EXPRESSWALA ACADEMY

Maths 1A: Algebra of Matrices

MCQ Test, Set 06

Time: 30 minutes | Maximum marks: 25

Name: _____ Class: _____ Date: _____

1. There are 25 questions. Each has exactly one correct answer: choose A, B, C or D.
2. Each correct answer carries 1 mark. There is no negative marking.
3. The key sheet and worked solutions are at the end of this test.

1. The number of possible orders of a matrix with 14 elements is

A. 3 **B.** 2 **C.** 4 **D.** 5

2. If $A = \begin{bmatrix} -6 & 7 & -5 \\ -4 & 0 & -5 \\ 6 & 2 & 3 \end{bmatrix}$, then $a_{23} \cdot a_{32} =$

A. -10 **B.** -3 **C.** 0 **D.** 10

3. If $A = [a_{ij}]_{3\times 3}$ with $a_{ij} = 3i - 2j$, then $a_{13} =$

A. -2 **B.** 7 **C.** -3 **D.** 3

4. In an upper triangular matrix of order 4, the number of elements that must be zero is

A. 4 **B.** 6 **C.** 10 **D.** 12

5. The matrix $\begin{bmatrix} -3 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & -5 \end{bmatrix}$ is

A. an identity matrix **B.** a null matrix

C. a scalar matrix **D.** a diagonal matrix

6. If $\operatorname{tr}(A) = -8$ and $\operatorname{tr}(B) = -5$, then $\operatorname{tr}(4A - 2B) =$

A. 320 **B.** -22 **C.** -3 **D.** -42

7. $\operatorname{tr}(5I_3) =$

A. 5 **B.** 3 **C.** 15 **D.** 45

8. If $\begin{bmatrix} x - y & 6 \\ x + 2y & 7 \end{bmatrix} = \begin{bmatrix} 4 & 6 \\ -14 & 7 \end{bmatrix}$, then $x + y =$

A. -8 **B.** -4 **C.** 4 **D.** 8

9. If $A = \begin{bmatrix} -5 & -3 \\ -3 & 7 \end{bmatrix}$ and $B = \begin{bmatrix} 7 & -2 \\ 6 & -3 \end{bmatrix}$, then $4A - 3B =$

A. $\begin{bmatrix} -27 & -10 \\ -18 & 31 \end{bmatrix}$ **B.** $\begin{bmatrix} -41 & -6 \\ -30 & 37 \end{bmatrix}$

C. $\begin{bmatrix} -43 & -1 \\ -33 & 33 \end{bmatrix}$ **D.** $\begin{bmatrix} 1 & -18 \\ 6 & 19 \end{bmatrix}$

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10. If $A = \begin{bmatrix} 4 & -2 \\ 2 & -3 \end{bmatrix}$ and $B = \begin{bmatrix} -2 & 7 \\ 3 & 5 \end{bmatrix}$, the element in row 2, column 1 of $2A + 3B$ is

A. 13 **B.** 5 **C.** 17 **D.** -5

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11. If A is a 4×5 matrix and B is a 5×2 matrix, the order of AB is

A. 4×2 **B.** 5×5 **C.** 4×5 **D.** 2×4

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12. If $A = \begin{bmatrix} 1 & 5 & 5 \\ 5 & 4 & -2 \end{bmatrix}$ and $B = \begin{bmatrix} -4 & 4 \\ -4 & -1 \\ -1 & 0 \end{bmatrix}$, the $(1,2)$ element of AB is

A. 14 **B.** -4 **C.** -1 **D.** -34

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13. If $A = \begin{bmatrix} 1 & 4 \\ 0 & 1 \end{bmatrix}$, then $A^6 =$

A. $\begin{bmatrix} 1 & 20 \\ 0 & 1 \end{bmatrix}$ **B.** $\begin{bmatrix} 6 & 24 \\ 0 & 6 \end{bmatrix}$

C. $\begin{bmatrix} 1 & 4096 \\ 0 & 1 \end{bmatrix}$ **D.** $\begin{bmatrix} 1 & 24 \\ 0 & 1 \end{bmatrix}$

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14. If $A = \begin{bmatrix} 5 & 0 \\ 0 & 5 \end{bmatrix}$, then $A^5 =$

A. $\begin{bmatrix} 10 & 0 \\ 0 & 10 \end{bmatrix}$ **B.** $\begin{bmatrix} 3125 & 0 \\ 0 & 3125 \end{bmatrix}$

C. $\begin{bmatrix} 625 & 0 \\ 0 & 625 \end{bmatrix}$ **D.** $\begin{bmatrix} 25 & 0 \\ 0 & 25 \end{bmatrix}$

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15. If A is 5×4 and B is 4×3, the order of $(AB)^T$ is

A. 4×5 **B.** 5×3 **C.** 3×4 **D.** 3×5

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16. If $A = \begin{bmatrix} 5 & -6 \\ -5 & 7 \end{bmatrix}$, then $A + A^T =$

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

C. $\begin{bmatrix} 10 & -11 \\ -11 & 14 \end{bmatrix}$ **D.** $\begin{bmatrix} 10 & -12 \\ -10 & 14 \end{bmatrix}$

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17. If A is a skew-symmetric matrix, then A^{16} is

A. skew-symmetric **B.** symmetric

C. an identity matrix **D.** a null matrix

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18. If $A = \begin{bmatrix} 0 & -1 \\ -4 & 6 \end{bmatrix}$ is written as $P + Q$ with P symmetric and Q skew-symmetric, then $Q =$

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

B. $\begin{bmatrix} 0 & -\frac{5}{2} \\ -\frac{5}{2} & 6 \end{bmatrix}$

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

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

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19. If $\begin{bmatrix} \frac{24}{25} & x \\ -\frac{7}{25} & \frac{24}{25} \end{bmatrix}$ is orthogonal, then $x =$

A. $-\frac{24}{25}$ **B.** $\frac{7}{25}$ **C.** $\frac{24}{25}$ **D.** $-\frac{7}{25}$

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20. If $k \begin{bmatrix} -12 & 6 & -4 \\ -4 & -12 & -6 \\ 6 & 4 & -12 \end{bmatrix}$ is orthogonal and $k > 0$, then $k =$

A. $\frac{1}{14}$ **B.** 14 **C.** $\frac{1}{42}$ **D.** $\frac{1}{196}$

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21. If A is involutory and $(I + A)^6 = k(I + A)$, then $k =$

A. 6 **B.** 32 **C.** 64 **D.** 63

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22. The matrix $\begin{bmatrix} 3 & -1 \\ 6 & -2 \end{bmatrix}$ is

A. nilpotent of index 2

B. orthogonal

C. involutory

D. idempotent

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23. If $\begin{bmatrix} 1 & -8 + yi \\ x - 9i & 5 \end{bmatrix}$ is Hermitian, then $x + y =$

A. 1 **B.** -17 **C.** -1 **D.** 17

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24. If $A = \begin{bmatrix} 5i - 5 & 3 - 2i \\ -2 - 5i & 3 + 4i \end{bmatrix}$, then $A^\theta =$

A. $\begin{bmatrix} 5i - 5 & -2 - 5i \\ 3 - 2i & 3 + 4i \end{bmatrix}$

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

C. $\begin{bmatrix} -5 - 5i & 5i - 2 \\ 3 + 2i & 3 - 4i \end{bmatrix}$

D. $\begin{bmatrix} -5 - 5i & 3 + 2i \\ 5i - 2 & 3 - 4i \end{bmatrix}$

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25. If $A = \begin{bmatrix} -5 & 3 \\ -4 & -4 \end{bmatrix}$ satisfies $A^2 - kA + lI = O$, then $k + l =$

A. -41 **B.** 41 **C.** -1 **D.** 23

Key sheet

1. C	**2.** A	**3.** C	**4.** B	**5.** D
6. B	**7.** C	**8.** A	**9.** B	**10.** A
11. A	**12.** C	**13.** D	**14.** B	**15.** D
16. C	**17.** B	**18.** D	**19.** B	**20.** A
21. B	**22.** D	**23.** A	**24.** C	**25.** D

Solutions

1. The number of possible orders of a matrix with 14 elements is

An $m \times n$ matrix has $mn = 14$ elements, so m can be any divisor of 14.

14 has 4 divisors, so there are 4 orders.

Ans: (C) 4

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2. If $A = \begin{bmatrix} -6 & 7 & -5 \\ -4 & 0 & -5 \\ 6 & 2 & 3 \end{bmatrix}$, then $a_{23} \cdot a_{32} =$

$a_{23} = -5,\ a_{32} = 2$

Product $= -10$

Ans: (A) -10

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3. If $A = [a_{ij}]_{3\times 3}$ with $a_{ij} = 3i - 2j$, then $a_{13} =$

Put $i = 1$, $j = 3$ in $a_{ij} = 3i - 2j$.

$a_{13} = -3$

Ans: (C) -3

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4. In an upper triangular matrix of order 4, the number of elements that must be zero is

The elements below the principal diagonal ($i > j$) must be zero.

$1 + 2 + \cdots + 3 = \frac{4 \cdot 3}{2} = 6$

Ans: (B) 6

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5. The matrix $\begin{bmatrix} -3 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & -5 \end{bmatrix}$ is

Look at the elements off the principal diagonal and on it.

It is a diagonal matrix.

Ans: (D) a diagonal matrix

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6. If $\operatorname{tr}(A) = -8$ and $\operatorname{tr}(B) = -5$, then $\operatorname{tr}(4A - 2B) =$

$\operatorname{tr}(4A - 2B) = 4\operatorname{tr}(A) - 2\operatorname{tr}(B)$

$= 4(-8) - 2(-5) = -22$

Ans: (B) -22

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7. $\operatorname{tr}(5I_3) =$

$\operatorname{tr}(I_3) = 3$

$\operatorname{tr}(5I_3) = 5 \times 3 = 15$

Ans: (C) 15

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8. If $\begin{bmatrix} x-y & 6 \\ x+2y & 7 \end{bmatrix} = \begin{bmatrix} 4 & 6 \\ -14 & 7 \end{bmatrix}$, then $x+y=$

$x-y=4,\ x+2y=-14$

So $x=-2$, $y=-6$ and $x+y=-8$.

Ans: (A) -8

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9. If $A=\begin{bmatrix} -5 & -3 \\ -3 & 7 \end{bmatrix}$ and $B=\begin{bmatrix} 7 & -2 \\ 6 & -3 \end{bmatrix}$, then $4A-3B=$

$4A-3B=\begin{bmatrix} -20 & -12 \\ -12 & 28 \end{bmatrix}-\begin{bmatrix} 21 & -6 \\ 18 & -9 \end{bmatrix}$

$=\begin{bmatrix} -41 & -6 \\ -30 & 37 \end{bmatrix}$

Ans: (B) $\begin{bmatrix} -41 & -6 \\ -30 & 37 \end{bmatrix}$

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10. If $A=\begin{bmatrix} 4 & -2 \\ 2 & -3 \end{bmatrix}$ and $B=\begin{bmatrix} -2 & 7 \\ 3 & 5 \end{bmatrix}$, the element in row 2, column 1 of $2A+3B$ is

$2a_{21}+3b_{21}=2(2)+3(3)$

$=13$

Ans: (A) 13

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11. If A is a 4×5 matrix and B is a 5×2 matrix, the order of AB is

The product of $m\times p$ and $p\times n$ matrices is $m\times n$.

So AB is 4×2.

Ans: (A) 4×2

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12. If $A=\begin{bmatrix} 1 & 5 & 5 \\ 5 & 4 & -2 \end{bmatrix}$ and $B=\begin{bmatrix} -4 & 4 \\ -4 & -1 \\ -1 & 0 \end{bmatrix}$, the $(1,2)$ element of AB is

Row 1 of A times column 2 of B:

$(1)(4)+(5)(-1)+(5)(0)=-1$

Ans: (C) -1

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13. If $A=\begin{bmatrix} 1 & 4 \\ 0 & 1 \end{bmatrix}$, then $A^6=$

$A^2=\begin{bmatrix} 1 & 8 \\ 0 & 1 \end{bmatrix}$, $A^3=\begin{bmatrix} 1 & 12 \\ 0 & 1 \end{bmatrix}$

Each multiplication adds 4 to the top right element, so $A^6=\begin{bmatrix} 1 & 24 \\ 0 & 1 \end{bmatrix}$.

Ans: (D) $\begin{bmatrix} 1 & 24 \\ 0 & 1 \end{bmatrix}$

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14. If $A = \begin{bmatrix} 5 & 0 \\ 0 & 5 \end{bmatrix}$, then $A^5 =$

$A = 5I$

$A^5 = (5)^5 I = \begin{bmatrix} 3125 & 0 \\ 0 & 3125 \end{bmatrix}$

Ans: (B) $\begin{bmatrix} 3125 & 0 \\ 0 & 3125 \end{bmatrix}$

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15. If A is 5×4 and B is 4×3, the order of $(AB)^T$ is

AB is 5×3.

So $(AB)^T = B^T A^T$ is 3×5.

Ans: (D) 3×5

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16. If $A = \begin{bmatrix} 5 & -6 \\ -5 & 7 \end{bmatrix}$, then $A + A^T =$

$A^T = \begin{bmatrix} 5 & -5 \\ -6 & 7 \end{bmatrix}$

$A + A^T = \begin{bmatrix} 10 & -11 \\ -11 & 14 \end{bmatrix}$

It is symmetric, as it must be.

Ans: (C) $\begin{bmatrix} 10 & -11 \\ -11 & 14 \end{bmatrix}$

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17. If A is a skew-symmetric matrix, then A^{16} is

$(A^k)^T = (A^T)^k = (-A)^k = (-1)^k A^k$.

With $k = 16$ (even), A^{16} is symmetric.

Ans: (B) symmetric

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18. If $A = \begin{bmatrix} 0 & -1 \\ -4 & 6 \end{bmatrix}$ is written as $P + Q$ with P symmetric and Q skew-symmetric, then $Q =$

$Q = \frac{1}{2}(A - A^T) = \frac{1}{2} \begin{bmatrix} 0 & 3 \\ -3 & 0 \end{bmatrix}$

$= \begin{bmatrix} 0 & \frac{3}{2} \\ -\frac{3}{2} & 0 \end{bmatrix}$

Ans: (D) $\begin{bmatrix} 0 & \frac{3}{2} \\ -\frac{3}{2} & 0 \end{bmatrix}$

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19. If $\begin{bmatrix} \frac{24}{25} & x \\ -\frac{7}{25} & \frac{24}{25} \end{bmatrix}$ is orthogonal, then $x =$

The two rows must be perpendicular:

$\frac{24}{25}\left(-\frac{7}{25}\right) + x \cdot \frac{24}{25} = 0$

$x = \frac{7}{25}$

Ans: (B) $\frac{7}{25}$

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20. If $k\begin{bmatrix}-12 & 6 & -4\\ -4 & -12 & -6\\ 6 & 4 & -12\end{bmatrix}$ is orthogonal and $k>0$, then $k=$

$(kM)(kM)^T = k^2MM^T = 196k^2I$

$196k^2 = 1 \Rightarrow k = \frac{1}{14}$

Ans: (A) $\frac{1}{14}$

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21. If A is involutory and $(I+A)^6 = k(I+A)$, then $k=$

$(I+A)^2 = I + 2A + A^2 = 2(I+A)$

$(I+A)^6 = 2^5(I+A) = 32(I+A)$

Ans: (B) 32

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22. The matrix $\begin{bmatrix}3 & -1\\ 6 & -2\end{bmatrix}$ is

$A^2 = \begin{bmatrix}3 & -1\\ 6 & -2\end{bmatrix}$

$A^2 = A$, so A is idempotent.

Ans: (D) idempotent

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23. If $\begin{bmatrix}1 & -8+yi\\ x-9i & 5\end{bmatrix}$ is Hermitian, then $x+y=$

Hermitian: $a_{21} = \overline{a_{12}} = -8 - yi$.

$x - 9i = -8 - yi \Rightarrow x = -8,\ y = 9$

$x + y = 1$

Ans: (A) 1

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24. If $A = \begin{bmatrix}5i-5 & 3-2i\\ -2-5i & 3+4i\end{bmatrix}$, then $A^\theta =$

$A^\theta = (\bar{A})^T$

$= \begin{bmatrix}-5-5i & 5i-2\\ 3+2i & 3-4i\end{bmatrix}$

Ans: (C) $\begin{bmatrix}-5-5i & 5i-2\\ 3+2i & 3-4i\end{bmatrix}$

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25. If $A = \begin{bmatrix}-5 & 3\\ -4 & -4\end{bmatrix}$ satisfies $A^2 - kA + lI = O$, then $k+l=$

$k = a + d = -9,\ l = ad - bc = 32$

$k + l = 23$

Ans: (D) 23
