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MATHS

BOOKS - CHHAYA PUBLICATION MATHS (BENGALI ENGLISH)

ALGEBRA

Wbhs Archive 2012

1. If A is a non-singular matrix of order 3 and x is a real number such that $\det(xA) = |x|\det(A)$ then the value of x is-

A. 0 or 1

B. 0 or -1

C. 1 or -1

D. 0 or ± 1

Answer: A

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2. If $A = \begin{pmatrix} 22 & 17 \\ 17 & 8 \end{pmatrix}$, then find $B = A + A^T$ and show that $B^T = B$.

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3. If $A = \begin{pmatrix} 5 & 8 \\ 8 & 13 \end{pmatrix}$, show that the matrix equation $x^2 - 18x + 1 = 0$ is satisfied by both the matrices A and A^{-1} (I is the identity matrix of order two).

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4. Without expanding prove that

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

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1. The necessary and sufficient condition that any matrix $A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$ of order 2×2 has an inverse is-

A. ab-cd=0

B. ad-bc $\ne$ 0

C. ac-bd $\ne$ 0

D. ad+bc $\ne$ 0

Answer: B

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2. Solve by Cramer's rule :

$$x + y = 2$$
$$y + z = 4$$
$$z + x = 6$$

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3. If $A = \begin{pmatrix} 0 & x \\ y & 0 \end{pmatrix}$ and $A^3 + A = 0$, then find the relation between x and y (x,y $\neq$ 0).

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4. If $m \in N$ and $m \geq 2$ prove that: $\left|111\ {}^{m}C_1\ {}^{m+1}C_1\ {}^{m+2}C_1\ {}^{m}C_2\ {}^{m+1}C_2\ {}^{m+2}C_2\right| = 1$.

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5. If A be a 2×2 matrix such that $A^2 = A$, then show that $(I - A)^2 = I - A$ where I is the unit matrix of order 2×2.

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

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2. If for a matrix A, A=A^{-1}, then show that

$A\left(A^3 + I\right) = A + I$ (I is the unit matrix).

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3. Show that the matrix $A = \begin{pmatrix} 2 & -3 \\ 3 & 4 \end{pmatrix}$ satisfies the equation $A^2 - 6A + 17I = O$ and hence find A^{-1} where I is the identity matrix and O is the null matrix of order 2×2.

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4. Show that the determinant $\begin{vmatrix} 1 & a & a^2 \\ a^2 & 1 & a \\ a & a^2 & 1 \end{vmatrix}$ is a perfect square.

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5. If $A = \frac{1}{3}\begin{pmatrix} -1 & 2 & -2 \\ -2 & 1 & 2 \\ 2 & 2 & 1 \end{pmatrix}$, show that $\mathrm{AA}^T = I_3$.

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Wbhs Archive 2015

1. If A is a 2×2 invertible matrix, then value of $\det A^{-1}$ is -

A. $-\det A$

B. $\dfrac{-1}{\det A}$

C. detA

D. $\dfrac{1}{\det A}$

Answer: D

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2. If $A = \begin{bmatrix} 3 & 1 \\ 7 & 5 \end{bmatrix}$, find x and y such that $A^2 + xI = yA$.

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3. Evaluate the following: $\begin{vmatrix} 9 & 9 & 12 \\ 1 & 3 & -4 \\ 1 & 9 & 12 \end{vmatrix}$

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4. If $A = \begin{pmatrix} 1 & 4 \\ 2 & 3 \end{pmatrix}$, then show that $A^2 - 4A - 5I = 0$,where $I = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$ and $O = \begin{pmatrix} 0 & 0 \\ 0 & 0 \end{pmatrix}$.

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5. Solve the following questions by Cramer's method

$x + y = 1, y + z = z, x + z = 3$

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

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7. One root of the equation $\begin{vmatrix} x+a & b & c \\ b & x+c & a \\ c & a & x+b \end{vmatrix} = 0$ is -

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Wbhs Archive 2016

1. If A is square matrix such that $A^2 = A$, then show that $(I + A)^3 = 7A + I$.

A. A

B. I

C. I-A

D. 3A

Answer: B

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

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3. If $A = \begin{pmatrix} 2 & -1 \\ -1 & 2 \end{pmatrix}$ and $A^2 - 4A + 3I = 0$ where I is the unit matrix of order 2, then find A^{-1}.

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4. Express the matrix $A = \begin{bmatrix} -3 & 4 & 1 \\ 2 & 3 & 0 \\ 1 & 4 & 5 \end{bmatrix}$ as the sum of symmetric matrix and a skew-symmetric matrix.

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5. Solve the following equations by matrix method :

(i) x+2y+z=7

x+2y+z=7

x+3z=11

x-y+z=4

(ii) x+y-2z=3

4x-2y-3z=11

2x-y+z=0

(iii) 9x+8y-7z=14

3x-2y-z=10

6x-5y+4z=4

(iv) 3x-3y-4y=11

2x+3y+2z=3

-x-2y+3z=-10.

(v) x+y+z=6

x-y+z=2

2x+y-z=1

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6. If p, q, r are not in G.P. and $\begin{vmatrix} 1 & \frac{q}{p} & \alpha + \frac{q}{p} \\ 1 & \frac{r}{p} & \alpha + \frac{r}{q} \\ p\alpha + q & q\alpha + r & 0 \end{vmatrix} = 0$ Show that $p\alpha^2 + 2q\alpha + r = 0$

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

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Wbjee Archive 2012

1. If $P = \begin{bmatrix} 1 & 2 & 1 \\ 1 & 3 & 1 \end{bmatrix}, Q = PP^T$, then the value of the determinant of Q is equal to -

A. 2

B. -2

C. 1

D. 0

Answer: A

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2. If P, Q, R are angles of ΔPQR then $\begin{vmatrix} -1 & \cos R & \cos Q \\ \cos R & -1 & \cos P \\ \cos Q & \cos P & -1 \end{vmatrix}$ is equal to (A) -1 (B) 0 (C) $\frac{1}{2}$ (D) 1

A. -1

B. 0

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

D. 1

Answer:

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3. The number of real values of α for which the system of equations :

$x + 3y + 5z = ax$

$5x + y + 3z = ay$

$3x + 5y + z = az$

has infinite number of solutions is-

A. 1

B. 2

C. 4

D. 6

Answer: A

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4. The system of linear equations $x-y-2z=6.\ -x+y+z=\mu, \lambda x+y+z=3$ has

A. infinite number of solutions for $\lambda \neq -1$ for all μ

B. infinte number of solutions for $\lambda \neq -1$ and $\mu = 3$

C. no solution for $\lambda \neq -1$

D. unique solution for $\lambda = -1$ and $\mu = 3$

Answer: B

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Wbjee Archive 2013

1. Let, $P = \begin{pmatrix} \cos\frac{\pi}{4} & -\sin\frac{\pi}{4} \\ \sin\frac{\pi}{4} & \cos\frac{\pi}{4} \end{pmatrix}$ and $x = \begin{pmatrix} \frac{1}{\sqrt{2}} \\ \frac{1}{\sqrt{2}} \end{pmatrix}$. Then P^3X is equal to-

A. $\begin{pmatrix} 0 \\ 1 \end{pmatrix}$

B. $\begin{pmatrix} -\frac{1}{\sqrt{2}} \\ \frac{1}{\sqrt{2}} \end{pmatrix}$

C. $\begin{pmatrix} -1 \\ 0 \end{pmatrix}$

D. $\begin{pmatrix} -\frac{1}{\sqrt{2}} \\ -\frac{1}{\sqrt{2}} \end{pmatrix}$

Answer: C

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2. Let, $I = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}$ and $P = \begin{pmatrix} 1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & -2 \end{pmatrix}$. Then the matrix $P^3 + 2P^2$ is equal to -

A. P

B. I-P

C. 2I+P

D. 2I-P

Answer: C

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3. Show that

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

A. 0

B. $(1 + a^2 + b^2)$

C. $\left(1+a^2+b^2\right)^2$

D. $\left(1+a^2+b^2\right)^3$

Answer: D

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

A. P

B. 2P

C. $-P$

D. $-2P$

Answer: A

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5. Consider the system of equations :

$$x + y + z = 0$$
$$\alpha x + \beta y + \gamma z = 0$$
$$\alpha^2 x + \beta^2 y + \gamma^2 z = 0$$

Then the system of equation has-

A. a unique solution for all values of α, β, γ

B. infinite number of solutions if any two of α, β, γ are equal

C. a unique solution if α, β, γ are distinct

D. more than one, but infinite number of solutions depending on values of α, β, γ.

Answer: B::C

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Wbjee Archive 2014

1. Let $n \geq 2$ be an integer, $A = \begin{pmatrix} \cos\left(\frac{2\pi}{n}\right) & \sin\left(\frac{2\pi}{n}\right) & 0 \\ \sin\left(\frac{2\pi}{n}\right) & \cos\left(\frac{2\pi}{n}\right) & 0 \\ 0 & 0 & 1 \end{pmatrix}$

and I is the idnetity matrix of order 3. Then

A. $A^n = I \quad \text{and} \quad A^{n-1} \neq I$

B. $A^m \neq I$ for any positive integer m

C. A is not invertible

D. $A^m = 0$ for a positive integer m

Answer: A

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2. Let I denote the 3×3 identity matrix and P be a matrix obtained by rearranging the columns of I. Then-

A. there are six distinct choices for P and det(P)=1

B. there are six distinct choices for P and det(P) = $\pm$ 1

C. there are some than one choices for P and some of them are not invertible.

D. there are more than one choices for P and $P^{-1} = I$ in each choice.

Answer: B

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Wbjee Archive 2015

1. The value of λ for which the system of equations $2x - y - z = 12, x - 2y + z = -4, x + y + z = 4$ has no solution is

A. 3

B. 1

C. 0 (zero)

D. -3

Answer: D

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2. 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 f(100) is equal to - (i)0 (ii)1 (iii)100 (iv)-100

A. 0 (zero)

B. 1

C. 100

D. 10

Answer: A

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3. If A and B are two matrices such that AB=B and BA=A then $A^2 + B^2$ equals-

A. 2AB

B. 2BA

C. A+B

D. AB

Answer: C

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4. If $A = \begin{pmatrix} 1 & 0 & 0 \\ 2 & 1 & 0 \\ 3 & 2 & 1 \end{pmatrix}$, $U_1, U_2, \text{ and } U_3$ are column matrices satisfying $AU_1 = \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix}$, $AU_2 = \begin{pmatrix} 2 \\ 3 \\ 0 \end{pmatrix}$ and $AU_3 = \begin{pmatrix} 2 \\ 3 \\ 1 \end{pmatrix}$ and U is 3×3 matrix when columns are U_1, U_2, U_3 then answer the following questions

The value of (3 2 0) $U\begin{pmatrix}3\\2\\0\end{pmatrix}$ is

A. 6

B. 0 (zero)

C. 1

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

Answer: B

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5. If ω is an imaginary cube root of untiy then the value of the determinant

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

A. -2ω

B. $-3\omega^2$

C. -1

D. 0 (zero)

Answer: B

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Wbjee Archive 2016

1. for $x, x, z > 0$ Prove that $\begin{vmatrix} 1 & \log_x y & \log_x z \\ \log_y x & 1 & \log_y z \\ \log_z x & \log_z y & 1 \end{vmatrix} = 0$

A. $\log x \cdot \log y \cdot \log z$

B. logx+logy+logy

C. 0

D. $1 - \{(\log x) \cdot (\log y) \cdot (\log z)\}$

Answer: C

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2. Let A is a 3×3 matrix and B is its adjoint matrix. If $|B| = 64$, then $|A| =$

A. ± 2

B. ± 4

C. ± 8

D. ± 12

Answer: C

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3. Let $Q = \begin{pmatrix} \cos\frac{\pi}{4} & -\sin\frac{\pi}{4} \\ \sin\frac{\pi}{4} & \cos\frac{\pi}{4} \end{pmatrix}$ and $X = \begin{pmatrix} \frac{1}{\sqrt{2}} \\ \frac{1}{\sqrt{2}} \end{pmatrix}$ then Q^3X is equal to

A. $\begin{pmatrix} 0 \\ 1 \end{pmatrix}$

B. $\begin{pmatrix} -\frac{1}{\sqrt{2}} \\ \frac{1}{\sqrt{2}} \end{pmatrix}$

C. $\begin{pmatrix} -1 \\ 0 \end{pmatrix}$

D. $\begin{pmatrix} -\frac{1}{\sqrt{2}} \\ -\frac{1}{\sqrt{2}} \end{pmatrix}$

Answer: C

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4. If the matrix $A = \begin{bmatrix} 2 & 0 & 2 \\ 0 & 2 & 0 \\ 2 & 0 & 02 \end{bmatrix}$ then $A^n = \begin{bmatrix} a & 0 & 0 \\ 0 & a & 0 \\ b & 0 & a \end{bmatrix}$, $n \in N$ where

A. a=2n, b=2^n

B. a=2^n, b=2n

C. $a = 2^n, b = n2^{n-1}$

D. $a = 2^n, b = n2^n$

Answer: D

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Jee Main Aieee Archive 2012

1. If $A = \begin{pmatrix} 1 & 0 & 0 \\ 2 & 1 & 0 \\ 3 & 2 & 1 \end{pmatrix} u_1 \text{ and } u_2$ are the column matrices such that $Au_1 = \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix} \text{ and } Au_2 = \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix} \text{ then } u_1 + u_2$ is equal to

A. $\begin{pmatrix} -1 \\ -1 \\ 0 \end{pmatrix}$

B. $\begin{pmatrix} 1 \\ -1 \\ -1 \end{pmatrix}$

C. $\begin{pmatrix} -1 \\ 1 \\ 0 \end{pmatrix}$

D. $\begin{pmatrix} -1 \\ 1 \\ -1 \end{pmatrix}$

Answer: B

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2. Let P and Q be 3×3 matrices with $P \neq Q$. If $P^3 = Q^3 and P^2 Q = Q^2 P$, then determinant of $(P^2 + Q^2)$ is equal to

(1) 2 (2) 1 (3) 0 (4) 1

A. 0

B. -1

C. -2

D. 1

Answer: A

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Jee Main Aieee Archive 2013

1. The number of values of k for which the system of equations:

$kx + (3k + 2)y = 4k$

$(3k - 1)x + (9k + 1)y = 4(k + 1)$ has no solution, are

A. infinite

B. 1

C. 2

D. 3

Answer: B

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2. If $P = \begin{bmatrix} 1 & \alpha & 3 \\ 1 & 3 & 3 \\ 2 & 4 & 4 \end{bmatrix}$ is the adjoint of a 3 x 3 matrix A and $|A| = 4$, then α is equal to

A. 4

B. 11

C. 5

D. 0

Answer: B

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Jee Main Aieee Archive 2014

1. If A is an 3×3 non-singular matrix such that $AA^T = A^T A$ and $B = A^{-1} A^T$, then BB^T equals

A. 1+B

B. I

C. B^{-1}

D. $\left(B^{-1}\right)^T$

Answer: B

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2. If $\alpha, \beta \neq 0$, and $f(n) = \alpha^n + \beta^n$ and $|31 + f(1)1 + f(2)1 + f(1)1 + f(2)1 + f(3)1 + f(2)1 + f(3)1 + f(4)| =$, then K is equal to (1) $\alpha\beta$ (2) $\frac{1}{\alpha\beta}$ (3) 1 (4) -1

A. $\alpha\beta$

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

C. 1

D. -1

Answer: C

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Jee Main Aieee Archive 2015

1. If $A = [12221 - 2a2b]$ is a matrix satisfying the equation $\forall^T = 9I$, where I is 3×3 identity matrix, then the ordered pair (a, b) is equal to : (1) $(2, -1)$ (2) $(-2, 1)$ (3) (2, 1) (4) $(-2, -1)$

A. (2,1)

B. (-2,-1)

C. (2,-1)

D. (-2,1)

Answer: B

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

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

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

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

A. contains two elements

B. contains more than two elements

C. is an empty set

D. is a singleton

Answer: A

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Jee Main Aieee Archive 2016

1. If $A = [5a - b32]$ and A adj $A = \forall^T$, then $5a + b$ is equal to: (1) -1 (2) 5 (3) 4 (4) 13

A. -1

B. 5

C. 4

D. 13

Answer: B

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2. 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. infinitely many values of λ

B. exactly one value of λ

C. exactly two values of λ

D. exactly three values of λ

Answer: D

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3. If $P = \begin{bmatrix} \frac{\sqrt{3}}{2} & \frac{1}{2} \\ -\frac{1}{2} & \frac{\sqrt{3}}{2} \end{bmatrix}, A = \begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix}$ and $Q = PAP^T$, the ltbr. $P(Q^{2005})P^T$ equal to

A. $\begin{bmatrix} 0 & 2015 \\ 0 & 0 \end{bmatrix}$

B. $\begin{bmatrix} 2015 & 1 \\ 0 & 2015 \end{bmatrix}$

C. $\begin{bmatrix} 2015 & 0 \\ 1 & 2015 \end{bmatrix}$

D. $\begin{bmatrix} 1 & 2015 \\ 0 & 1 \end{bmatrix}$

Answer: D

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4. The number of distinct real roots of $|s \in x \cos x \cos x \cos x s \in x \cos x \cos x \cos x s \in x| = 0$ in the interval $-\frac{\pi}{4} \leq x \leq \frac{\pi}{4}$ is 0 b. 2 c. 1 d. 3

A. 4

B. 3

C. 2

D. 1

Answer: C

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Jee Advanced Archive 2013

1. For 3×3 matrices $MandN,$ which of the following statement (s) is (are) NOT correct ? $N^T MN$ is symmetricor skew-symmetric, according as m is symmetric or skew-symmetric. $MN - NM$ is skew-symmetric for all symmetric matrices $MandN.$ MN is symmetric for all symmetric matrices $MandN$ $(adjM)(adjN) = adj(MN)$ for all invertible matrices $MandN.$

A. $N^T MN$ is symmetric or skew symmetric, according as M is symmetric or skew symmetric.

B. MN-NM is skew symmetric for all symmetric matrices M and N.

C. MN is symmetric for all symmetric matrices M and N.

D. (Adj M) (Adj N)=Adj(MN) for all invertible matrices M and N.

Answer: C::D

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2. Let ω be a complex cube root of unity with $\omega \neq 1 and P = [p_{ij}]$ be a $n \times n$ matrix withe $p_{ij} = \omega^{i+j}$. Then $p^2 \neq O, whe \cap =$ a.57 b. 55 c. 58 d. 56

A. 57

B. 55

C. 58

D. 56

Answer: B::C::D

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Jee Advanced Archive 2014

1. Let M be a 2 x 2 symmetric matrix with integer entries. Then M is invertible if (a)The first column of M is the transpose of the second row of M (b)The second row of Mis the transpose of the first olumn of M (c) M is a diagonal matrix with non-zero entries in the main diagonal (d)The product of entries in the main diagonal of Mis not the square of an integer

A. the first column of M is the transpose of the second row of M.

B. the second row of M is the transpose of the first column of M.

C. M is a diagonal matrix with non-zero entries in the main diagonal.

D. the product of entries in the main diagonal of M is not the square of an integer.

Answer: C::D

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2. Let m and N be two 3x3 matrices such that MN=NM. Further if $M \neq N^2$ and $M^2 = N^4$ then which of the following are correct.

A. determinant of $(M^2 + MN^2)$ is 0.

B. there is a 3×3 non-zero matrix U such that $(M^2 + MN^2)U$ is the zero matrix.

C. determinant of $(M^2 + MN^2) \geq 1$

D. for a 3×3 matrix U, if $(M^2 + MN^2)U$ equals the zero matrix then U is the zero matrix.

Answer: A::B

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Jee Advanced Archive 2015

1. Let $X and Y$ be two arbitrary, 3×3 , non-zero, skew-symmetric matrices and Z be an arbitrary 3×3 , non-zero, symmetric matrix. Then which of the following matrices is (are) skew symmetric? a.$Y^3 Z^4 Z^4 Y^3$ b. $x^{44} + Y^{44}$ c. $X^4 Z^3 - Z^3 X^4$ d. $X^{23} + Y^{23}$

A. $Y^3 Z^4 - Z^4 Y^3$

B. $X^{44} + Y^{44}$

C. $X^4 Z^3 - Z^3 X^4$

D. $X^{23} + Y^{23}$

Answer: C::D

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2. Which of the following values of α satisfying the equation $|(1+\alpha)^2(1+2\alpha)^2(1+3\alpha)^2(2+\alpha)^2(2+2\alpha)^2(2+3\alpha)^2(3+\alpha)^2(3+2\alpha)$

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

A. -4

B. 9

C. -9

D. 4

Answer: B::C

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Jee Advanced Archive 2016

1. Let $p = \begin{bmatrix} 3 & -1 & -2 \\ 2 & 0 & \alpha \\ 3 & -5 & 0 \end{bmatrix}$, where $\alpha \in \mathbb{R}$. Suppose $Q = [q_{ij}]$ is a matrix such that $PQ = kl$, where $k \in \mathbb{R}, k \neq 0$ and l is the identity matrix of order 3. If $q_{23} = -\frac{k}{8}$ and $\det(Q) = \frac{k^2}{2}$, then

A. $\alpha = 0$, k=8

B. $4\alpha - k + 8 = 0$

C. det(Padj(Q))=2^9

D. det(Qadj(P))=2^{13}

Answer: B::C

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2. let

$$z = \frac{-1 + \sqrt{3i}}{2}, wherei = \sqrt{-1} \text{ and } r, s\varepsilon P1, 2, 3\Big\}. LetP = \begin{bmatrix} (-z)^r & z \\ z^{2s} & z \end{bmatrix}$$

and I be the idenfity matrix or order 2. Then the total number of ordered pairs (r,s) or which $P^2 = -I$ is

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

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

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4. Let $P = \begin{bmatrix} 1 & 0 & 0 \\ 4 & 1 & 0 \\ 16 & 4 & 1 \end{bmatrix}$ and I be the identity matrix of order 3. If $Q = [qij]$ is a matrix, such that $P^{50} - Q = I$, then $\frac{q_{31} + q_{32}}{q_{21}}$ equals

A. 52

B. 103

C. 201

D. 205

Answer: B

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5. Let $a, \lambda, \mu \in R,$ Consider the system of linear equations $ax + 2y = \lambda 3x - 2y = \mu$ Which of the flollowing statement (s) is (are) correct?

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

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

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

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

Answer: B::C::D

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Example

1. If $A = \begin{bmatrix} 0 & 2 & 3 \\ 2 & 1 & 4 \end{bmatrix}$ and $B = \begin{bmatrix} 7 & 6 & 3 \\ 1 & 4 & 5 \end{bmatrix}$, find 2A+3B.

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2. Construct a 2x3 matricx whose elements are given by $a_{ij} = \frac{(i-2j)^2}{2}$

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3. Determine the matrices A and B, where

$$A + 2B = \begin{bmatrix} 1 & 2 & 0 \\ 6 & -3 & 3 \\ -5 & 3 & 1 \end{bmatrix} \text{ and } 2A - B = \begin{bmatrix} 2 & -1 & 5 \\ 2 & -1 & 6 \\ 0 & 1 & 2 \end{bmatrix}.$$

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4. Find, where possible, A + B, A - B, AB and BA stating with reasons, where the operations are not pssible, when

$$A = \begin{bmatrix} 4 & 2 & -1 \\ 3 & -7 & 1 \end{bmatrix} \text{ and } B = \begin{bmatrix} 2 & 3 \\ -3 & 0 \\ -1 & 5 \end{bmatrix}$$

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5. Verify that the matrix equation $A^2 - 4A + 3I = 0$ is satisfied by the matrix

$A = \begin{bmatrix} 2 & -1 \\ -1 & 2 \end{bmatrix}$, where $I = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ and $0 = \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$. Hence obtain A^{-1}.

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6. If $A = \begin{bmatrix} 1 & 0 \\ -1 & 7 \end{bmatrix}$ and $I = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$, then find k so that $A^2 = 8A + kI$

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7. If $A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$ and $I = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

Show that, $A^2 - (a+d)A = (bc - ad)I$.

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8. Verify that $(AB)^T = B^T A^T$, where

$$A = \begin{bmatrix} 1 & 2 & 3 \\ 3 & -2 & 1 \end{bmatrix} \text{ and } B = \begin{bmatrix} 1 & 2 \\ 2 & 0 \\ -1 & 1 \end{bmatrix}.$$

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9. If A and B are two matrices such that AB = 0, can we deduce that either A or B is a zero matrix? Illustrate by an example.

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10. If $P = \begin{bmatrix} -1 & 3 & 5 \\ 1 & -3 & -5 \\ -1 & 3 & 5 \end{bmatrix}$, show that, $P^2 = P$ hence find matrix Q such that $3P^2 - 2P + Q = I$, where I is the unit matrix of order 3.

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11. find the values of x,y,z and t when the following matrices are equal :

$$\begin{bmatrix} x+y & y-z \\ 5-t & 7+x \end{bmatrix} \text{ and } \begin{bmatrix} t-x & z-t \\ z-y & x+z+t \end{bmatrix}$$

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12. If $A = \begin{pmatrix} 2 & 3 \\ 6 & 5 \end{pmatrix}$ and $B = \begin{pmatrix} 3 & 7 \\ 4 & 0 \end{pmatrix}$, express $(A+B)^2$ as a matrix and show that, $(A+B)^2 = A^2 + AB + BA + B^2$.

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13. A,B,C are matrices each of order 2×2 with AB = AC.

Does it imply that B = C? Give an example In support of your conclusion.

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14. If $A = \begin{bmatrix} 1 & 2 & 3 \\ 3 & -2 & 1 \\ 4 & 2 & 1 \end{bmatrix}, X = \begin{bmatrix} x \\ y \\ z \end{bmatrix}$ and $B = \begin{bmatrix} 6 \\ 2 \\ 7 \end{bmatrix}$ write down the linear equations represented by AX = B.

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15. Represent the following linear equations in matrix form:

$a_1x + b_1y + c_1z + d_1 = 0$, $a_2x + b_2y + c_2z + d_2 = 0$ and $a_3x + b_3y_+ c_3z + d_3 = 0$

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16. Let $A = \begin{bmatrix} 2 & 0 & 1 \\ 2 & 1 & 3 \\ 1 & -1 & 0 \end{bmatrix}$ and $f(x) = x^2 - 5x + 6$, find f(A).

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17. If $A = \begin{pmatrix} \cos\alpha & \sin\alpha \\ -\sin\alpha & \cos\alpha \end{pmatrix}$, prove by mathematical induction that , $A^n = \begin{pmatrix} \cos n\alpha & \sin n\alpha \\ -\sin n\alpha & \cos n\alpha \end{pmatrix}$ where $n(\geq 2)$ is a positive integer.

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18. If $A = \begin{bmatrix} 1 & 1 & 1 \\ 0 & 1 & 1 \\ 0 & 0 & 1 \end{bmatrix}$, Prove by mathematical induction that,

$A^n = \begin{bmatrix} 1 & n & \frac{n(n+1)}{2} \\ 0 & 1 & n \\ 0 & 0 & 1 \end{bmatrix}$ for every positive integer n.

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19. Express the matrix $A = \begin{bmatrix} -3 & 4 & 1 \\ 2 & 3 & 0 \\ 1 & 4 & 5 \end{bmatrix}$ as the sum of a symmetric and a skew. Symmetric matrix.

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20. If $A = \frac{1}{3}\begin{bmatrix} -1 & 2 & -2 \\ -2 & 1 & 2 \\ 2 & 2 & 1 \end{bmatrix}$ show that $\mathrm{AA}^T = I$.

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21. If $A = \begin{bmatrix} 1 & -1 & 0 \\ -1 & 2 & 1 \\ 0 & 1 & 1 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & 1 & -1 \\ 0 & 1 & -1 \\ 0 & 0 & 1 \end{bmatrix}$ show that $B^T AB$ is a diagonal matrix, where B^T is the transpose of B.

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22. If $f(x) = \begin{bmatrix} \cos x & -\sin x & 0 \\ \sin x & \cos x & 0 \\ 0 & 0 & 1 \end{bmatrix}$ show that $f(\alpha)f(\beta) = f(\alpha + \beta)$.

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23. If $A = \begin{bmatrix} i & i \\ -i & i \end{bmatrix}$ and $B = \begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix}$ then show that $A^8 = 128B$.

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24. Find the values of a,b and c if the matrix $A = \begin{bmatrix} 0 & 2b & c \\ a & b & -c \\ a & -b & c \end{bmatrix}$ satisfies A'A = I.

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25. Find the matrices A and B when $A + B = 2B^t$ and $3A + 2B = I_3$ where B^t denotes the transpose of B and I_3 is the identity matrix of order 3.

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Multiple Choice Type Questions

1. State which of the statement is true?

A. The product KA of a matrix A and a scalar K is the matrix whose each element is K times the corresponding element of A.

B. If A and B are two matrices of orders $m \times n$ and $r \times s$ respectively $(r \neq m, s \neq n)$ then the matrix (A+B) can be obtained.

C. The product matrix AB can be obtained if the number of rows in A equal to the number of columns in B.

D. For two matrices A and B, if both AB and BA are defined, then A and B are matrices of the same order.

Answer: A

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2. State which of the statement is false?

A. If A and B are matrices of order $m \times n$ and $n \times p$ respectively, then AB is a matrix of order $m \times p$.

B. Multiplication of matrices, in general, does not satisfy the commutative law.

C. For two matrices A and B, the product AB may not be equal to the product BA when both AB and BA are defined and they are of the same order.

D. Multiplication of matrices does not satisfy the associative law.

Answer: D

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3. State which of the statement is false?

A. For three matrices A,B and C, the relation CA = CB always implies A = B.

B. A square matrix A can be expressed as the sum of a symmetric and a skew-symmetric matrix.

C. Matrices $A \neq 0, B \neq 0$ can imply AB = 0 where 0 is the null matrix.

D. A square matrix of order 3 is said to be orthogonal if $\mathrm{AA}^T = A^T A = I$ where I is the unit matrix of order 3.

Answer: A

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4. If A and B are two matrices such that $AB = A$ and $BA = B$ then B is equal to__

A. 1

B. -1

C. 2

D. -2

Answer: A

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5. If a square matrix A is equal to its transpose A^T , then A is called a___

A. symmetric matrix

B. indentity matrix

C. skew-symmetric matrix

D. none of these

Answer: A

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6. If A^T is the transpose of a square matrix A then A is called a skew-symmetrix matrix if it is___

A. $A^T = -A$

B. $AA^T = A$

C. $A^T A = A$

D. A^{-1}

Answer: A

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7. $(AB)^T$ =

A. $B^T A^T$

B. $A^T B^T$

C. $A^T B$

D. $B^T A$

Answer: A

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8. If A is a square matrix and I is the unit matrix of the same order as A, then A.I =

A. A

B. A^T

C. $-A$

D. $A.\ A^T$

Answer: A

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9. If $A=[a_{ij}]$ is a 2×2 matrix such that $a_{ij}=i+2j$ then A will be___

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

B. $\begin{bmatrix}2 & 4\\ 3 & 5\end{bmatrix}$

C. $\begin{bmatrix}3 & 5\\ 4 & 6\end{bmatrix}$

D. none of these

Answer: C

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10. If $A = [a_{ij}]$ is a care 2×2 matrix whose elements are $a_{ij} = \frac{1}{2}(i + 2j)^2$, then A will be____

A. $\begin{bmatrix} \frac{9}{2} & \frac{25}{2} \\ 8 & 18 \end{bmatrix}$

B. $\begin{bmatrix} \frac{9}{2} & \frac{15}{2} \\ 8 & 18 \end{bmatrix}$

C. $\begin{bmatrix} \frac{9}{2} & \frac{25}{2} \\ 8 & 9 \end{bmatrix}$

D. $\begin{bmatrix} \frac{9}{2} & \frac{15}{2} \\ 4 & 18 \end{bmatrix}$

Answer: A

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11. If $A = [a_{ij}]$ is a 3×2 matrix whose elements are given by $a_{ij} = 3i - 2j$, then A will be__

A. $\begin{bmatrix} 1 & 1 \\ 4 & 2 \\ 7 & 5 \end{bmatrix}$

B. $\begin{bmatrix} 1 & -1 \\ 4 & 2 \\ 7 & 5 \end{bmatrix}$

C. $\begin{bmatrix} -1 & -1 \\ 4 & 2 \\ 7 & 5 \end{bmatrix}$

D. $\begin{bmatrix} 1 & -1 \\ 4 & -2 \\ 7 & 5 \end{bmatrix}$

Answer: B

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12. If $A = [a_{ij}]$ is a 2×3 matrix whose elements are given by $a_{ij} = \frac{1}{2}|3i - 4j|,$ then A will be ___

A. $\begin{bmatrix} \frac{1}{2} & \frac{5}{2} & \frac{9}{2} \\ 1 & 1 & 3 \end{bmatrix}$

B. $\begin{bmatrix} 1 & 5 & 9 \\ \frac{1}{2} & \frac{1}{2} & \frac{3}{2} \end{bmatrix}$

C. $\begin{bmatrix} \frac{1}{2} & \frac{5}{2} & 9 \\ 1 & 1 & 3 \end{bmatrix}$

D. $\begin{bmatrix} \frac{1}{2} & \frac{5}{2} & \frac{9}{2} \\ \frac{1}{2} & \frac{1}{2} & \frac{3}{2} \end{bmatrix}$

Answer: A

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13. If A and B are two symmetric matrices of order $n \times n$ the state which of the statements is not true?

A. A+B a symmetric

B. A+B a skew-symmetric

C. A+B a square matrix

D. A+B a zero matrix

Answer: B

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14. If $A = \begin{bmatrix} 0 & 7 \\ 0 & 0 \end{bmatrix}$ and $f(x) = 1 + x + x^2 + \dots + x^{20}$ then f(A) =

A. 0

B. $\begin{bmatrix} 1 & 7 \\ 0 & 0 \end{bmatrix}$

C. $\begin{bmatrix} 1 & 7 \\ 0 & 1 \end{bmatrix}$

D. $\begin{bmatrix} 0 & 7 \\ 1 & 1 \end{bmatrix}$

Answer: C

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15. If A be a square matrix then A^2 will be

A. symmetric matrix

B. skew-symmetric matrix

C. diagonal matrix

D. none of these

Answer: D

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16. If $\begin{bmatrix} 2x - y & 5 \\ 3 & y \end{bmatrix} = \begin{bmatrix} 6 & 5 \\ 3 & -2 \end{bmatrix}$, then the value of x is____

A. 0

B. 1

C. 2

D. 3

Answer: C

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17. If $\begin{bmatrix} 1 & 4 \\ 2 & 0 \end{bmatrix} = \begin{bmatrix} x & y^2 \\ z & 0 \end{bmatrix}, y < 0$ then x-y+z is equal to___

A. 5

B. 2

C. 1

D. -3

Answer: A

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18. If $A-2B=\begin{bmatrix}1 & 5\\ 3 & 7\end{bmatrix}$ and $2A-3B=\begin{bmatrix}-2 & 5\\ 0 & 7\end{bmatrix}$ then matrix B is equal to__

A. $\begin{bmatrix}-4 & -5\\ -6 & -7\end{bmatrix}$

B. $\begin{bmatrix}0 & 6\\ -3 & 7\end{bmatrix}$

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

D. $\begin{bmatrix}6 & -1\\ 0 & 1\end{bmatrix}$

Answer: A

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19. If $A = \begin{bmatrix} 4 & 2 \\ -1 & 1 \end{bmatrix}$ then $(A - 2I)(A - 3I)$ is equal to__

A. A

B. I

C. 0

D. $5I$

Answer: C

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20. If $A = \begin{bmatrix} x & y \\ z & -x \end{bmatrix}$, such that $A^2 = I$, then____

A. $1 + x^2 + yz = 0$

B. $1 - x^2 + yz = 0$

C. $1 - x^2 - yz = 0$

D. $1 + x^2 - yz = 0$

Answer: C

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21. If the matrix A is both symmetric and skew-symmetricx then____

A. A is a diagonal matrix

B. A is a zero matrix

C. A is a square matrix

D. none of these

Answer: B

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22. If A is a square matrix such that $A^2 = A$, then $(I + A)^3 - 7A$ is equal to___

A. A

B. I-A

C. I

D. 3A

Answer: C

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Very Short Answer Type Questions

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

Find the matrices

A+2B

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

Find the matrices

2B - 3C

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

Find the matrices

4C - A

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

Find the matrices

A + 4B - 3C

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5. If $A = \begin{pmatrix} 2 & 4 \\ 5 & 6 \end{pmatrix}$ and $B = \begin{pmatrix} 3 & 6 \\ 5 & 9 \end{pmatrix}$, find the square matrix X of order 2×2 such that, 3A + 4B = 2x.

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6. Find a matrix X such that 2A + B + X = 0 where $A = \begin{bmatrix} -1 & 2 \\ 3 & 4 \end{bmatrix}, B = \begin{bmatrix} 3 & -2 \\ 1 & 5 \end{bmatrix}$

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7. Find the matrices A and B for which:

$A + B = \begin{bmatrix} 1 & 5 & 10 \\ 5 & 9 & 8 \end{bmatrix}$ and $A - B = \begin{bmatrix} -1 & -1 & -4 \\ 1 & 1 & 6 \end{bmatrix}$

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8. Find the matrices A and B for which:

$$A - 2B = \begin{pmatrix} -7 & 7 \\ 4 & -8 \end{pmatrix} \text{ and } A - 3B = \begin{pmatrix} -11 & 9 \\ 4 & -13 \end{pmatrix}$$

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9. Find the matrices A and B for which:

$$2A + B = \begin{bmatrix} 1 & 2 & 3 \\ -1 & -2 & -3 \\ 4 & 2 & 3 \end{bmatrix} \text{ and } A + 2B = \begin{bmatrix} 0 & 2 & 3 \\ 4 & 1 & 7 \\ 1 & 1 & 5 \end{bmatrix}$$

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10. If $A = \begin{pmatrix} 3 & 5 \\ 2 & a \end{pmatrix}, B = \begin{pmatrix} 4 & b \\ 2 & 9 \end{pmatrix}$ and $C = \begin{pmatrix} 26 & a \\ 14 & 45 \end{pmatrix}$ find a and b when 2A + 5B = C.

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11. If a matrix has 18 elements, what are the possible orders it can have?

What if it has 5 elements?

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12. Find the values of x and y, if

$$2\begin{bmatrix}1 & 3\\ 0 & x\end{bmatrix}+\begin{bmatrix}y & 0\\ 1 & 2\end{bmatrix}=\begin{bmatrix}5 & 6\\ 1 & 8\end{bmatrix}$$

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13. Find the values of x, y and z if $\begin{bmatrix}x+y+z\\ z+x\\ y+z\end{bmatrix}=\begin{bmatrix}9\\ 5\\ 7\end{bmatrix}$

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14. If $A=\begin{bmatrix}2 & 0 & -5\\ -3 & 4 & 7\end{bmatrix}$ and $B=\begin{bmatrix}3 & 1 & -1\\ 4 & 5 & 0\end{bmatrix}$ then prove that

$(A+B)'=A'+B'$

$(A - B)' = A' - B$

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15. If $A = \begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix}, \quad \text{write} \quad \text{AA}^T$

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16. If $A = [1, 2, 3], \quad \text{write} \quad \text{AA}^T$

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17. If two matrices A and B of orders $2 \times m$ and $3 \times n$ respectively are conformable for the products AB of order $p \times 4$, find the values of m, n and p.

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18. If A and B be two matrices such that A + B and AB are both defined, show that A and B are both square matrices of the same order.

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19. If A is a 3×3 square matrix with $|A| = 2$ then find $|5A|$

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20. If $A = \begin{pmatrix} 2 \\ 3 \\ -1 \end{pmatrix}$ and B = (3 5 7), find AB.

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21. If A=[1 2 3 4] and $B = \begin{bmatrix} 1 \\ 2 \\ 3 \\ 4 \end{bmatrix}$ find AB and BA.

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22. Evaluate: $[xyz] \times \begin{bmatrix} a & h & g \\ h & b & f \\ g & f & c \end{bmatrix} \times \begin{bmatrix} x \\ y \\ z \end{bmatrix}$.

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23. If $A = \begin{bmatrix} 1 & 2 & 3 \\ 2 & -1 & 5 \\ -3 & 2 & 4 \end{bmatrix}, X = \begin{bmatrix} x \\ y \\ z \end{bmatrix}$ and $B = \begin{bmatrix} 14 \\ 15 \\ 13 \end{bmatrix}$ then write down the linear equations in x, y, z represented by the matrix equation AX = B.

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24. Represent the following equations in matrix form:

$a_1x + b_1y + c_1 = 0$

$a_2x + b_2y + c_2 = 0$

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25. Represent the following equations in matrix form:

$a_1x + b_1y + c_1z = k_1$

$a_2x + b_2y + c_2z = k_2$

$a_3x + b_3y + c_3z = k_3$

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26. If $A = \begin{bmatrix} 2 & 3 \\ 4 & 5 \end{bmatrix}$, prove that $A - A^T$ is a skew-symmetric matrix.

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Short Answer Type Questions

1. Solve for x and y, if $2\begin{bmatrix} x & 5 \\ 7 & y-3 \end{bmatrix} + \begin{bmatrix} 3 & 4 \\ 1 & 2 \end{bmatrix} = \begin{bmatrix} 7 & 14 \\ 15 & 14 \end{bmatrix}$

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2. Solve for x, y and z, $\text{if } \begin{pmatrix} x+y & 2 \\ 1 & 0 \end{pmatrix} = \begin{pmatrix} 2 & x-z \\ 2x-y & 0 \end{pmatrix}$

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3. Find the value of x, y, z and t for which the following two matrices may be equal:

$$\begin{bmatrix} x-z & -z-x \\ 7-t & 6+z \end{bmatrix} \text{ and } \begin{bmatrix} 3-t & 5-t \\ t+5 & x-y \end{bmatrix}$$

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4. Solve for a, b, c and d when

$$\begin{pmatrix} b+c & c+a \\ 7-d & 6-c \end{pmatrix} = \begin{pmatrix} 9-d & 8-d \\ a+b & a+b \end{pmatrix}$$

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5. Find the value of x, y, z and t for which

$$3\begin{bmatrix} x & y \\ z & t \end{bmatrix} = \begin{bmatrix} x & 6 \\ -1 & 2t \end{bmatrix} + \begin{bmatrix} 4 & x+y \\ z+t & 3 \end{bmatrix}$$

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6. Test whether the following matrices A and B are conformable for A + B, AB and BA and find their values when they are conformable :

$$A = \begin{pmatrix} 1 & 2 \\ 0 & 1 \end{pmatrix} \text{ and } B = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$$

$$A = \begin{bmatrix} 2 & 3 \\ 5 & 6 \\ 7 & 8 \end{bmatrix} \text{ and } B = \begin{bmatrix} 3 & 8 & 5 \\ 2 & 1 & 1 \\ 1 & 3 & 3 \end{bmatrix}$$

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7. When are two matrices A and B said to be conformable for the product AB?

If $A = \begin{pmatrix} 1 & 2 & 3 \\ 1 & 3 & 3 \\ 1 & 2 & 4 \end{pmatrix}$ and $B = \begin{pmatrix} 6 & -2 & -3 \\ -1 & 1 & 0 \\ -1 & 0 & 1 \end{pmatrix}$ show that,

AB = BA.

Is it, in general, true for matrix multiplication? Give an example to justify your answer.

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8. If $A = \begin{pmatrix} 4 & 2 & -1 \\ 3 & -7 & 1 \end{pmatrix}$ and $B = \begin{pmatrix} 2 & 3 \\ -3 & 0 \\ -1 & 5 \end{pmatrix}$, find AB and BA.

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9. If $A = \begin{bmatrix} 1 & 2 & 1 \\ 1 & -1 & 1 \\ 2 & 3 & -1 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & 4 & 0 \\ -1 & 2 & 2 \\ 0 & 0 & 2 \end{bmatrix}$, find the matrix AB - 2B.

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10. If $A = \begin{bmatrix} 0 & 1 & 2 \\ 1 & 2 & 3 \\ 3 & 1 & 1 \end{bmatrix}$ and $B = \begin{bmatrix} 2 & 1 & 3 \\ -1 & 0 & 1 \\ 3 & -1 & 4 \end{bmatrix}$, show that, $AB \neq BA$.

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11. If $P = \begin{bmatrix} 2 & -2 & -4 \\ -1 & 3 & 4 \\ 1 & -2 & -3 \end{bmatrix}$ then show that, $p^2 = p$.

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12. If $A = \begin{bmatrix} 2 & -3 & -5 \\ -1 & 4 & 5 \\ 1 & -3 & -4 \end{bmatrix}$ and $B = \begin{bmatrix} -1 & 3 & 5 \\ 1 & -3 & -5 \\ -1 & 3 & 5 \end{bmatrix}$ show that

AB = BA = 0, where 0 is the zero matrix of order 3×3.

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13. If $A = \begin{bmatrix} 1 & 1 & -1 \\ 2 & -3 & 4 \\ 3 & -2 & 3 \end{bmatrix}$ and $B = \begin{bmatrix} -1 & -1 & 1 \\ 2 & 2 & -2 \\ -3 & -3 & 3 \end{bmatrix}$, prove that

$AB \neq 0$ but BA = 0.

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14. Prove that the product of the matrices

$$\begin{bmatrix} \cos^2\alpha & \cos\alpha\sin\alpha \\ \cos\alpha\sin\alpha & \sin^2\alpha \end{bmatrix} \text{ and } \begin{bmatrix} \cos^2\beta & \cos\beta\sin\beta \\ \cos\beta\sin\beta & \sin^2\beta \end{bmatrix}$$

is the null matrix when α and β differ by an odd multiple of $\frac{\pi}{2}$.

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15. If $A = \begin{pmatrix} 1 & 4 \\ 2 & 3 \end{pmatrix}$, show that, $A^2 - 4A - 5I = 0$ where $I = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$ and $0 = \begin{pmatrix} 0 & 0 \\ 0 & 0 \end{pmatrix}$.

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16. If $A = \begin{pmatrix} 1 & 2 \\ -3 & 0 \end{pmatrix}$, show that, $A^2 + 3A + 5I = \begin{pmatrix} 3 & 8 \\ -12 & -1 \end{pmatrix}$.

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17. If $A = \begin{bmatrix} 1 & 0 \\ -1 & 7 \end{bmatrix}$ and $I = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ then show find the value of k so that $A^2 = 8A + kI$.

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18. If $A=\begin{pmatrix}1 & 2\\ -1 & -2\end{pmatrix}$ and $B=\begin{pmatrix}-1 & 3\\ -3 & 1\end{pmatrix}$. then show that, $(A+B)^2 \neq A^2+2AB+B^2$.

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19. If $\begin{pmatrix}2 & 1\\ 3 & 4\end{pmatrix}\times\begin{pmatrix}x\\ y\end{pmatrix}=\begin{pmatrix}1\\ -1\end{pmatrix}$, find x and y.

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20. If $A=\begin{bmatrix}3 & -2\\ 4 & -2\end{bmatrix}$, find k such that $A^2=kA-2I_2$

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21. If $A=\begin{pmatrix}4 & 2\\ -1 & 1\end{pmatrix}$ and $I=\begin{pmatrix}1 & 0\\ 0 & 1\end{pmatrix}$, prove that, $(A-2I)(A-3I)=\begin{pmatrix}0 & 0\\ 0 & 0\end{pmatrix}$.

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22. If $A = \begin{pmatrix} 1 & i \\ -i & 1 \end{pmatrix}$ and $B = \begin{pmatrix} i & -1 \\ -1 & -i \end{pmatrix}$, find AB and $BA\left(i = \sqrt{-1}\right)$.

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23. If $X = \begin{bmatrix} 1 & -3 & -4 \\ -1 & 3 & 4 \\ 1 & -3 & -4 \end{bmatrix}$, show that, $X^2 = 0$ where 0 is the null matrix of order 3×3.

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24. If $A = \begin{pmatrix} 1 & -3 & 4 & 2 \\ 0 & 5 & -2 & 3 \end{pmatrix}$ and $B = \begin{pmatrix} -5 & 0 & 6 & 4 \\ 7 & 8 & -2 & 5 \end{pmatrix}$, find a matrix X of order 2×4 such that $3A - 2X = B$.

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25. If $A = \begin{pmatrix} 3 & 2 \\ 3 & 3 \end{pmatrix}$ and $B = \begin{pmatrix} 1 & -\frac{2}{3} \\ -1 & 1 \end{pmatrix}$ show that $AB = I_2$ where I_2 is the unit matrix of order 2.

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26. If $A = \begin{bmatrix} 1 & -1 \\ 2 & -1 \end{bmatrix}, B = \begin{bmatrix} a & 1 \\ b & -1 \end{bmatrix}$, and $(A+B)^2 = A^2 + B^2$, find a and b.

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27. If $A = \begin{bmatrix} 1 & 1 \\ 2 & 2 \\ 3 & 3 \end{bmatrix}$, find AA^T.

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28. If $A = \begin{pmatrix} x & -2 \\ 2 & 1 \end{pmatrix}, B = \begin{pmatrix} 3 & 4 \\ 0 & 1 \end{pmatrix}, C = \begin{pmatrix} -1 & -2 \\ y & 2 \end{pmatrix}$ and A + B = BC. find x and y.

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29. If A and B are two matrices such that AB = 0, can we deduce that either A or B is a zero matrix? Illustrate by an example.

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30. Show that thematrix A=$\begin{bmatrix} 2 & 3 \\ 1 & 2 \end{bmatrix}$ satisfies the equations $A^2 - 4A + I = 0$ where I is 2×2 identity matrix and O is 2×2 zero matrix. Using the equations. Find A^{-1}.

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31. If $A = \begin{bmatrix} 2 & -1 \\ 3 & 2 \end{bmatrix}$ and $B = \begin{bmatrix} 0 & 4 \\ -1 & 7 \end{bmatrix}$, find $3A^2 - 2B + I$

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32. Find the value of x such that

$$\begin{bmatrix}1 & x & 1\end{bmatrix} \times \begin{bmatrix}1 & 3 & 2\\ 2 & 5 & 1\\ 15 & 3 & 2\end{bmatrix} \times \begin{bmatrix}1\\ 2\\ x\end{bmatrix} = 0$$

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Long Answer Type Questions

1. If $A = \begin{bmatrix}2 & 0 & 1\\ 1 & 0 & -1\\ 0 & -1 & 1\end{bmatrix}$, find the matrix for the polynomial $A^2 - 4A + 3I.$

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2. If $A = \begin{bmatrix}3 & -5\\ -4 & 2\end{bmatrix}$, find $A^2 - 5A - 14I.$

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3. If

$$A = \begin{bmatrix} 2 & 0 & 9 \\ -1 & 6 & 10 \\ 4 & -1 & 2 \end{bmatrix}, B = \begin{bmatrix} 0 & -1 & -2 \\ 3 & 2 & -1 \\ 4 & -2 & 0 \end{bmatrix} \text{ and } C = \begin{bmatrix} 1 & -2 & 0 \\ 0 & 1 & 2 \\ 3 & 0 & -1 \end{bmatrix}$$

then show that,

A(BC) = (AB)C

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4. If

$$A = \begin{bmatrix} 2 & 0 & 9 \\ -1 & 6 & 10 \\ 4 & -1 & 2 \end{bmatrix}, B = \begin{bmatrix} 0 & -1 & -2 \\ 3 & 2 & -1 \\ 4 & -2 & 0 \end{bmatrix} \text{ and } C = \begin{bmatrix} 1 & -2 & 0 \\ 0 & 1 & 2 \\ 3 & 0 & -1 \end{bmatrix}$$

then show that,

A(B+C) = AB + AC.

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5. Given $A = \begin{bmatrix} 1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & -1 \end{bmatrix}$ and $B = \begin{bmatrix} 2 & x & x \\ x & 4 & 5 \\ x & 6 & 7 \end{bmatrix}$, determine the value of x, if there be any, for which the property AB = BA may hold.

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6. A,B,C are matrices each of order 2×2 with AB = AC.

Does it imply that B = C? Give an example in support of your conclusion.

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7. If $A + I_3 = \begin{bmatrix} 1 & 3 & 4 \\ -1 & 1 & 3 \\ -2 & -3 & 1 \end{bmatrix}$, evaluate $(A + I_3)(A - I_3)$, where I_3 represents 3×3 unit matrix.

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8. Let $f(x) = 2x^2 + 3x + 5$ and $A = \begin{bmatrix} 2 & 1 \\ 3 & 4 \end{bmatrix}$. find f(A).

A. `

B.

C.

D.

Answer: $\begin{bmatrix} 25 & 15 \\ 45 & 55 \end{bmatrix}$

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9. If $A = \begin{bmatrix} 1 & 2 \\ 2 & 1 \end{bmatrix}$ and $f(x) = x^2 - 2x - 3,$ show that f(A) = 0.

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10. If $A = \begin{bmatrix} 1 & x & -2 \\ 2 & 2 & 4 \\ 0 & 0 & 2 \end{bmatrix}$ and $A^2 + 2I_3 = 3A$ find x, here I_3 is the unit matrix of order 3.

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11. If $A = \begin{bmatrix} 2 & 1 \\ 3 & 4 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & -2 \\ -1 & 1 \end{bmatrix}$ verify that, $(AB)^T = B^T A^T$ where A^T is the transpose of A.

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12. If $A = \begin{bmatrix} -2 & 1 & 3 \\ 0 & 4 & -1 \end{bmatrix}$ and $B = \begin{bmatrix} 2 & 1 \\ -3 & 0 \\ 4 & -5 \end{bmatrix}$, show that,

(AB)' = B'A' where A' is the transpose of A.

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13. If $A = \begin{bmatrix} 1 & 2 & 5 \\ -1 & 3 & -4 \end{bmatrix}$ and $B = \begin{bmatrix} 3 & -2 & 1 \\ 0 & -1 & 4 \\ 5 & 2 & -1 \end{bmatrix}$, show that,

$(AB)^T = B^T A^T$ where A^T is the transpose of A.

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14. If $A = \begin{bmatrix} -1 \\ 2 \\ 3 \end{bmatrix}$ and $B = [-2 \quad -1 \quad -4]$ then verify that $(AB)^T = B^T A^T$.

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15. If $A = \begin{bmatrix} \cos\alpha & \sin\alpha \\ -\sin\alpha & \cos\alpha \end{bmatrix}$ then prove that, AA' = I. Hence find A^{-1}

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16. If $A = \begin{pmatrix} 3 & 1 \\ -1 & 2 \end{pmatrix}$, $I = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$ and $O = \begin{pmatrix} 0 & 0 \\ 0 & 0 \end{pmatrix}$, show that $A^2 - 5A + 7I = o$. Hence find A^{-1}.

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17. If $A = \begin{bmatrix} 4 & 5 \\ 5 & 6 \end{bmatrix}$, show that $A^2 = 10A + I$ where I is a unit matrix of order 2. Hence find inverse matrix of A.

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18. Show that, matrix $A = \begin{bmatrix} 2 & -3 \\ 3 & 4 \end{bmatrix}$ satisfies the equation $A^2 - 6A + 17 = 0$. Hence find A^{-1}

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19. If the matrix $A = \frac{1}{3}\begin{pmatrix} a & 2 & 2 \\ 2 & 1 & b \\ 2 & c & 1 \end{pmatrix}$ obeys the law $\mathrm{AA}' = I,$ find a,b,and c (Here A' is the transpose of A and I is the unit matrix of order 3).

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20. If $A = \begin{bmatrix} 1 & -2 & 2 \\ 0 & 1 & -1 \\ 0 & 0 & 1 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & 2 & 0 \\ 2 & 3 & -1 \\ 0 & -1 & -2 \end{bmatrix}$, then show that, (A'B)A is a diagonal matrix.

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21. Express the matrix $A = \begin{bmatrix} 4 & 2 & -1 \\ 3 & 5 & 7 \\ 1 & -2 & 1 \end{bmatrix}$ as the sum of a symmetric matrix and a skew-symmetric matrix.

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22. If $A = \begin{bmatrix} 1 & 2 \\ 0 & 1 \end{bmatrix}$ show, by mathematical induction, that $A^n = \begin{bmatrix} 1 & 2n \\ 0 & 1 \end{bmatrix}$ for all $n \in N$.

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23. If $A = \begin{bmatrix} 3 & -4 \\ 1 & -1 \end{bmatrix}$, then by principle of mathematics induction show that, $A^n = \begin{bmatrix} 1+2n & -4n \\ n & 1-2n \end{bmatrix}$ for all $n \in N$.

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24. If $A = \begin{bmatrix} \cos\theta & i\sin\theta \\ i\sin\theta & \cos\theta \end{bmatrix}$, then prove by principle of mathematical induction that $A^n = \begin{bmatrix} \cos n\theta & i\sin\theta \\ i\sin\theta & \cos n\theta \end{bmatrix}$ for all $n \in N$.

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25. If $A=\begin{bmatrix} a & b \\ 0 & 1 \end{bmatrix}$, prove by mathematical induction that,

$A^n=\begin{bmatrix} a^n & \frac{b(a^n-1)}{a-1} \\ 0 & 1 \end{bmatrix}$ for every positive integer n.

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26. if $A=\begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$, prove by mathematical induction that,

$A^n=\begin{bmatrix} 3^{n-1} & 3^{n-1} & 3^{n-1} \\ 3^{n-1} & 3^{n-1} & 3^{n-1} \\ 3^{n-1} & 3^{n-1} & 3^{n-1} \end{bmatrix}$ for every positive integer n.

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27. Show tha, $A=\begin{bmatrix} 1 & 2 & 2 \\ 2 & 1 & 2 \\ 2 & 2 & 1 \end{bmatrix}$ satisfies the equation $A^2-4A-5I_3=0$. Hence find A^{-1}.

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28. If $A = \begin{bmatrix} 0 & -\tan.\ \frac{\alpha}{2} \\ \tan.\ \frac{\alpha}{2} & 0 \end{bmatrix}$ and I is the identify matrix of order 2, Show that I+A=(I-A) $\begin{bmatrix} \cos\alpha & -\sin\alpha \\ \sin\alpha & \cos\alpha \end{bmatrix}$.

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29. If $I = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$ and $E = \begin{pmatrix} 0 & 1 \\ 0 & 0 \end{pmatrix}$ prove that, $(2I + 3E)^3 = 8I + 36E$.

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Sample Question For Competive Examination

1. If A and B are square matrices of the same order such that $A^2 = A, B^2 = B, AB = BA = 0$, then__

A. $(A + B)^2 = A + B$

B. $AB^2 = 0$

C. $(A-B)^2 = A-B$

D. none of these

Answer: A,B

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2. A matrix $A = [a_{ij}]_{m \times n} is.....$

A. a horizontal matrix if $m > n$

B. a horizontal matrix if $m < n$

C. a vertical matrix if $m > n$

D. a vertical matrix if $m < n$

Answer: B,C

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3. If $ad - bc \neq 0$, A={:[(a,b),(c,d)]:} and A^(2)+xA+yI_(2)=O`, then______

A. $x = -(a+b)$

B. $x = -(a+d)$

C. y = ad - bc

D. y = bc - ad

Answer: B,C

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4. If A and B are square matrices of the same order such that AB = A and BA = B, then......

A. $A^2 = A$

B. $B^2 = B$

C. $A = I$

D. $B = I$

Answer: A,B

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5. If $A = \begin{bmatrix} 0 & -1 \\ 1 & 0 \end{bmatrix}$ and $B = \begin{bmatrix} 0 & i \\ i & 0 \end{bmatrix}$, then

A. $A^2 = I$

B. $B^2 = I$

C. $A^2 = -I$

D. $B^2 = -I$

Answer: C,D

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6. For what value of y are the following matrices equal?

$A = \begin{bmatrix} 2x+1 & 3y \\ 0 & y^2 - 5y \end{bmatrix}, B = \begin{bmatrix} x+3 & y^2+2 \\ 0 & -6 \end{bmatrix}$

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7. If $A = \begin{bmatrix} i & -i \\ -i & i \end{bmatrix}$ and $B = \begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix}$ then the value of $A^4 = KB$, find the value of K.

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8. If $A = \begin{bmatrix} a & b \\ b & a \end{bmatrix}$ and $A^2 = \begin{bmatrix} \alpha & \beta \\ \beta & \alpha \end{bmatrix}$ such that $\beta = Kab$. Then the value of K will be___

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9. If $A = \begin{bmatrix} 1 & 0 \\ \frac{1}{2} & 1 \end{bmatrix}$ then $A^{100} = \begin{bmatrix} 1 & 0 \\ 10 \times \lambda & 1 \end{bmatrix}$, find the value of λ.

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10. If $A = \begin{bmatrix} 1 & 2 & x \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$, $B = \begin{bmatrix} 1 & -2 & y \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ and $AB = I_3$, then find the value of x + y + 1.

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11. A and B arer two matrices of order 3×3 which satisfy AB = A and BA = B.

Which of the following are true?

A. $A^2B = A^2$

B. $B^2A = B^2$

C. ABA = A

D. BAB = B

Answer: A,B,C,D

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12. A and B arer two matrices of order 3 × 3 which satisfy AB = A and BA =B then$(A+B)^7$ is equal to___

A. 7(A+B)

B. $7I_{3\times3}$

C. $64(A+B)$

D. $128I_{3\times3}$

Answer: D

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13. A and B arer two matrices of order 3 × 3 which satisfy AB = A and BA = B. then$(A+I)^5$ is equal to (where I is identify matrix)___

A. I + 60A

B. I + 16A

C. I + 31A

D. none of these

Answer: C

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14. Let A be matrix of order 2×2 such that $A^2 = 0$ (where 0 is null matrix) and I is an identify matrix.

$A^2 - (a+d)A + (ad - bc)I$ is equal to___

A. I

B. 0

C. $-I$

D. none of these

Answer: B

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15. If $A \neq 0$, $A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$, ad- c = 0 and $A^2 - (a+d)A + (ad - bc)I = 0$ then the value of a + d will be--

A. 1

B. 0

C. -1

D. none of these

Answer: B

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16. Let a be a matrix of order 2×2 such that $A^2 = O$.

$(I + A)^{100} =$

A. 100A

B. 100(I+A)

C. 100I+A

D. I+100A

Answer: D

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17. Let $A = [a_{ij}]_{m \times n}$ is defined by $a_{ij} = i + j$. Then the sum of all the elements of the matrix is

A. $\frac{mn}{2}(m+n+2)$

B. $\frac{mn}{2}(m+n-2)$

C. $\frac{mn}{2}(m+2n+2)$

D. $\frac{mn}{2}(2m+n+2)$

Answer: A

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18. A matrix A is said to be an Idempotent matrix if $A^2 = A$. Then which of the following is true

A. $I + A$ is Idempotent

B. $I - A$ is Idempotent

C. Both are Idempotent

D. None of these

Answer: B

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