1. $A_{(\alpha)} = \begin{bmatrix} \cos\alpha & -\sin\alpha \\ \sin\alpha & \cos\alpha \end{bmatrix}$, $A_{(\beta)} = \begin{bmatrix} \cos\beta & -\sin\beta \\ \sin\beta & \cos\beta \end{bmatrix}$.

Which one of the following is correct ?

(a) $A_{(-\alpha)} A_{(-\beta)} = A_{(\alpha+\beta)}$
(b) $A_{(-\alpha)} A_{(\beta)} = A_{(\beta-\alpha)}$
(c) $A_{(\alpha)} + A_{(-\beta)} = A_{\{-(\beta-\alpha)\}}$
(d) $A_{(\alpha)} + A_{(\beta)} = A_{(\alpha+\beta)}$

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

What is the maximum value of f(x) ?

(a) 2 (b) 4
(c) 6 (d) 8

3. If the matrix $\begin{bmatrix} \cos\theta & \sin\theta & 0 \\ \sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{bmatrix}$ is singular, then what is one of the values of θ ?

(a) $\frac{\pi}{4}$ (b) $\frac{\pi}{2}$
(c) π (d) 0

4. For what values of k, does the system of linear equations $x+y+z=2, 2x+y-z=3, 3x+2y+kz=4$ have a unique solution ?

(a) $k=0$ (b) $-1<k<1$
(c) $-2<k<2$ (d) $k \neq 0$

5. Let $A = \begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & x \\ 0 & 1 \end{bmatrix}$

If AB = BA, then what is the value of x ?

(a) −1 (b) 0
(c) 1 (d) Any real number

6. If a matrix B is obtained from a square matrix A by interchanging any two of its rows, then what is $|A+B|$ equal to

(a) $2|A|$ (b) $2|B|$
(c) 0 (d) $|A|-|B|$

7. Let $A = (a_{ij})_{n\times n}$ and adj $A = (\alpha_{ij})$

If $A = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 4 \\ 2 & 3 & -1 \end{bmatrix}$, what is the value of α_{23} ?

(a) 1 (b) −1
(c) 8 (d) −8

8. Let A and B be two invertible square matrices each of order n. What is adj (AB) equal to ?

(a) (adj A) (adj B) (b) (adj A) + (adj B)
(c) (adj A) − (adj B) (d) (adj B) (adj A)

9. M is a matrix with real entries given by

$$M = \begin{bmatrix} 4 & k & 0 \\ 6 & 3 & 0 \\ 2 & t & k \end{bmatrix}$$

Which of the following conditions guarantee the invertibility of M ?

1. $k \neq 2$ 2. $k \neq 0$
3. $t \neq 0$ 4. $t \neq 1$

Select the correct answer using the code given below :

(a) 1 and 2 (b) 2 and 3
(c) 1 and 4 (d) 3 and 4

10. Let $A = \begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$ be a square matrix of order 3. Then for any positive integer n, what is A^n equal to ?

(a) A (b) $3^n A$
(c) $(3^{n-1})A$ (d) 3A

11. Let A and B be two matrices such that AB is defined. If AB = 0, then which one of the following can be definitely concluded ?

(a) A = 0 or B = 0
(b) A = 0 and B = 0
(c) A and B are non-zero square matrices
(d) A and B cannot both be non-singular

12. If A is a matrix of order $p \times q$ and B is a matrix of order $s \times t$, under which one of the following conditions does AB exist ?

(a) p = t (b) p = s
(c) q = t (d) q = s

13. If A is a square matrix such that $A - A^T = 0$, then which one of the following is correct ?

(a) A must be a null matrix
(b) A must be a unit matrix
(c) A must be a scalar matrix
(d) None of the above

14. What is the largest value of a third order determinant whose elements are 0 or 1 ?

(a) 0 (b) 1
(c) 2 (d) 3

15. What is the inverse of $A = \begin{bmatrix} 1+i & 1+i \\ -1+i & 1-i \end{bmatrix}$?

(a) $\frac{1}{4}\begin{bmatrix} 1-i & -1-i \\ 1-i & 1+i \end{bmatrix}$ (b) $\frac{1}{4}\begin{bmatrix} 1+i & -1+i \\ 1+i & -1-i \end{bmatrix}$

(c) $\frac{1}{4}\begin{bmatrix} 1+i & 1-i \\ -1-i & 1+i \end{bmatrix}$ (d) $\frac{1}{4}\begin{bmatrix} 1+i & 1-i \\ -1-i & -1+i \end{bmatrix}$

16. In respect of the equation

$$\begin{bmatrix} 2 & 3 \\ 4 & 6 \end{bmatrix}\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 5 \\ c-5 \end{bmatrix}$$

correctly match List I with List II and select the correct answer using the code given below the lists:

List I (Value of c)	List II (Nature of the Equation)
A. 5	1. The equation has no solution
B. 10	2. The equation has a unique solution
C. 15	3. The equation has an infinite set of solutions
	4. The equation has two infi nite sets of independent solutions

Code:

	A	B	C
(a)	4	2	3
(b)	1	1	3
(c)	2	2	4
(d)	4	1	3

17. If $A^{-1}=\begin{bmatrix}1 & -2\\ -2 & 2\end{bmatrix}$, what is det (A) ?

(a) 2 (b) -2

(c) $\frac{1}{2}$ (d) $-\frac{1}{2}$

18. From the matrix equation AB = AC, which one of the following can be concluded ?
(a) B = C for any matrix A
(b) B = C, if A is singular
(c) B = C, if A is non-singular
(d) A = B = C for any matrix A

19. What is the value of $\begin{vmatrix}a & b & c\\ b & c & a\\ c & a & b\end{vmatrix}$ if $a^3+b^3+c^3=0$?

(a) 0 (b) 1
(c) 3 abc (d) -3 abc

20. If $A=\begin{bmatrix}1 & 2\\ 0 & 3\end{bmatrix}$ is a 2×2 matrix and $f(x)=x^2-x+2$ is a polynomial, then what is f(A) ?

(a) $\begin{bmatrix}1 & 7\\ 1 & 7\end{bmatrix}$ (b) $\begin{bmatrix}2 & 6\\ 0 & 8\end{bmatrix}$

(c) $\begin{bmatrix}2 & 6\\ 0 & 6\end{bmatrix}$ (d) $\begin{bmatrix}2 & 6\\ 0 & 7\end{bmatrix}$

21. If A is a non-null row matrix with 5 columns and B is a non-null column matrix with 5 rows, how many rows are there in $A\times B$?
(a) 1 (b) 5
(c) 10 (d) 25

DIRECTIONS (Qs. 22-23) : *The following questions consist of two statements, one labelled as the 'Assertion (A)' and the other as 'Reason (R)'. You are to examine these two statements carefully and select the answer.*

(a) Both A and R are individually true and R is the correct explanation of A
(b) Both A and R are individually true but R is not the correct explanation of A
(c) A is true but R is false
(d) A is false but R is true

22. **Assertion(A):** If $A=\begin{pmatrix}2 & 3\\ 1 & 4\end{pmatrix}, B=\begin{pmatrix}1 & 0\\ 0 & 1\end{pmatrix}$, then $(A+B)^2 = A^2+B^2+2AB$.
Reason(R): In the above AB = BA

23. **Assertion(A):** If $A=\begin{pmatrix}\cos\alpha & \sin\alpha\\ \cos\alpha & \sin\alpha\end{pmatrix}$ and $B=\begin{pmatrix}\cos\alpha & \cos\alpha\\ \sin\alpha & \sin\alpha\end{pmatrix}$, then $AB \neq 1$.
Reason(R): The product of two matrices can never be equal to an identity matrix.

24. If A is any 2×2 matrix such that $\begin{bmatrix}1 & 2\\ 0 & 3\end{bmatrix}A=\begin{bmatrix}-1 & 0\\ 6 & 3\end{bmatrix}$ then what is A equal to?

(a) $\begin{bmatrix}-5 & 1\\ -2 & 2\end{bmatrix}$ (b) $\begin{bmatrix}-5 & -2\\ 1 & 2\end{bmatrix}$

(c) $\begin{bmatrix}-5 & -2\\ 2 & 1\end{bmatrix}$ (d) $\begin{bmatrix}5 & 2\\ -2 & -1\end{bmatrix}$

25. If A is a 3×3 matrix such that $|A|=4$, then what is A(adj A) equal to?

(a) $\begin{bmatrix}1 & 0 & 0\\ 0 & 1 & 0\\ 0 & 0 & 1\end{bmatrix}$ (b) $\begin{bmatrix}4 & 0 & 0\\ 0 & 4 & 0\\ 0 & 0 & 4\end{bmatrix}$

(c) $\begin{bmatrix}16 & 0 & 0\\ 0 & 16 & 0\\ 0 & 0 & 16\end{bmatrix}$

(d) Cannot be determined, as data is insufficient

26. If $A=\begin{bmatrix}x & x^2 & 1+x^2\\ y & y^2 & 1+y^2\\ z & z^2 & 1+z^2\end{bmatrix}$ where x, y, z are distinct what is |A|?

(a) 0
(b) x^2y-y^2x+xyz
(c) $(x-y)(y-z)(z-x)$
(d) xyz

27. Under which of the following condition(s), will the matrix $A=\begin{bmatrix}0 & 0 & q\\ 2 & 5 & 1\\ 8 & p & p\end{bmatrix}$ be singular?

1. $q=0$
2. $p=0$
3. $p=20$

Select the correct answer using the code given below:
(a) 1 and 2 (b) 3 only
(c) 1 and 3 (d) 1 or 3

28. Consider the following statements:
1. If det A = 0, then det (adj A) = 0
2. If A is non- singular, then $\det(A^{-1})=(\det A)^{-1}$
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

29. Let A be an $m\times n$ matrix. Under which one of the following conditions does A^{-1} exist?
(a) m = n only (b) m = n and det $A\neq 0$
(c) m = n and det A = 0 (d) $m\neq n$

30. Let A and B be two matrices of order $n\times n$. Let A be non-singular and B be singular. Consider the following:
1. AB is singular
2. AB is non-singular
3. $A^{-1}B$ is singular
4. $A^{-1}B$ is non singular

Which of the above is/ are correct?
(a) 1 and 3 (b) 2 and 4 only
(c) 1 only (d) 3 only

31. Let A be a square matrix of order $n \times n$ where $n \geq 2$. Let B be a matrix obtained from A with first and second rows interchanged. Then which one of the following is correct?
(a) $\det A = \det B$ (b) $\det A = -\det B$
(c) $A = B$ (d) $A = -B$

32. What should be the value of k so that the system of linear equations $x - y + 2z = 0, kx - y + z = 0, 3x + y - 3z = 0$ does not possess a unique solution?
(a) 0 (b) 3
(c) 4 (d) 5

33. The matrix $A = \begin{bmatrix} 1 & 2 \\ 2 & 2 \end{bmatrix}$ satisfies which one of the following polynomial equations?
(a) $A^2 + 3A + 2I = 0$ (b) $A^2 + 3A - 2I = 0$
(c) $A^2 - 3A - 2I = 0$ (d) $A^2 - 3A + 2I = 0$

34. For how many values of k, will the system of equations $(k+1)x + 8y = 4k$ and $kx + (k+3)y = 3k - 1$, have an infinite number of solutions ?
(a) 1 (b) 2
(c) 3 (d) None of the above

35. For what value of p, is the system of equations :
$p^3x + (p+1)^3 y = (p+2)^3$
$px + (p+1)y = p + 2$
$x + y = 1$
consistent ?
(a) $p = 0$ (b) $p = 1$
(c) $p = -1$ (d) For all $p > 1$

36. If $A = \begin{bmatrix} 2x & 0 \\ x & x \end{bmatrix}$ and $A^{-1} = \begin{bmatrix} 1 & 0 \\ -1 & 2 \end{bmatrix}$, then what is the value of x ?
(a) $-\frac{1}{2}$ (b) $\frac{1}{2}$
(c) 1 (d) 2

37. Let $A = [a_{ij}]_{m \times m}$ be a matrix and $C = [c_{ij}]_{m \times m}$ be another matrix where c_{ij} is the cofactor of a_{ij}. Then, what is the value of $|AC|$?
(a) $|A|^{m-1}$ (b) $|A|^m$
(c) $|A|^{m+1}$ (d) Zero

38. If ω is the cube root of unity, then what is one root of the equation

$$\begin{vmatrix} x^2 & -2x & -2\omega^2 \\ 2 & \omega & -\omega \\ 0 & \omega & 1 \end{vmatrix} = 0 ?$$

(a) 1 (b) –2
(c) 2 (d) ω

39. If $A = \begin{bmatrix} 2 & 2 \\ 2 & 2 \end{bmatrix}$, then what is A^n equal to ?
(a) $\begin{bmatrix} 2^n & 2^n \\ 2^n & 2^n \end{bmatrix}$ (b) $\begin{bmatrix} 2n & 2n \\ 2n & 2n \end{bmatrix}$
(c) $\begin{bmatrix} 2^{2n-1} & 2^{2n-1} \\ 2^{2n-1} & 2^{2n-1} \end{bmatrix}$ (d) $\begin{bmatrix} 2^{2n+1} & 2^{2n+1} \\ 2^{2n+1} & 2^{2n+1} \end{bmatrix}$

40. If the least number of zeroes in a lower triangular matrix is 10, then what is the order of the matrix ?
(a) 3×3 (b) 4×4
(c) 5×5 (d) 10×10

41. If the inverse of $\begin{bmatrix} 1 & p & q \\ 0 & x & 0 \\ 0 & 0 & 1 \end{bmatrix}$ is $\begin{bmatrix} 1 & -p & -q \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ then what is the value of x ?
(a) 1 (b) Zero
(c) –1 (d) $\frac{1}{p} + \frac{1}{q}$

42. If $AB = \begin{bmatrix} 4 & 11 \\ 4 & 5 \end{bmatrix}$ and $A = \begin{bmatrix} 3 & 2 \\ 1 & 2 \end{bmatrix}$, then what is the value of the determinant of the matrix B ?
(a) 4 (b) – 6
(c) $-\frac{1}{4}$ (d) – 28

43. The determinant

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

is independent of which one of the following?
(a) a and b (b) b and c
(c) a and c (d) All of these

44. If $X = \begin{bmatrix} 1 & -2 \\ 0 & 3 \end{bmatrix}$, and I is a 2×2 identity matrix, then $X^2 - 2X + 3I$ equals to which one of the following ?
(a) –I (b) –2X
(c) 2X (d) 4X

45. If the matrix B is the adjoint of the square matrix A and α is the value of the determinant of A, then what is AB equal to ?
(a) α (b) $\left(\frac{1}{\alpha}\right)I$
(c) I (d) αI
where I is identity matrix

46. What is the determinant

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

(a) $\begin{vmatrix} 1 & a & a^2 \\ 1 & b & b^2 \\ 1 & c & c^2 \end{vmatrix}$ (b) $\begin{vmatrix} 1 & a^2 & a^3 \\ 1 & b^2 & b^3 \\ 1 & c^2 & c^3 \end{vmatrix}$

(c) $\begin{vmatrix} 1 & a & a^3 \\ 1 & b & b^3 \\ 1 & c & c^3 \end{vmatrix}$ (d) $\begin{vmatrix} a & a^2 & a^3 \\ b & b^2 & b^3 \\ c & c^2 & c^3 \end{vmatrix}$

47. If $x^2+y^2+z^2=1$, then what is the value of

$$\begin{vmatrix} 1 & z & -y \\ -z & 1 & x \\ y & -x & 1 \end{vmatrix} = ?$$

(a) 0 (b) 1
(c) 2 (d) $2-2xyz$

48. If $|A_{n\times n}|=3$ and $|\text{adj } A|=243$, what is the value of n ?
(a) 4 (b) 5
(c) 6 (d) 7

49. Under what condition does A (BC) = (AB) C hold, where A, B, C are three matrices ?
(a) AB and BC both must exist
(b) Only Ab must exist
(c) Only BC must exist

50. If A is matrix of order 3×2 and B is matrix of order 2×3, then what is $|kAB|$ equal to (where k is any scalar quantity)?
(a) $k|AB|$ (b) $k^2|AB|$
(c) $k^3|AB|$ (d) $|AB|$

51. If $\begin{bmatrix} 5 & 0 \\ 0 & 7 \end{bmatrix}^{-1}\begin{bmatrix} x \\ -y \end{bmatrix}=\begin{bmatrix} -1 \\ 2 \end{bmatrix}$, then which one of the following is correct ?
(a) $x=5, y=14$ (b) $x=-5, y=14$
(c) $x=-5, y=-14$ (d) $x=5, y=-14$

52. Which one of the following statements is correct ? The system of linear equations,
$2x+3y=4$ and $4x+6y=7$, has
(a) no solution
(b) a unique solution
(c) exactly 3 solutions
(d) an infinite number of solutions

53. Suppose the system of equations
$a_1x+b_1y+c_1z=d_1$
$a_2x+b_2y+c_2z=d_2$
$a_3x+b_3y+c_3z=d_3$
has a unique solution (x_0, y_0, z_0). If $x_0=0$, then which one of the following is correct ?

(a) $\begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix}=0$ (b) $\begin{vmatrix} d_1 & b_1 & c_1 \\ d_2 & b_2 & c_2 \\ d_3 & b_3 & c_3 \end{vmatrix}=0$

(c) $\begin{vmatrix} d_1 & a_1 & c_1 \\ d_2 & a_2 & c_2 \\ d_3 & a_3 & c_3 \end{vmatrix}=0$ (d) $\begin{vmatrix} d_1 & a_1 & b_1 \\ d_2 & a_2 & b_2 \\ d_3 & a_3 & b_3 \end{vmatrix}=0$

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54. If a, b, c are in GP, then what is the value of

$$\begin{vmatrix} a & b & a+b \\ b & c & b+c \\ a+b & b+c & 0 \end{vmatrix} ?$$

(a) 0 (b) 1
(c) -1 (d) None of these

55. If $\text{adj } A=\begin{bmatrix} a & 0 \\ -1 & b \end{bmatrix}$ and $ab\neq 0$, then what is the value of $|A^{-1}|$?
(a) 1 (b) ab
(c) $1/\sqrt{ab}$ (d) $1/ab$

56. If $l+m+n=0$, then the system of equations
$-2x+y+z=l$
$x-2y+z=m$
$x+y-2z=n$
has
(a) a trivial solution (b) no solution
(c) a unique solution (d) infinitely many solutions

57. If $(a_1/x)+(b_1/y)=c_1, (a_2/x)+(b_2/y)=c_2$

$\Delta_1=\begin{vmatrix} a_1 & b_1 \\ a_2 & b_2 \end{vmatrix}$, $\Delta_2=\begin{vmatrix} b_1 & c_1 \\ b_2 & c_2 \end{vmatrix}$, $\Delta_3=\begin{vmatrix} c_1 & a_1 \\ c_2 & a_2 \end{vmatrix}$,

then (x, y) is equal to which one of the following?
(a) $(\Delta_2/\Delta_1, \Delta_3/\Delta_1)$ (b) $(\Delta_3/\Delta_1, \Delta_2/\Delta_1)$
(c) $(-\Delta_1/\Delta_2, -\Delta_1/\Delta_3)$ (d) $(-\Delta_1/\Delta_2, -\Delta_1/\Delta_3)$

58. What is the value of $\begin{vmatrix} \sin 10^\circ & -\cos 10^\circ \\ \sin 80^\circ & \cos 80^\circ \end{vmatrix}$?
(a) 0 (b) 1
(c) -1 (d) 1/2

59. If $\begin{vmatrix} 2 & 4 & 0 \\ 0 & 5 & 16 \\ 0 & 0 & 1+p \end{vmatrix}=20$, then what is the value of p?
(a) 0 (b) 1
(c) 2 (d) 5

60. If A and B are two matrices such that $AB=A$ and $BA=B$, then which one of the following is correct?
(a) $(A^T)^2=A^T$ (b) $(A^T)^2=B^T$
(c) $(A^T)^2=(A^{-1})^{-1}$ (d) None of the above

61. If $\begin{bmatrix} 1 & 3 \\ 0 & 1 \end{bmatrix}A=\begin{bmatrix} 1 & -1 \\ 0 & 1 \end{bmatrix}$, then what is the matrix A?

(a) $\begin{bmatrix} 1 & -3 \\ 0 & 1 \end{bmatrix}$ (b) $\begin{bmatrix} 2 & 2 \\ 0 & 2 \end{bmatrix}$

(c) $\begin{bmatrix} -4 & -1 \\ 1 & 0 \end{bmatrix}$ (d) $\begin{bmatrix} 1 & -4 \\ 0 & 1 \end{bmatrix}$

62. Under which one of the following condition does the system of equations
$kx+y+z=k-1$
$x+ky+z=k-1$
$x+y+kz=k-1$
have no solution?
(a) $k=1$ (b) $k\neq -2$
(c) $k=1$ or $k=-2$ (d) $k=-2$

Let $A=\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$ and $B=\begin{bmatrix} a & 0 \\ 0 & b \end{bmatrix}$ where a, b are natural numbers, then which one of the following is correct?

(a) There exist more than one but finite number of B's such

that $AB = BA$

(b) There exists exactly one B such that $AB = BA$

(c) There exist infinitely many B's such that $AB = BA$

(d) There cannot exist any B such that $AB = BA$

Consider a matrix $M = \begin{bmatrix} 3 & 4 & 0 \\ 2 & 1 & 0 \\ 3 & 1 & k \end{bmatrix}$ and the following statements

Statement A : Inverse of M exists.

Statement B : $k \neq 0$

Which one of the following in respect of the above matrix and statement is correct?

(a) A implies B, but B does not imply A

(b) B implies A, but A does not imply B

(c) Neither A implies B nor B implies A

(d) A implies B as well as B implies A

65. If $\begin{vmatrix} y & x & y+z \\ z & y & x+y \\ x & z & z+x \end{vmatrix} = 0$, then which one of the following is correct?

(a) Either $x+y=z$ or $x=y$

(b) Either $x+y=-z$ or $x=z$

(c) Either $x+z=y$ or $z=y$

(d) Either $z+y=$ x or $x=y$

66. What is the value of k, if

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

(a) 1 (b) -1

(c) 2 (d) 0

67. Which one of the following is correct in respect of the matrix

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

(a) A^{-1} does not exist (b) $A = (-1)I$

(c) A is a unit matrix (d) $A^2 = I$

68. If $A = \begin{bmatrix} 3 & 2 \\ 1 & 4 \end{bmatrix}$, then what is A (adj A) equal to ?

(a) $\begin{bmatrix} 0 & 10 \\ 10 & 0 \end{bmatrix}$ (b) $\begin{bmatrix} 10 & 0 \\ 0 & 10 \end{bmatrix}$

(c) $\begin{bmatrix} 1 & 10 \\ 10 & 1 \end{bmatrix}$ (d) $\begin{bmatrix} 10 & 1 \\ 1 & 10 \end{bmatrix}$

69. What is the inverse of $\begin{bmatrix} 0 & 0 & 1 \\ 0 & 1 & 0 \\ 1 & 0 & 0 \end{bmatrix}$?

(a) $\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ (b) $\begin{bmatrix} 0 & 0 & 1 \\ 0 & 1 & 0 \\ 1 & 0 & 0 \end{bmatrix}$

(c) $\begin{bmatrix} -1 & 0 & 1 \\ 0 & -1 & 0 \\ 0 & 0 & -1 \end{bmatrix}$ (d) $\begin{bmatrix} 0 & 0 & -1 \\ 0 & -1 & 0 \\ -1 & 0 & 0 \end{bmatrix}$

70. Consider the following statements in respect of symmetric matrices A and B

1. AB is symmetric.
2. $A^2 + B^2$ is symmetric.

Which of the above statement(s) is/are correct?

(a) 1 only (b) 2 only

(c) Both 1 and 2 (d) Neither 1 nor 2

71. *The following item consists of two statements, one labelled the Assertion (A) and the other labelled the Reason (R). You are to examine these two statements carefully and decide if the Assertion (A) and Reason (R) are individually true and if so, whether the reason is a correct explanation of the Assertion. Select your answer using the codes given below.*

Assertion (A) : $M = \begin{bmatrix} 5 & 10 \\ 4 & 8 \end{bmatrix}$ is invertible.

Reason (R) : M is singular.

(a) Both A and R are true and R is the correct explanation of A

(b) Both A and R are true but R is not the correct explanation of A

(c) A is true but R is false

(d) A is false but R is true

72. If X and Y are the matrices of order 2×2 each and $2X - 3Y = \begin{bmatrix} -7 & 0 \\ 7 & -13 \end{bmatrix}$ and $3X + 2Y = \begin{bmatrix} 9 & 13 \\ 4 & 13 \end{bmatrix}$, then what is Y equal to?

(a) $\begin{bmatrix} 1 & 3 \\ -2 & 1 \end{bmatrix}$ (b) $\begin{bmatrix} 1 & 3 \\ 2 & 1 \end{bmatrix}$

(c) $\begin{bmatrix} 3 & 2 \\ -1 & 5 \end{bmatrix}$ (d) $\begin{bmatrix} 3 & 2 \\ 1 & -5 \end{bmatrix}$

73. If a, b, c, are non-zero real numbers and

$$\begin{bmatrix} 1+a & 1 & 1 \\ 1 & 1+b & 1 \\ 1 & 1 & 1+c \end{bmatrix} = 0,$$

then what is the value of $\frac{1}{a} + \frac{1}{b} + \frac{1}{c}$?

(a) 2 (b) 1

(c) -1 (d) 0

74. If a matrix A is symmetric as well as anti-symmetric, then which one of the following is correct?

(a) A is a diagonal matrix (b) A is a null matrix

(c) A is a unit matrix (d) A is a triangular matrix

75. If $A = \begin{bmatrix} 1 & -2 & -3 \\ 2 & 1 & -2 \\ 3 & 2 & 1 \end{bmatrix}$, then which one of the following is correct?

(a) A is symmetric matrix

(b) A is anti- symmetric matrix

(c) A is singular matrix

(d) A is non-singular matrix

correct?
(a) A is symmetric matrix
(b) A is anti- symmetric matrix
(c) A is singular matrix
(d) A is non-singular matrix

76. $A=\begin{vmatrix}2a & 3r & x\\ 4b & 6s & 2y\\ -2c & -3t & -z\end{vmatrix}=\lambda\begin{vmatrix}a & r & x\\ b & s & y\\ c & t & z\end{vmatrix}$, then what is the value of λ?
(a) 12 (b) –12
(c) 7 (d) –7

77. What is the value of $\begin{vmatrix}1-i & \omega^2 & -\omega\\ \omega^2+i & \omega & -i\\ 1-2i-\omega^2 & \omega^2-\omega & i-\omega\end{vmatrix}$, where ω is the cube root of unity?
(a) –1 (b) 1
(c) 2 (d) 0

78. If $A=\begin{bmatrix}\omega & 0\\ 0 & \omega\end{bmatrix}$, where ω is cube root of unity, then what is A^{100} equal to?
(a) A (b) $-A$
(c) Null matrix (d) Identity matrix

79. A matrix X has $(a+b)$ rows and $(a+2)$ columns; and a matrix Y has $(b+1)$ rows and $(a+3)$ columns. If both XY and YX exist, then what are the values of a, b respectively?
(a) 3, 2 (b) 2, 3
(c) 2, 4 (d) 4, 3

80. If $\begin{vmatrix}a & b & c\\ l & m & n\\ p & q & r\end{vmatrix}=2$, then what is the value of the determinant $\begin{vmatrix}6a & 3b & 15c\\ 2l & m & 5n\\ 2p & q & 5r\end{vmatrix}$?
(a) 10 (b) 20
(c) 40 (d) 60

81. Let $A=\begin{bmatrix}5 & 6 & 1\\ 2 & -1 & 5\end{bmatrix}$. Let there exist a matrix B such that $AB=\begin{bmatrix}35 & 49\\ 29 & 13\end{bmatrix}$. What is B equal to?
(a) $\begin{bmatrix}5 & 1 & 4\\ 2 & 6 & 3\end{bmatrix}$ (b) $\begin{bmatrix}2 & 6 & 3\\ 5 & 1 & 4\end{bmatrix}$
(c) $\begin{bmatrix}5 & 2\\ 1 & 6\\ 4 & 3\end{bmatrix}$ (d) $\begin{bmatrix}2 & 5\\ 6 & 1\\ 3 & 4\end{bmatrix}$

82. Consider the following statements
1. If $A'=A$; then A is a singular matrix, where A' is the transpose of A.
2. If A is a square matrix such that $A^3=I$, then A is non-singular.
Which of the statements given above is/are correct?
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

83. If the system of equations $2x+3y=7$ and $2ax+(a+b)y=28$ has infinitely many solutions, then which one of the following is correct?
(a) $a=2b$ (b) $b=2a$
(c) $a=-2b$ (d) $b=-2a$

84. If the lines $3y+4x=1$, $y=x+5$ and $5y+bx=3$ are concurrent, then what is the value of b?
(a) 1 (b) 3
(c) 6 (d) 0

85. What is the value of $\begin{vmatrix}\cos 15^\circ & \sin 15^\circ\\ \cos 45^\circ & \sin 45^\circ\end{vmatrix}\times\begin{vmatrix}\cos 45^\circ & \cos 15^\circ\\ \sin 45^\circ & \sin 15^\circ\end{vmatrix}$?
(a) $\frac{1}{4}$ (b) $\frac{\sqrt{3}}{2}$
(c) $-\frac{1}{4}$ (d) $-\frac{3}{4}$

86. Let A be an $n\times n$ matrix. If $\det(\lambda A)=\lambda^s \det(A)$, what is the value of s?
(a) 0 (b) 1
(c) –1 (d) n

87. If A be a real skew- symmetric matrix of order n such that $A^2+I=0$, I being the identity matrix of the same order as that of A, then what is the order of A?
(a) 3 (b) Odd
(c) Prime number (d) Even

88. Let $A=\begin{bmatrix}1 & 2\\ 3 & 4\end{bmatrix}=\left[a_{ij}\right]$, where $i,j=1,2$, If its inverse matrix is $\left[b_{ij}\right]$, what is b_{22}?
(a) –2 (b) 1
(c) $\frac{3}{2}$ (d) $-\frac{1}{2}$

89. If $\begin{bmatrix}1 & -3 & 2\\ 2 & -8 & 5\\ 4 & 2 & \lambda\end{bmatrix}$ is not an invertible matrix, then what is the value of λ?
(a) –1 (b) 0
(c) 1 (d) 2

90. If $A=\begin{bmatrix}0 & 1\\ -1 & 0\end{bmatrix}$, $B=\begin{bmatrix}i & 0\\ 0 & -i\end{bmatrix}$, $C=\begin{bmatrix}0 & -i\\ -i & 0\end{bmatrix}$, then which one of the following is **not** correct?
(a) $A^2=B^2$ (b) $B^2=C^2$
(c) $AB=C$ (d) $AB=BA$

91. If $x+iy=\begin{vmatrix}6i & -3i & 1\\ 4 & 3i & -1\\ 20 & 3 & i\end{vmatrix}$, then what is $x-iy$ equal to?
(a) $3+i$ (b) $1+3i$
(c) $3i$ (d) 0

92. If $|A|=8$, where A is square matrix of order 3, then what is $|\text{adj } A|$ equal to?
(a) 16 (b) 24
(c) 64 (d) 512

93. Consider the following statements in respect of a square matrix A and its transpose A^T.
1. $A+A^T$ is always symmetric.
2. $A-A^T$ is always anti-symmetric
Which of the statements given above is/are correct?
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

94. If a matrix A is such that
$3A^3+2A^2+5A+I=0$,
Then what is A^{-1} equal to?
(a) $-(3A^2+2A+5)$ (b) $3A^2+2A+5I$
(c) $3A^2-2A-5I$ (d) $(3A^2+2A-5I)$

95. Let A and B be matrices of order 3×3. If $AB=0$, then which of the following can be concluded?
(a) $A=0$ and $B=0$ (b) $|A|=0$ and $|B|=0$
(c) Either $|A|=0$ or $|B|=0$ (d) Either $A=0$ or $B=0$

96. If A is a square matrix, then what is adj $A^T-(adj\ A)^T$ equal to?
(a) $2|A|$ (b) $2|A|I$
(c) Null Matrix (d) Unit Matrix

97. What is the value of
$\begin{vmatrix}1 & \omega & 2\omega^2\\ 2 & 2\omega^2 & 4\omega^3\\ 3 & 3\omega^3 & 6\omega^4\end{vmatrix}$,
where ω is the cube root of unity?
(a) 0 (b) 1
(c) 2 (d) 3

98. If the matrix
$A=\begin{bmatrix}2-x & 1 & 1\\ 1 & 3-x & 0\\ -1 & -3 & -x\end{bmatrix}$
is singular, then what is the solution set S?
(a) $S=\{0,2,3\}$ (b) $S=\{-1,2,3\}$
(c) $S=\{1,2,3\}$ (d) $S=\{2,3\}$

99. Consider the following statements.
I. The inverse of a square matrix, if it exists, is unique.
II. If A and B are singular matrices of order n, then AB is also a singular matrix of order n.
Which of the statements given above is/are correct?
(a) Only I (b) Only II
(c) Both I and II (d) Neither I nor II

100. What is the value of the determinant
$\begin{vmatrix}x+1 & x+2 & x+4\\ x+3 & x+5 & x+8\\ x+7 & x+10 & x+14\end{vmatrix}$?
(a) $x+2$ (b) x^2+2
(c) 2 (d) -2

101. If 5 and 7 are the roots of the equation
$\begin{vmatrix}x & 4 & 5\\ 7 & x & 7\\ 5 & 8 & x\end{vmatrix}=0$, then what is the third root?
(a) -12 (b) 9
(c) 13 (d) 14

102. Find the value of k in which the system of equations $kx+2y=5$ and $3x+y=1$ has no solution?
(a) 0 (b) 3
(c) 6 (d) 15

103. If the matrix
$A=\begin{bmatrix}\alpha & \beta\\ \beta & \alpha\end{bmatrix}$
is such that $A^2=I$, then which one of the following is correct?
(a) $\alpha=0,\beta=1$ or $\alpha=1,\beta=0$
(b) $\alpha=0,\beta\neq 1$ or $\alpha\neq 1,\beta=1$
(c) $\alpha=1,\beta\neq 0$ or $\alpha\neq 1,\beta=1$
(d) $\alpha\neq 0,\beta\neq 0$

104. If $A=\begin{bmatrix}\alpha & 0\\ 1 & 1\end{bmatrix}$ and $B=\begin{bmatrix}1 & 0\\ 2 & 1\end{bmatrix}$
such that $A^2=B$, then what is the value of α?
(a) -1 (b) 1
(c) 2 (d) 4

105. $A=\begin{bmatrix}3 & 1\\ 0 & 4\end{bmatrix}$ and $B=\begin{bmatrix}1 & 1\\ 0 & 2\end{bmatrix}$, then which of the following is/are correct?
I. AB is defined II. BA is defined
III. $AB=BA$
Select the correct answer using the codes given below.
(a) Only I (b) Only II
(c) Both I and II (d) I, II and III

106. The simultaneous equations $3x+5y=7$ and $6x+10y=18$ have
(a) no solution
(b) infinitely many solutions
(c) unique solution
(d) any finite number of solutions

107. The roots of the equation $\begin{vmatrix}x & \alpha & 1\\ \beta & x & 1\\ \beta & \gamma & 1\end{vmatrix}=0$ are independent of
(a) α (b) β
(c) γ (d) α, β and γ

108. What is the value of the determinant
$\begin{vmatrix}a-b & b+c & a\\ b-c & c+a & b\\ c-a & a+b & c\end{vmatrix}$?
(a) $a^3+b^3+c^3$ (b) $3bc$
(c) $a^3+b^3+c^3-3abc$ (d) 0

109. If $\begin{vmatrix} p & -q & 0 \\ 0 & p & q \\ q & 0 & p \end{vmatrix} = 0$, then which one of the following is correct?
(a) p is one of the cube roots of unity
(b) q is one of the cube roots of unity
(c) $\frac{p}{q}$ is one of the cube roots of unity
(d) None of the above

110. If $a^{-1}+b^{-1}+c^{-1}=0$ such that $\begin{vmatrix} 1+a & 1 & 1 \\ 1 & 1+b & 1 \\ 1 & 1 & 1+c \end{vmatrix} = \lambda$, then what is λ equal to?
(a) $-abc$ (b) abc
(c) 0 (d) 1

111. Consider the following statements in respect of the square matrices A and B of same order:
1. A and B are non-zero and $AB = 0 \Rightarrow$ either $|A|=0$ or $|B|=0$
2. $AB=0 \Rightarrow A=0$ or $B=0$
Which of the above statements is/are correct?
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

112. For what value of x does $\begin{pmatrix}1 & 3 & 2\end{pmatrix}\begin{pmatrix}1 & 3 & 0 \\ 3 & 0 & 2 \\ 2 & 0 & 1\end{pmatrix}\begin{pmatrix}0 \\ 3 \\ x\end{pmatrix} = (0)$ hold?
(a) -1 (b) 1
(c) 9/8 (d) $-9/8$

113. Consider the following statements:
1. every zero matrix is a square matrix.
2. A matrix has a numerical value.
3. A unit matrix is a diagonal matrix.
Which of the above statements is/are correct?
(a) 2 only (b) 3 only
(c) 2 and 3 (d) 1 and 3

114. If a matrix A has inverses B and C, then which one of the following is correct?
(a) B may not be equal to C
(b) B should be equal to C
(c) B and C should be unit matrices
(d) None of the above

115. If $A = \begin{pmatrix}1 & 2 \\ 2 & 3\end{pmatrix}$ and $B = \begin{pmatrix}1 & 0 \\ 1 & 0\end{pmatrix}$ then what is determinant of AB?
(a) 0 (b) 1
(c) 10 (d) 20

116. What is $\begin{vmatrix} -a^2 & ab & ac \\ ab & -b^2 & bc \\ ac & bc & -c^2 \end{vmatrix}$ equal to?
(a) 4abc (b) $4a^2bc$
(c) $4a^2b^2c^2$ (d) $-4a^2b^2c^2$

117. A and B are two matrices such that AB = A and BA = B then what is B^2 equal to?
(a) B (b) A
(c) I (d) $-I$
where I is the identity matrix

118. The sum and product of matrices A and B exist. Which of the following implications are necessarily true?
1. A and B are square matrices of same order.
2. A and B are non-singular matrices
Select the correct answer using the code given below:
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

119. If A is a square matrix such that $A^2 = I$ where I is the identity matrix, then what is A^{-1} equal to?
(a) A + 1 (b) Null matrix
(c) A (d) Transpose of A

120. If two rows of a determinant are identical, then what is the value of the determinant?
(a) 0 (b) 1
(c) -1 (d) can be any real value

121. If $\begin{vmatrix} 8 & -5 & 1 \\ 5 & x & 1 \\ 6 & 3 & 1 \end{vmatrix} = 2$ then what is the value of x?
(a) 4 (b) 5
(c) 6 (d) 8

122. What is the order of the product $\begin{bmatrix}x & y & z\end{bmatrix}\begin{bmatrix}a & h & g \\ h & b & f \\ g & f & c\end{bmatrix}\begin{bmatrix}x \\ y \\ z\end{bmatrix}$?
(a) 3×1 (b) 1×1
(c) 1×3 (d) 3×3

123. If $A = \begin{bmatrix}1 & 2 \\ 1 & 1\end{bmatrix}$ and $B = \begin{bmatrix}0 & -1 \\ 1 & 2\end{bmatrix}$, then what is $B^{-1}A^{-1}$ equal to?
(a) $\begin{bmatrix}1 & -3 \\ -1 & 2\end{bmatrix}$ (b) $\begin{bmatrix}-1 & 3 \\ 1 & -2\end{bmatrix}$
(c) $\begin{bmatrix}-1 & 3 \\ -1 & -2\end{bmatrix}$ (d) $\begin{bmatrix}-1 & -3 \\ 1 & -2\end{bmatrix}$

1	(d)	25	(b)	49	(a)	73	(c)	97	(a)
2	(c)	26	(c)	50	(c)	74	(b)	98	(a)
3	(a)	27	(d)	51	(c)	75	(d)	99	(a)
4	(d)	28	(c)	52	(a)	76	(b)	100	(d)
5	(b)	29	(b)	53	(b)	77	(d)	101	(a)
6	(c)	30	(b)	54	(a)	78	(a)	102	(c)
7	(c)	31	(b)	55	(a)	79	(b)	103	(a)
8	(d)	32	(d)	56	(d)	80	(d)	104	(b)
9	(a)	33	(c)	57	(c)	81	(c)	105	(d)
10	(c)	34	(c)	58	(b)	82	(b)	106	(a)
11	(c)	35	(c)	59	(b)	83	(b)	107	(a)
12	(d)	36	(b)	60	(a)	84	(c)	108	(c)
13	(d)	37	(c)	61	(d)	85	(c)	109	(c)
14	(c)	38	(b)	62	(c)	86	(d)	110	(b)
15	(a)	39	(c)	63	(c)	87	(a)	111	(a)
16	(b)	40	(b)	64	(d)	88	(d)	112	(d)
17	(d)	41	(a)	65	(b)	89	(c)	113	(b)
18	(c)	42	(b)	66	(a)	90	(d)	114	(b)
19	(c)	43	(b)	67	(d)	91	(d)	115	(a)
20	(b)	44	(c)	68	(b)	92	(c)	116	(c)
21	(a)	45	(d)	69	(b)	93	(c)	117	(a)
22	(a)	46	(b)	70	(b)	94	(a)	118	(a)
23	(c)	47	(c)	71	(d)	95	(d)	119	(c)
24	(c)	48	(c)	72	(c)	96	(c)	120	(a)