right)$ is equal to:

A. $4 + 2\sqrt{3}$

B. $-2 + \sqrt{3}$

C. $-2 - \sqrt{3}$

D. $-4 - 2\sqrt{3}$

Answer: C



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9. Let A be any 3×3 invertible matrix. Then which one of the following is not always true?

A. $\text{adj}(A) = |A| \cdot A^{-1}$

B. $\text{adj}(\text{adj}(A)) = |A| \cdot A$

C. $\text{adj}(\text{adj}(A)) = |A|^2 \cdot (\text{adj}(A))^{-1}$

D. $\text{adj}(\text{adj}(A)) = |A| \cdot (\text{adj}(A))^{-1}$

Answer: B



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10. The number of real values of λ for which the system of linear equations $2x+4y-\lambda z=0$, $4x + \lambda y + 2z = 0$, $\lambda x + 2y + 2z = 0$ has infinitely many solutions, is :

A. 0

B. 1

C. 2

D. 3

Answer: B



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11. If $A = \begin{vmatrix} 5a & -b \\ 3 & 2 \end{vmatrix}$ and $\text{adj } A = AA^T$, then $5a+b$ is equal to

A. 4

B. 13

C. -1

D. 5

Answer: D



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12. 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

- A. exactly two values of λ .
- B. exactly three values of λ
- C. infinitely many values of λ
- D. exactly one values of λ

Answer: B



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13. The number of distinct real roots of the equation,

$$\begin{vmatrix} \cos x & \sin x & \sin x \\ \sin x & \cos x & \sin x \\ \sin x & \sin x & \cos x \end{vmatrix} = 0 \text{ in the interval } \left[-\frac{\pi}{4}, \frac{\pi}{4} \right] \text{ is :}$$

- A. 1

B. 4

C. 2

D. 3

Answer: C



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

$2x_1 - 2x_2 + x_3 = \lambda x_1$ $2x_1 - 3x_2 + 2x_3 = \lambda x_2$ $-x_1 + 2x_2 = \lambda x_3$ has
a non-trivial solution, (1) is an empty set (2) is a singleton (3) contains two
elements (4) contains more than two elements

A. contains two elements.

B. contains more than two elements

C. is an empty set.

D. is a singleton

Answer: A



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15. The least value of the product xyz for which the determinant

$$\begin{vmatrix} x & 1 & 1 \\ 1 & y & 1 \\ 1 & 1 & z \end{vmatrix}$$
 is non-negative, is: (A) $-16\sqrt{2}$ (B) $-2\sqrt{2}$ (C) -1 (D) -8

A. $-2\sqrt{2}$

B. -1

C. $-16\sqrt{2}$

D. -8

Answer: D



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

$|31 + f(1)1 + f(2)1 + f(1)1 + f(2)1 + f(3)1 + f(2)1 + f(3)1 + f(4)| = 1$, then K is equal to (1) $\alpha\beta$ (2) $\frac{1}{\alpha\beta}$ (3) 1 (4) -1

A. 1

B. -1

C. $\alpha\beta$

D. $\frac{1}{\alpha\beta}$

Answer: A



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17. If A is an 3×3 non-singular matrix such that $A' = A'A$ and

$B = A^{-1}A'$, then BB equals (1) $I + B$ (2) I (3) B^{-1} (4) $(B^{-1})'$

A. B^{-1}

B. $(B^{-1})'$

C. $I + B$

D. I

Answer: D



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18. If B is a 3×3 matrices such that $B^2 = 0$ then

$$\det \left[(1 + B)^{50} - 50B \right] = 0$$

A. 1

B. 2

C. 3

D. 50

Answer: A



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

A. $a + b + c$

B. abc

C. 1

D. -1

Answer: B



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Exercise 1 Concept Builder

1. If $1, \omega, \omega^2$ are the cube roots of unity, then $\Delta = \begin{vmatrix} 1 & \omega^n & \omega^{2n} \\ \omega^n & \omega^{2n} & 1 \\ \omega^{2n} & 1 & \omega^n \end{vmatrix}$ is equal to :

A. ω^2

B. 0

C. 1

D. ω

Answer: B



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2. if $A = \begin{bmatrix} \alpha & 2 \\ 2 & \alpha \end{bmatrix}$ and $|A^3| = 125$ then the value of α is

A. ± 1

B. ± 2

C. ± 3

D. ± 5

Answer: C



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3. If $\begin{vmatrix} a & b & 0 \\ 0 & a & b \\ b & 0 & a \end{vmatrix} = 0$, ($a \neq 0$) then

- A. a is one of cube root of unity
- B. b is one of cube root of unity
- C. (a/b) is one of cube root of unity
- D. (a/b) is one of cube root of -1

Answer: D



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4. If $A = \begin{bmatrix} 1 & 2 \\ 3 & 5 \end{bmatrix}$, then the value of the determinant $|A^{2009} - 5A^{2008}|$ is

- A. - 6
- B. - 5
- C. - 4

D. 4

Answer: A



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5. 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 θ .

A. x only

B. θ only

C. x and θ both

D. None of these

Answer: B



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6. If $\Delta = \begin{vmatrix} 1 & 2 & 3 \\ 2 & 3 & 5 \\ 3 & 6 & 12 \end{vmatrix}$ and $\Delta' = \begin{vmatrix} 4 & 8 & 15 \\ 3 & 6 & 12 \\ 2 & 3 & 5 \end{vmatrix}$, then

- A. $\Delta' = 2\Delta$
- B. $\Delta' = -2\Delta$
- C. $\Delta' = \Delta$
- D. $\Delta' = -\Delta$

Answer: D



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7. If C_{ij} is the cofactor of the element a_{ij} of the determinant

$$\begin{vmatrix} 2 & -3 & 5 \\ 6 & 0 & 4 \\ 1 & 5 & -7 \end{vmatrix}$$

, then write the value of $a_{32} \cdot c_{32}$.

- A. 110
- B. 22

C. – 110

D. – 22

Answer: A



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8. The parameter on which the value of the determinant

$$|1aa^2\cos(p-d)x \cos px \cos(p+d)x \sin(p-d)x \sin px \sin(p+d)x|$$

does not depend is a b. p c. d d. x

A. a

B. p

C. d

D. x

Answer: B



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9. If $a \neq b \neq c$, are value of x which satisfies the equation

$$\begin{vmatrix} 0 & x-a & x-b \\ x+a & 0 & x-c \\ x+b & x+c & 0 \end{vmatrix} = 0 \text{ is given by}$$

A. $x = 0$

B. $x = a$

C. $x = b$

D. $x = c$

Answer: A



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10. If $\begin{vmatrix} x^2 + x & 3x - 1 & -x + 3 \\ 2x + 1 & 2 + x^2 & x^3 - 3 \\ x - 3 & x^2 + 4 & 3x \end{vmatrix} = a_0 + a_1x + a_2x^2 + \dots + a_7x^7$,

then the value of a_0 is

A. 25

B. 24

C. 23

D. 21

Answer: D



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11. Matrix M_r is defined as $M_r = \begin{pmatrix} r & r-1 \\ r-1 & r \end{pmatrix}$, $r \in \mathbb{N}$. The value of $\det(M_1) + \det(M_2) + \det(M_3) + \dots + \det(M_{2014})$ is

A. 2013

B. 2014

C. $(2013)^2$

D. $(2014)^2$

Answer: D



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12. If a, b, c are complex numbers, then the determinant

$$\Delta = \begin{vmatrix} 0 & -b & -c \\ \bar{b} & 0 & -a \\ \bar{c} & \bar{a} & 0 \end{vmatrix}, \text{ is}$$

- A. purely real
- B. purely imaginary
- C. complex
- D. 0

Answer: B



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13. If in a triangle ABC, $\begin{vmatrix} 1 & \sin A & \sin^2 A \\ 1 & \sin B & \sin^2 B \\ 1 & \sin C & \sin^2 C \end{vmatrix} = 0$ then the triangle is

- A. equilateral or isosceles
- B. equilateral or right-angled

C. right angled or isosceles

D. None of these

Answer: A



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14. The value of $\begin{vmatrix} .^{10} C_4 & .^{10} C_5 & .^{11} C_m \\ .^{11} C_6 & .^{11} C_7 & .^{12} C_{m+2} \\ .^{12} C_8 & .^{12} C_9 & .^{13} C_{m+4} \end{vmatrix}$ is equal to zero when m is

A. 6

B. 5

C. 4

D. 1

Answer: B



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15. If $f(x) = \begin{vmatrix} \cos^2 x & \cos x \cdot \sin x & -\sin x \\ \cos x \sin x & \sin^2 x & \cos x \\ \sin x & -\cos x & 0 \end{vmatrix}$ then for all x

A. $f(x) = 0$

B. $f(x) = 1$

C. $f(x) = 2$

D. None of these

Answer: B



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16. If $p\lambda^4 + q\lambda^3 + r\lambda^2 + s\lambda + t = \begin{vmatrix} b^2 + c^2 & a^2 + \lambda & a^2 + \lambda \\ b^2 + \lambda & c^2 + a^2 & b^2 + \lambda \\ c^2 + \lambda & c^2 + \lambda & a^2 + b^2 \end{vmatrix}$ is

an identity in λ where p, q, r, s, t are constants, then the value of t is

A. 1

B. 2

C. 0

D. None of these

Answer: D



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17. If a, b, c are in A.P then the value of $\begin{vmatrix} x+1 & x+2 & x+a \\ x+2 & x+3 & x+b \\ x+3 & x+4 & x+c \end{vmatrix}$ is

A. 3

B. -3

C. 0

D. None of these

Answer: C



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18.

$$[\sin^2(13^\circ), \sin^2(77^\circ), \tan 135^\circ], [\sin^2(77^\circ), \tan 135^\circ, \sin^2(13^\circ)], [\tan 135^\circ, \sin^2(13^\circ), \sin^2(77^\circ)]$$

A. -1

B. 0

C. 1

D. 2

Answer: B



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19. The roots of the equations $\begin{vmatrix} 1+x & 3 & 5 \\ 2 & 2+x & 5 \\ 2 & 3 & x+4 \end{vmatrix} = 0$ are

A. 2,1,-9

B. 1,1,-9

C. -1, 1, -9

D. -2, -1, -8

Answer: B



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20. The value of the determinant

$$\left| \left((a^x + a^{-x})^2, (a^x - a^{-x})^2, 1 \right), \left((b^x + b^{-x})^2, (b^x - b^{-x})^2, 1 \right), \left((c^x + c^{-x})^2, (c^x - c^{-x})^2, 1 \right) \right|$$

(A) is 0 (B) is independent of a (C) depends on b only (D) depends on a,b, and c

A. 0

B. 2abc

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

D. None of these

Answer: A



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21. If a, b, c, are in A.P, find value of

$$|ay + 45y + 78y + a3y + 56y + 89y + b4y + 67y + 910y + c|$$

A. 0

B. $y^2 + 10$

C. $(4(y^2 + 5))$

D. y^3

Answer: A



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22. 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

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

A. $\Delta' = 2\Delta$

B. $\Delta' = \Delta(1 - pqr)$

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

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

Answer: D



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

A. divisible by x but not y

B. divisible by y but not x

C. divisible by neither x nor y

D. divisible by both x and y

Answer: D



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24. If $\begin{vmatrix} a & b & a\alpha + b \\ b & c & b\alpha + c \\ a\alpha + b & b\alpha + c & 0 \end{vmatrix} = 0$ then

- A. a,b,c are in A.P.
- B. a,b,c are in G.P.
- C. a,b,c are in H.P.
- D. α is not root of $ax^2 + 2bx + c = 0$

Answer: B



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25. If $z = \begin{vmatrix} -5 & 3 + 4i & 5 - 7i \\ 3 - 4i & 6 & 8 + 7i \\ 5 + 7i & 8 - 7i & 9 \end{vmatrix}$, then z is

- A. purely real
- B. purely imaginary
- C. $a + ib$, where $a \neq 0, b \neq 0$
- D. $a + ib$, where $b = 4$

Answer: A



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26. For how many values of 'x' in the closed interval $[-4, -1]$ is the

matrix $\begin{bmatrix} 3 & -1+x & 2 \\ 3 & -1 & x+2 \\ x+3 & -1 & 2 \end{bmatrix}$ singular? (A) 2 (B) 0 (C) 3 (D) 1

A. 2

B. 0

C. 3

D. 1

Answer: D



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27. The value of the determinant $\begin{vmatrix} 1+x & 2 & 3 & 4 \\ 1 & 2+x & 3 & 4 \\ 1 & 2 & 3+x & 4 \\ 1 & 2 & 3 & 4+x \end{vmatrix}$ is

A. $x^2(x + 10)$

B. $x^3(x + 10)$

C. $x^4(x + 10)$

D. None of these

Answer: B



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28. Determinant $\begin{vmatrix} a+b+nc & (n-1)a & (n-1)b \\ (n-1)c & b+c+na & (n-1)b \\ (n-1)c & (n-1)a & c+a+nb \end{vmatrix}$ is equal to

A. $(a+b+c)^3$

B. $n(a+b+c)^3$

C. $(n-1)(a+b+c)^3$

D. None of these

Answer: B



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29. If $\begin{vmatrix} a & 5x & p \\ b & 10y & 5 \\ c & 15z & 15 \end{vmatrix} = 125$, then find the value of $\begin{vmatrix} 3a & 3b & c \\ x & 2y & z \\ p & 5 & 5 \end{vmatrix}$

A. 25

B. 125

C. 5

D. 10

Answer: A



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30. If ω is the complex cube root of unity then

$$\begin{vmatrix} 1 & 1+i+\omega^2 & \omega^2 \\ 1-i & -1 & \omega^2-1 \\ -i & -i+\omega-1 & -1 \end{vmatrix} =$$

A. 1

B. i

C. w

D. 0

Answer: D



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31. For positive numbers x,y,z the numerical value of the determinant

$$\begin{vmatrix} 1 & \log_x y & \log_x z \\ \log_y x & 3 & \log_y z \\ \log_z x & \log_z y & 5 \end{vmatrix} \text{ is}$$

A. 0

B. $\log x \log y \log z$

C. 1

D. 8

Answer: D



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32. If the value of $(a + b + c) = 0$ then determinant

$$\begin{vmatrix} a - b - c & 2a & 2a \\ 2b & b - c - a & 2b \\ 2c & 2c & c - a - b \end{vmatrix}$$
 is equal to ,

A. 0

B. 1

C. 2

D. 3

Answer: A



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33. 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. 4

C. 3

D. 0

Answer: D



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34. If $\text{adj}B = A$, $|P| = |Q| = 1$, then $\text{adj}(Q^{-1}BP^{-1})$ is

a. PQ b. QAP c.

d. PA^1Q

A. PQ

B. QAP

C. PAQ

D. $PA^{-1}Q$

Answer: C



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35. If $A = \begin{bmatrix} 1 & \tan x \\ -\tan x & 1 \end{bmatrix}$, then the value of $|A' A^{-1}|$

A. 2

B. 1

C. 4

D. 3

Answer: B



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36. The matrix $\begin{bmatrix} \lambda & -1 & 4 \\ -3 & 0 & 1 \\ -1 & 1 & 2 \end{bmatrix}$ is invertible if

A. $\lambda \neq -17$

B. $\lambda \neq -18$

C. $\lambda \neq -19$

D. $\lambda \neq -20$

Answer: A



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37. If $A = \begin{bmatrix} 3 & 2 \\ 0 & 1 \end{bmatrix}$ then: $(A^{-1})^3 =$

A. $\frac{1}{27} \begin{bmatrix} 1 & -26 \\ 0 & 27 \end{bmatrix}$

B. $\frac{1}{27} \begin{bmatrix} 1 & 26 \\ 0 & 27 \end{bmatrix}$

C. $\frac{1}{26} \begin{bmatrix} 1 & -26 \\ 0 & -27 \end{bmatrix}$

D. $\frac{1}{26} \begin{bmatrix} -1 & -26 \\ 0 & -27 \end{bmatrix}$

Answer: A



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38. The matrix $\begin{bmatrix} \lambda & -1 & 4 \\ -3 & 0 & 1 \\ -1 & 1 & 2 \end{bmatrix}$ is invertible if

A. $\lambda \neq -17$

B. $\lambda \neq -18$

C. $\lambda \neq -19$

D. $\lambda \neq -20$

Answer: A



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39. If $A = \begin{bmatrix} 1 & 0 & 3 \\ 2 & 1 & 1 \\ 0 & 0 & 2 \end{bmatrix}$, then the value of $|\text{adj}(\text{adj } A)|$ is

A. 14

B. 16

C. 15

D. 12

Answer: B



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40. If $A = \begin{bmatrix} 0 & -1 & 2 \\ 2 & -2 & 0 \end{bmatrix}$, $B = \begin{bmatrix} 0 & 1 \\ 1 & 0 \\ 1 & 1 \end{bmatrix}$ and $M = AB$, then the value of M^{-1}

is

A. $\begin{bmatrix} \frac{2}{3} & \frac{-1}{3} \\ \frac{1}{3} & \frac{4}{5} \end{bmatrix}$

B. $\begin{bmatrix} \frac{1}{3} & \frac{-1}{3} \\ \frac{1}{3} & \frac{1}{6} \end{bmatrix}$

C. $\begin{bmatrix} 2 & \frac{-1}{3} \\ \frac{2}{3} & 0 \end{bmatrix}$

D. None of these

Answer: B



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41. If for $AX = B$, $B = \begin{bmatrix} 9 \\ 52 \\ 0 \end{bmatrix}$ and $A^{-1} = \begin{bmatrix} 3 & -\frac{1}{2} & -\frac{1}{2} \\ -4 & \frac{3}{4} & \frac{5}{4} \\ 2 & -\frac{1}{4} & -\frac{3}{4} \end{bmatrix}$, then $X =$

A. $\begin{bmatrix} 3 \\ 3/4 \\ -3/4 \\ -1/2 \end{bmatrix}$

B. $\begin{bmatrix} 1/2 \\ 2 \\ 2 \end{bmatrix}$

C. $\begin{bmatrix} -4 \\ 2 \\ 3 \end{bmatrix}$

D. $\begin{bmatrix} 1 \\ 3 \\ -21 \end{bmatrix}$

Answer: D



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42. If matrix $\begin{bmatrix} 1 & 2 & -1 \\ 3 & 4 & 5 \\ 2 & 6 & 7 \end{bmatrix}$ and its inverse is denoted by

$$A^{-1} = \begin{bmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{bmatrix} \text{ value of } a_{32} =$$

A. 21/20

B. 1/5

C. -2/5

D. 2/5

Answer: C



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43. If $A = \begin{bmatrix} 1 & 0 \\ 1 & 1 \end{bmatrix}$, then value of A^{-a} is

A. $[(-1, 0)(a, 1)]$

B. $[(0, -1)(2, a)]$

C. $[(1, 0)(- a, 1)]$

D. None of these

Answer: C



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44. If A is a non-singular matrix of order 3, then $|\text{adj } A| = |A|^n$ here the value of n is

A. 2

B. 4

C. 6

D. 8

Answer: A



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45. If $A = \begin{bmatrix} 2 & 4 & 5 \\ 4 & 8 & 10 \\ -6 & -12 & -15 \end{bmatrix}$. Then rank of A is equal to :

A. 0

B. 1

C. 2

D. 3

Answer: B



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46. If the area of triangle with vertices $(2,-6)$, $(5,4)$ and $(k,4)$ is 35. Then k equal to

A. 12 or 2

B. 12 or -2

C. -12 or -2

D. -12 or 2

Answer: B



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$$47. \Delta = \begin{vmatrix} 1 + a^2 + a^4 & 1 + ab + a^2b^2 & 1 + ac + a^2c^2 \\ 1 + ab + a^2b^2 & 1 + b^2 + b^4 & 1 + bc + b^2c^2 \\ 1 + ac + a^2c^2 & 1 + bc + b^2c^2 & 1 + c^2c^4 \end{vmatrix} \text{ is equal to}$$

A. -1

B. 1

C. 2

D. -2

Answer: C



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48. The rank of the matrix $\begin{bmatrix} -1 & 2 & 5 \\ 2 & -4 & a-4 \\ 1 & -2 & a+1 \end{bmatrix}$ is

A. 1 if $a = 6$

B. 2 if $a = -1$

C. 3 if $a = 2$

D. 1 if $a = -6$

Answer: D



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49. If $y = \begin{vmatrix} \sin x & \cos x & \sin x \\ \cos x & -\sin x & \cos x \\ x & 1 & 1 \end{vmatrix}$, then $\frac{dy}{dx}$ is

A. 0

B. 1

C. -1

D. None of these

Answer: B



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50. Consider the system of linear equations

$$a_1x + b_1y + c_1z + d_1 = 0,$$

$$a_2x + b_2y + c_2z + d_2 = 0,$$

$a_3x + b_3y + c_3z + d_3 = 0$, Let us denote by $\Delta(a,b,c)$ the determinant

$$\begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix}, \text{ if } \Delta(a, b, c) \neq 0, \text{ then the value of } x \text{ in the unique solution}$$

of the above equations is

A. $\frac{\Delta(bcd)}{\Delta(abc)}$

B. $\frac{-\Delta(bcd)}{\Delta(abc)}$

C. $\frac{\Delta(acd)}{\Delta(abc)}$

D. $\frac{\Delta(abd)}{\Delta(abc)}$

Answer: A



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

- A. is divisible by $f(x)$ for all x
- B. is not divisible by $f(x)$ for all x
- C. is equal to 0
- D. None of these

Answer: A



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53. If the system of equations $x - ky - z = 0$, $kx - y - z = 0$, $x + y - z = 0$ has a non-zero solution then the possible values of k are

A. -1, 2

B. 1,2

C. 0,1

D. -1,1

Answer: D



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54. If the system of linear equations

$$x + 2ay + az = 0$$

$$x + 3by + bz = 0$$

$$x + 4cy + cz = 0$$

has a non-zero solution, then a, b, c

A. are in A.P

B. are in G.P

C. are in H.P

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

Answer: C



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55. If the system of equations, $a^2x - ay = 1 - a$ and $bx + (3-2b)y = 3 + a$ possess a unique solution $x = 1, y = 1$, then

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

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

C. $a = 0, b = 0$

D. None of these

Answer: A,B



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56. Consider the system of equations : $x + ay = 0$, $y + az = 0$ and $z + ax = 0$. Then the set of all real values of 'a' for which the system has a unique solution is :

A. $\mathbb{R} - \{1\}$

B. $\mathbb{R} - \{-1\}$

C. $\{1, -1\}$

D. $\{1, 0, -1\}$

Answer: B



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57. The system of linear equations

$$x + y + z = 2$$

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

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

has a unique solution, if

A. $k = 0$

B. $k \neq 0$

C. $-1 < k < 1$

D. $-2 < k < 2$

Answer: B



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58. if the system of equation

$ax + y + z = 0, x + by = z = 0,$ and $x + y + cz = 0 (a, b, c \neq 1)$ has a nontrivial solution , then the value of $\frac{1}{1-a} + \frac{1}{1-b} + \frac{1}{1-c}$ is:

A. 0

B. 1

C. 2

D. 3

Answer: B



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59. If the system of linear equations

$$x + 2ay + az = 0$$

$$x + 3by + bz = 0$$

$$x + 4cy + cz = 0$$

has a non-zero solution, then a, b, c

A. satisfy $a + 2b + 3c = 0$

B. are in A.P

C. are in G.P

D. are in H.P.

Answer: D



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60. The system of equations $\alpha x + y + z = \alpha - 1$

$$x + \alpha y + z = \alpha - 1, x + y + \alpha z = \alpha - 1$$

has infinite solutions, if α is

A. -2

B. either -2 or 1

C. not -2

D. 1

Answer: D



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61. 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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62. For what value of m does the system of equations $3x + my = m$, $2x - 5y = 20$ has solution satisfying the conditions $x > 0, y > 0$?

A. $m \in (0, \infty)$

B. $m \in \left(-\infty, -\frac{15}{2} \right) \cup (30, \infty)$

C. $m \in \left(-\frac{15}{2}, \infty \right)$

D. None of these

Answer: B



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63. The system of simultaneous equations

$$kx + 2y - z = 1$$

$$(k - 1)y - 2z = 2$$

$$(k + 2)z = 3$$

have a unique solution if k equals

A. -1

B. -2

C. 0

D. 1

Answer: A



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64. 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. exactly 3 solutions

B. a unique solution

C. no solution

D. infinite solutions

Answer: C



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65. 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.

A. AP

B. GP

C. HP

D. None of these

Answer: C



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Exercise 2 Concept Applicator

1. The coefficient of x in

$$f(x) = \begin{vmatrix} x & 1 + \sin x & \cos x \\ 1 & \log(1+x) & 2 \\ x^2 & 1+x^2 & 0 \end{vmatrix}, \quad -1 < x \leq 1, \text{ is}$$

A. 1

B. - 2

C. - 1

D. 0

Answer: B



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2. If $a_n = \frac{1}{n+1} + 1$ then find the value of $a_1 + a_3 + a_5$

A. > 1

B. > -1

C. < 1

D. < -1

Answer: B



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

of the determinant $\begin{vmatrix} [x] + 1 & [y] & [z] \\ [x] & [y] + 1 & [z] \\ [x] & [y] & [z] + 1 \end{vmatrix}$ is

A. [z]

B. [y]

C. [x]

D. none of these

Answer: A



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4. Prove that

$$\begin{vmatrix} x^2 & x^2 - (y - z)^2 & yz \\ y^2 & y^2 - (z - x)^2 & zx \\ z^2 & z^2 - (x - y)^2 & xy \end{vmatrix} = (x - y)(y - z)(z - x)(x + y + z)(x^2 + y^2 + z^2)$$

A. 0

B. 1

C. 2

D. 3

Answer: C



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5. If a, b, c are non-zero, then the system of equations
 $(\alpha + a)x + \alpha y + \alpha z = 0, \alpha x + (\alpha + b)y + \alpha z = 0, \alpha x + \alpha y + (\alpha + c)z = 0$
has a non-trivial solution if $\alpha^{-1} = -(\alpha^{-1} + b^{-1} + c^{-1})$ b.
 $\alpha^{-1} = a + b + c$ c. $\alpha + a + b + c = 1$ d. none of these

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

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

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

D. none of these

Answer: A



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6. If m is a positive integer and

$$D_r = \left| 2r - 1 {}^m C_r 1m^2 - 12^m m + 1s \in^2 (m^2) s \in^2 (m) s \in^2 (m+1) \right| .$$

Prove that $\sum_{r=0}^m D_r = 0$.

A. 0

B. 4

C. 3

D. 1

Answer: A



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

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

A. $x + y + z$

B. $x - y + z$

C. 0

D. None of these

Answer: C



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8. If ω is a non-real cube root of unity, then

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

A. 0

B. -1

C. 2

D. None of these

Answer: A



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9. prove that

$$\begin{vmatrix} (a-x)^2 & (a-y)^2 & (a-z)^2 \\ (b-x)^2 & (b-y)^2 & (b-z)^2 \\ (c-x)^2 & (c-y)^2 & (c-z)^2 \end{vmatrix}$$

$$\begin{vmatrix} (1+ax)^2 & (1+bx)^2 & (1+cx)^2 \\ (1+ay)^2 & (1+by)^2 & (1+cy)^2 \\ (1+az)^2 & (1+bx)^2 & (1+cz)^2 \end{vmatrix}$$

$$= 2(b-c)(c-a)(a-b) \times (y-z)(z-x)(x-y)$$

A. $\Delta_1 = \Delta_2$

B. $\Delta_1 + \Delta_2 = 0$

C. $\Delta_1 = -2\Delta_2$

D. $\Delta_1 = -2\Delta_2$

Answer: A



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10. Evaluate

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

A. $xyz(x-y)(y-z)(z-x)$

B. $\frac{xyz}{6}(x-y)(y-z)(z-x)$

C. $\frac{xyz}{12}(x-y)(y-z)(z-x)$

D. None of these

Answer: C



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11. If $\begin{vmatrix} x^n & x^{x+2} & x^{2n} \\ 1 & x^a & a \\ x^{n+5} & x^{a+6} & x^{2n+5} \end{vmatrix} = 0 \quad \forall x \in \mathbb{R} \text{ where } n \in \mathbb{N}$, the value of a is

A. n

B. n-1

C. n+1

D. None of these

Answer: C



12. The value of the determinant $\begin{vmatrix} 1^2 & 2^2 & 3^2 & 4^2 \\ 2^2 & 3^2 & 4^2 & 5^2 \\ 3^2 & 4^2 & 5^2 & 6^2 \\ 4^2 & 5^2 & 6^2 & 7^2 \end{vmatrix}$ is

- A. 1
- B. 0
- C. 2
- D. None of these

Answer: B



13. The value of the determinant $\begin{vmatrix} 1 & (5^{2x} - 5^{-2x})^2 & (5^{2x} - 5^{-2x})^2 \\ 1 & (6^{2x} - 6^{-2x})^2 & (6^{2x} - 6^{-2x})^2 \\ 1 & (7^{2x} - 7^{-2x})^2 & (7^{2x} - 7^{-2x})^2 \end{vmatrix}$ is

- A. 210^{2x}

B. 210^{-2x}

C. 0

D. none of these

Answer: C



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

$$\begin{vmatrix} 1 + a^2x & (1 + b^2)x & (1 + c^2)x \\ (1 + a^2)x & 1 + b^2x & (1 + c^2)x \\ (1 + a^2)x & (1 + b^2)x & (1 + c^2)x \end{vmatrix} \text{ then } f(x) \text{ is a polynomial of degree}$$

A. 1

B. 0

C. 3

D. 2

Answer: D



15. If $A_1B_1C_1$, $A_2B_2C_2$ and $A_3B_3C_3$ are three digit numbers, each of

which is divisible by k , then $\Delta = \begin{vmatrix} A_1 & B_1 & C_1 \\ A_2 & B_2 & C_2 \\ A_3 & B_3 & C_3 \end{vmatrix}$ is

A. divisible by k

B. divisible by k^2

C. divisible by k^3

D. None of these

Answer: A



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16. If $S_r = \alpha^r + \beta^r + \gamma^r$ then show that

$$\begin{vmatrix} S_0 & S_1 & S_2 \\ S_1 & S_2 & S_3 \\ S_2 & S_3 & S_4 \end{vmatrix} = (\alpha - \beta)^2(\beta - \gamma)^2(\gamma - \alpha)^2$$

A. S_6

B. $S_5 - S_3$

C. $S_6 - S_4$

D. none

Answer: D



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17. If $f(x) = \begin{vmatrix} \cos^2 x & \cos x \cdot \sin x & -\sin x \\ \cos x \sin x & \sin^2 x & \cos x \\ \sin x & -\cos x & 0 \end{vmatrix}$ then for all x

A. $f(x) = 0$

B. $f(x) = 1$

C. $f(x) = 2$

D. None of these

Answer: B



18. the value of the determinant

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

- A. dependent on a_i $i=1,2,3,4$
- B. dependent on b_i $i=1,2,3,4$
- C. dependent on $a_i b_i$ $i=1,2,3,4$
- D. 0

Answer: D



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$$19. f'(x) = \begin{vmatrix} \cos x & x & 1 \\ 2 \sin x & x^2 & 2x \\ \tan x & x & 1 \end{vmatrix}. \text{ The value of } \lim_{x \rightarrow 0} \frac{f(x)}{x} \text{ is equal to}$$

A. 1

B. - 1

C. 0

D. None of these

Answer: C



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20. If the matrix $A = \begin{bmatrix} y+a & b & c \\ a & y+b & c \\ a & b & y+c \end{bmatrix}$ has rank 3, then

A. $y \neq (a+b+c)$

B. $y \neq 1$

C. $y = 0$

D. $y \neq -(a+b+c)$ and $y \neq 0$

Answer: D



21. If the system of linear equations $x_1 + 2x_2 + 3x_3 = 6$, $x_1 + 3x_2 + 5x_3 = 9$, $2x_1 + 5x_2 + ax_3 = b$, is consistent and has infinite number of solutions, then :-

- A. $a = 8$, b can be any real number
- B. $b = 15$, a can be any real number
- C. $a \in \mathbb{R} - \{8\}$ and $b \in \mathbb{R} - \{15\}$
- D. $a = 8$, $b = 15$

Answer: D



22. If a, b, c are in G.P. with common ratio r_1 and α, β, γ 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. $a + b + c$ b. abc c. 1 d.

none of these

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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23. Let $A = [a_{ij}]_{3 \times 3}$ be such that

$$a_{ij} = \begin{cases} 3 & \text{when } \hat{i} = \hat{j} \\ 0 & \text{when } \hat{i} \neq \hat{j} \end{cases} \text{ then } \left\{ \frac{\det(\text{adj}(\text{adj } A))}{5} \right\} \text{ equals :}$$

(where { } denotes fractional part function)

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

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

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

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

Answer: B



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24. Let λ and α be real. Let S denote the set of all values of λ for which the system of linear equations

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

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

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

has a non-trivial solution then S contains

A. $(-1, 1)$

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

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

D. $(-\sqrt{2}, \sqrt{2})$

Answer: C



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25. Prove that the value of each the following determinants is zero:

$$\left| \sin^2\left(x + \frac{3\pi}{2}\right) \sin^2\left(x + \frac{5\pi}{2}\right) \sin^2\left(x + \frac{7\pi}{2}\right) \sin^{x+\frac{3\pi}{2}} \sin^{x+\frac{5\pi}{2}} \sin^{x+\frac{7\pi}{2}} \sin^x \right|$$

A. 1

B. 2

C. 3

D. 0

Answer: D



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26. For what value of p , is the system of equation

$$p^3x + (p+1)^3y = (p+2)^3 \text{ and } px + (p+1)y = (p+2) \quad \text{and}$$

$x + y = 1$ inconsistent

- A. $p = 0$
- B. $p = 1$
- C. $p = -1$
- D. For all $p > 1$

Answer: C



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27. If the sides of a ΔABC and a, b, c and

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

then prove that ΔABC is an isosceles triangle.

A. ΔABC cannot be equilateral triangle

B. ΔABC is a right angled isosceles triangle

C. ΔABC is an isosceles triangle

D. None of these

Answer: C



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28. Suppose $\alpha, \beta, \gamma \in \mathbb{R}$ are such that $\sin \alpha, \sin \beta, \sin \gamma \neq 0$

and $\Delta = \begin{vmatrix} \sin^2 \alpha & \sin \alpha \cos \alpha & \cos^2 \alpha \\ \sin^2 \beta & \sin \beta \cos \beta & \cos^2 \beta \\ \sin^2 \gamma & \sin \gamma \cos \gamma & \cos^2 \gamma \end{vmatrix}$ then Δ cannot exceed

A. 1

B. 0

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

D. None of these

Answer: A



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

- A. $f(x)$ is increasing for $\forall x \in \left(0, \frac{\pi}{2}\right)$
- B. $f(x)$ is non-increasing for $\forall x \in \left(0, \frac{\pi}{2}\right)$
- C. $f(x)$ is decreasing for $\forall x \in \left(0, \frac{\pi}{2}\right)$
- D. $f(x)$ is decreasing for $\forall x \in \left(0, \frac{-\pi}{2}, 0\right)$

Answer: B



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30. Given that matrix $A = \begin{bmatrix} x & 3 & 2 \\ 1 & y & 4 \\ 2 & 2 & z \end{bmatrix}$. If $xyz = 60$ and $8x + 4y + 3z = 20$,

then $A(\text{adj } A)$ is equal to

- A. $\begin{bmatrix} 64 & 0 & 0 \\ 0 & 64 & 0 \\ 0 & 0 & 64 \end{bmatrix}$
- B. $\begin{bmatrix} 88 & 0 & 0 \\ 0 & 88 & 0 \\ 0 & 0 & 88 \end{bmatrix}$

C. $\begin{bmatrix} 68 & 0 & 0 \\ 0 & 68 & 0 \\ 0 & 0 & 68 \end{bmatrix}$

D. $\begin{bmatrix} 34 & 0 & 0 \\ 0 & 34 & 0 \\ 0 & 0 & 34 \end{bmatrix}$

Answer: C



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