



MATHS

BOOKS - SHRI BALAJI MATHS (ENGLISH)

MATRICES

Exercise 1 Single Choice Problems

1. Let $A = BB^T + CC^T$, where $B = \begin{bmatrix} \cos \theta \\ \sin \theta \end{bmatrix}$, $C = \begin{bmatrix} \sin \theta \\ -\cos \theta \end{bmatrix}$, $\theta \in R$.

Then prove that A is unit matrix.

A. $\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$

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

C. $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

D. $\begin{bmatrix} 0 & 0 \\ 0 & 1 \end{bmatrix}$

Answer: C



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2. Let $A = \begin{bmatrix} 0 & 0 & -1 \\ 0 & -1 & 0 \\ -1 & 0 & 0 \end{bmatrix}$ Then only correct statement about the

matrix A is (A) A is a zero matrix (B) $A^2 = I$ (C) A^{-1} does not exist (D)

$A = (-1)I$ where I is a unit matrix

A. A is a zero matrix

B. $A^2 = I$, where I is a unit matrix

C. A^{-1} does not exist

D. $A = (-1)I$, where I is a unit matrix

Answer: B



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

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

(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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4. If $A^{-1} = \begin{bmatrix} \sin^2 \alpha & 0 & 0 \\ 0 & \sin^2 \beta & 0 \\ 0 & 0 & \sin^2 \gamma \end{bmatrix}$ and

$$B^{-1} = \begin{bmatrix} \cos^2 \alpha & 0 & 0 \\ 0 & \cos^2 \beta & 0 \\ 0 & 0 & \cos^2 \gamma \end{bmatrix}$$

where α, β, γ are any real numbers

and

$$C = A^{-5} + B^{-5} + 5A^{-1}B^{-1}(A^{-3} + B^{-3}) + 10A^{-2}B^{-2}(A^{-1} + B^{-1})$$

then find $|C|$

A. A) 0

B. B) 1

C. C) 2

D. D) 3

Answer: B



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5. If $A = \begin{bmatrix} 3 & -3 & 4 \\ 2 & -3 & 4 \\ 0 & -1 & 1 \end{bmatrix}$, then $A^{-1} =$

A. A

B. A^2

C. A^3

D. A^4

Answer: C



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6. Let $M = [a_{ij}]_{3 \times 3}$ where $a_{ij} \in \{-1, 1\}$. Find the maximum possible value of $\det(M)$. (A) 3 (B) 4 (C) 5 (D) 6

A. 3

B. 4

C. 5

D. 6

Answer: D



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7.

Let

matrix

$$A = \begin{bmatrix} x & 3 & 2 \\ 1 & y & 4 \\ 2 & 2 & z \end{bmatrix}, \text{ if } xyz = 2\lambda \text{ and } 8x + 4y + 3z = \lambda + 28, \text{ then}$$

(adj A) A equals :

$$\text{A. } \begin{bmatrix} \lambda + 1 & 0 & 0 \\ 0 & \lambda + 1 & 0 \\ 0 & 0 & \lambda + 1 \end{bmatrix}$$

$$\text{B. } \begin{bmatrix} \lambda & 0 & 0 \\ 0 & \lambda & 0 \\ 0 & 0 & \lambda \end{bmatrix}$$

$$\text{C. } \begin{bmatrix} \lambda^2 & 0 & 0 \\ 0 & \lambda^2 & 0 \\ 0 & 0 & \lambda^2 \end{bmatrix}$$

$$\text{D. } \begin{bmatrix} \lambda + 2 & 0 & 0 \\ 0 & \lambda + 2 & 0 \\ 0 & 0 & \lambda + 2 \end{bmatrix}$$

Answer: B
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8. If the trace of the matrix $A = \begin{bmatrix} x - 2 & e^x & -\sin x \\ \cos x^2 & x^2 - x + 3 & \ln|x| \\ \cot x & \tan^{-1}x & x - 7 \end{bmatrix}$ is zero,

then x is equal to :

- A. -2 or 3
- B. -3 or -2
- C. -3 or 2
- D. 2 or 3

Answer: C



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9. if $A = [a_{ij}]_{2 \times 2}$ where $a_{ij} = \{i + j, i \neq j \text{ and } i^2 - 2j, i = j\}$ then

A^{-1} is equal to

- A. $\frac{1}{9} \begin{bmatrix} 0 & 3 \\ 3 & 1 \end{bmatrix}$
- B. $\frac{1}{9} \begin{bmatrix} 0 & -3 \\ 3 & -1 \end{bmatrix}$

$$\text{C. } \frac{1}{9} \begin{bmatrix} 0 & -3 \\ -3 & -1 \end{bmatrix}$$

$$\text{D. } \frac{1}{3} \begin{bmatrix} 0 & 3 \\ 3 & 1 \end{bmatrix}$$

Answer: A



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10. If $\begin{pmatrix} 1 & -\tan \theta \\ \tan \theta & 1 \end{pmatrix} \begin{pmatrix} 1 & \tan \theta \\ -\tan \theta & 1 \end{pmatrix}^{-1} = \begin{bmatrix} a & -b \\ b & a \end{bmatrix}$, then

A. $a = b = 1$

B. $a = \cos 2\theta, b = \sin 2\theta$

C. $a = \sin 2\theta, b = \cos 2\theta$

D. $a = 1, b = \sin 2\theta$

Answer: B



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11. A square matrix P satisfies $P^2 = I - P$ where I is identity matrix. If $P^n = 5I - 8P$, then n is

A. 4

B. 5

C. 6

D. 7

Answer: C



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12. Let matrix $A = \begin{bmatrix} x & y & -z \\ 1 & 2 & 3 \\ 1 & 1 & 2 \end{bmatrix}$ where $x, y, z \in \mathbb{N}$. If

$\det. (adj(adj. A)) = 2^8 \cdot (3^4)$ then the number of such matrices A is :

A. 220

B. 45

C. 55

D. 110

Answer: C



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13. If A is a 2×2 non singular matrix, then $\text{adj}(\text{adj } A)$ is equal to :

A. A^2

B. A

C. A^{-1}

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

Answer: B



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14. $A = \begin{bmatrix} a & b \\ b & -a \end{bmatrix}$ and $MA = A^{2m}$, $m \in N$ for some matrix M , then which one of the following is correct ?

A. $M = \begin{bmatrix} a^{2m} & b^{2m} \\ b^{2m} & -a^{2m} \end{bmatrix}$

B. $M = (a^2 + b^2)^m \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

C. $M = (a^m + b^m) \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

D. $M = (a^2 + b^2)^{m-1} \begin{bmatrix} a & b \\ b & -a \end{bmatrix}$

Answer: D



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15. Let A be a square matrix satisfying $A^2 + 5A + 5I = 0$ the inverse of $A + 2I$ is equal to

A. $A - 2I$

B. $A + 3I$

C. $A - 3I$

D. non-existent

Answer: B

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16. Let $A = \begin{bmatrix} 3 & -5 \\ 7 & -12 \end{bmatrix}$ and $B = \begin{bmatrix} 12 & -5 \\ 7 & -3 \end{bmatrix}$ be two given matrices, then $(AB)^{-1}$ is :

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

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

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

D. $\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$

Answer: B

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17. If matrix $A = \begin{bmatrix} 2 & 2 \\ 2 & 3 \end{bmatrix}$ then the value of $[\text{adj. } A]$ equals to :

A. 2

B. 3

C. 4

D. 6

Answer: A



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18. Let M be a column vector (not null vector) and $A = \frac{MM^T}{M^T M}$ the matrix A is : (where M^T is transpose matrix of M)

A. idempotent

B. nilpotent

C. involutory

D. none of these

Answer: A



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19. If $A = \begin{pmatrix} 1 & 2 \\ 0 & 1 \end{pmatrix}$, $P = \begin{pmatrix} \cos \theta & \sin \theta \\ -\sin \theta & \cos \theta \end{pmatrix}$, $Q = P^T A P$, find $PQ^{2014}P^T$: (a) $\begin{pmatrix} 1 & 2^{2014} \\ 0 & 1 \end{pmatrix}$ (b) $\begin{pmatrix} 1 & 4028 \\ 0 & 1 \end{pmatrix}$ (c) $(P^T)^{2013} A^{2014} P^{2013}$ (d) $P^T A^{2014} P$

A. $\begin{pmatrix} 1 & 2^{2014} \\ 0 & 1 \end{pmatrix}$

B. $\begin{pmatrix} 1 & 4028 \\ 0 & 1 \end{pmatrix}$

C. $(P^T)^{2013} A^{2014} P^{2013}$

D. $P^T A^{2014} P$

Answer: B



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20. If M be a square matrix of order 3 such that $|M| = 2$, then

$\left| \text{adj} \left(\frac{M}{2} \right) \right|$ equals to :

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

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

C. $\frac{1}{8}$

D. $\frac{1}{16}$

Answer: D



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21. If A is matrix of order 3 such that $|A| = 5$ and $B = \text{adj } A$, then the

value of $\left| |A^{-1}| (AB)^T \right|$ is equal to

A. 5

B. 1

C. 25

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

Answer: B

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Exercise 2 One Or More Than One Answer Is Are Correct

1. If A and B are two orthogonal matrices of order n and $\det(A) + \det(B) = 0$; then which of the following must be correct ?

A. $\det(A + B) = \det(A) + \det(B)$

B. $\det(A + B) = 0$

C. A and B both are singular matrices

D. $A + B = 0$

Answer: A::B

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2. Let M be a 3×3 matrix satisfying $M^3 = 0$. Then which of the following statement(s) are true: (a) $|M^2 + M + I| \neq 0$ (b) $|M^2 - M + I| = 0$ (c) $|M^2 + M + I| = 0$ (d) $|M^2 - M + I| \neq 0$

A. $\left| \frac{1}{2}M^2 + M + I \right| \neq 0$

B. $\left| \frac{1}{2}M^2 - M + I \right| = 0$

C. $\left| \frac{1}{2}M^2 + M + I \right| = 0$

D. $\left| \frac{1}{2}M^2 - M + I \right| \neq 0$

Answer: A::D



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3. Let $A_\alpha = \begin{bmatrix} \cos \alpha & -\sin \alpha & 0 \\ \sin \alpha & \cos \alpha & 0 \\ 0 & 0 & 1 \end{bmatrix}$, then :

A. $A_{\alpha+\beta} = A_\alpha A_\beta$

B. $A_{\alpha}^{-1} = A_{-\alpha}$

C. $A_{\alpha}^{-1} = -A_{\alpha}$

D. $A_{\alpha}^2 = -I$

Answer: A::B



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4. $A^3 - 2A^2 - A + 2I = 0$ if $A =$

A. I

B. $2I$

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

D. $\begin{bmatrix} 2 & 1 & -2 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \end{bmatrix}$

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



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5. Let A be 3×3 symmetric invertible matrix with real positive elements.

Then the number of zero elements in A^{-1} are less than or equal to :

A. 0

B. 1

C. 2

D. 3

Answer: D



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Exercise 3 Matching Type Problems

1. Consider a square matrix A of order 2 which has its elements as 0, 1, 2 and

4. Let N denote the number of such matrices.

	Column-I		Column-II
(A)	Possible non-negative value of $\det(A)$ is	(P)	2
(B)	Sum of values of determinants corresponding to N matrices is	(Q)	4
(C)	If absolute value of $(\det(A))$ is least, then possible value of $ \text{adj}(\text{adj}(\text{adj } A)) $	(R)	-2
(D)	If $\det(A)$ is least, then possible value of $\det(4A^{-1})$ is	(S)	0
		(T)	8



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	Column-I		Column-II
(A)	If A is an idempotent matrix and I is an identity matrix of the same order, then the value of n , such that $(A + I)^n = I + 127A$ is	(P)	9
(B)	If $(I - A)^{-1} = I + A + A^2 + \dots + A^7$, then $A^n = O$ where n is	(Q)	10
(C)	If A is matrix such that $a_{ij} = (i + j)(i - j)$, then A is singular if order of matrix is	(R)	7
(D)	If a non-singular matrix A is symmetric, such that A^{-1} is also symmetric, then order of A can be	(S)	8

2.



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3. 

(C)	If $P = \begin{bmatrix} 1 & -1 & 1 \\ 2 & 1 & -3 \\ 1 & 1 & 1 \end{bmatrix}$, $10Q = \begin{bmatrix} 4 & 2 & 2 \\ -5 & 0 & t \\ 1 & -2 & 3 \end{bmatrix}$ and $Q = P^{-1}$, then the value of t is equal to	(R)	4
(D)	If $y = \tan u$ where $u = v - \frac{1}{v}$ and $v = \ln x$, then the value of $\frac{dy}{dx}$ at $x = e$ is equal to λ then $[\lambda]$ is equal to (where $[\]$ denotes greatest integer function)	(S)	5

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Column-I		Column-II	
(A)	If P and Q are variable points on $C_1 : x^2 + y^2 = 4$ and $C_2 : x^2 + y^2 - 8x - 6y + 24 = 0$ respectively then the maximum value of PQ , is equal to	(P)	1
(B)	Let P, Q, R be invertible matrices of second order such that $A = PQ^{-1}, B = QR^{-1}, C = RP^{-1}$, then the value of $\det. (ABC + BCA + CAB)$ is equal to	(Q)	2
(C)	The perpendicular distance of the point whose position vector is $(1, 3, 5)$ from the line $\vec{r} = \hat{i} + 2\hat{j} + 3\hat{k} + \lambda(\hat{i} + 2\hat{j} + 2\hat{k})$ is equal to	(R)	9
(D)	Let $f(x)$ be a continuous function in $[-1, 1]$ such that $f(x) = \begin{cases} \frac{\ln(px^2 + qx + r)}{x^2} & ; -1 \leq x < 0 \\ 1 & ; x = 0 \\ \frac{\sin(e^{x^2} - 1)}{x^2} & ; 0 < x \leq 1 \end{cases}$ then the value of $(p + q + r)$, is equal to	(S)	8

4.

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Exercise 4 Subjective Type Problems

1. A and B are two square matrices such that $A^2B = BA$ and if $(AB)^{10} = A^k B^{10}$ then the value of $k - 1020$ is.

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2. Let A be a 2×3 matrix, whereas B be a 3×2 matrix. If $\det. (AB) = 4$, then the value of $\det. (BA)$ is

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3. Let $M = [a_{ij}]_{3 \times 3}$ where $a_{ij} \in \{-1, 1\}$. Find the maximum possible value of $\det(M)$.

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4. The set of natural numbers is divided into array of rows and columns in the form of matrices as

$A_1 = [1], A_2 = \begin{bmatrix} 2 & 3 \\ 4 & 5 \end{bmatrix}, A_3 = \begin{bmatrix} 6 & 7 & 8 \\ 9 & 10 & 11 \\ 12 & 13 & 14 \end{bmatrix}$ and so on. Let the trace

of A_{10} be λ . Find unit digit of λ ?

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