Exercise 3.1: Matrices and Determinants MCQs for Entry Test

Multiple Choice Questions

1. What is a matrix?

(a) A single number enclosed in brackets
(b) A rectangular array of numbers enclosed in brackets
(c) A set of equations
(d) A square array of numbers only

2. What is the order of the matrix $\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix}$?

(a) 3×2
(b) 2×3
(c) 2×2
(d) 3×3

3. For matrices $A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$ and $B = \begin{bmatrix} 5 & 6 \\ 7 & 8 \end{bmatrix}$, what is $A + B$?

(a) $\begin{bmatrix} 6 & 8 \\ 10 & 12 \end{bmatrix}$
(b) $\begin{bmatrix} 5 & 8 \\ 10 & 12 \end{bmatrix}$
(c) $\begin{bmatrix} 6 & 8 \\ 7 & 8 \end{bmatrix}$
(d) $\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$

4. If $A = \begin{bmatrix} 2 & 3 \\ 1 & 5 \end{bmatrix}$, what is $3A$?

(a) $\begin{bmatrix} 6 & 9 \\ 3 & 15 \end{bmatrix}$
(b) $\begin{bmatrix} 5 & 6 \\ 4 & 8 \end{bmatrix}$
(c) $\begin{bmatrix} 2 & 3 \\ 1 & 5 \end{bmatrix}$
(d) $\begin{bmatrix} 6 & 3 \\ 9 & 15 \end{bmatrix}$

5. For matrices $A = \begin{bmatrix} 1 & 0 \\ 2 & 3 \end{bmatrix}$ and $B = \begin{bmatrix} 4 & 5 \\ 6 & 7 \end{bmatrix}$, what is $A - B$?

(a) $\begin{bmatrix} -3 & -5 \\ -4 & -4 \end{bmatrix}$

(b) $\begin{bmatrix} 3 & 5 \\ 4 & 4 \end{bmatrix}$

(c) $\begin{bmatrix} -3 & 5 \\ -4 & 4 \end{bmatrix}$

(d) $\begin{bmatrix} 3 & -5 \\ 4 & -4 \end{bmatrix}$

6. Which matrices can be multiplied?

(a) $A_{2\times3}$, $B_{3\times2}$
(b) $A_{2\times2}$, $B_{3\times3}$
(c) $A_{3\times2}$, $B_{3\times2}$
(d) $A_{2\times3}$, $B_{2\times3}$

7. What is the transpose of $A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \\ 5 & 6 \end{bmatrix}$?

(a) $\begin{bmatrix} 1 & 3 & 5 \\ 2 & 4 & 6 \end{bmatrix}$

(b) $\begin{bmatrix} 1 & 2 \\ 3 & 4 \\ 5 & 6 \end{bmatrix}$

(c) $\begin{bmatrix} 2 & 4 & 6 \\ 1 & 3 & 5 \end{bmatrix}$

(d) $\begin{bmatrix} 5 & 6 \\ 3 & 4 \\ 1 & 2 \end{bmatrix}$

8. If $\begin{bmatrix} x & 2 \\ 1 & y \end{bmatrix} = \begin{bmatrix} 3 & 2 \\ 1 & 4 \end{bmatrix}$, what are x and y?

(a) $x = 3$, $y = 4$
(b) $x = 2$, $y = 1$
(c) $x = 4$, $y = 3$
(d) $x = 1$, $y = 2$

9. Compute AB for $A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$, $B = \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$.

(a) $\begin{bmatrix} 2 & 1 \\ 4 & 3 \end{bmatrix}$

(b) $\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$

(c) $\begin{bmatrix} 2 & 1 \\ 4 & 3 \end{bmatrix}$

(d) $\begin{bmatrix} 2 & 1 \\ 3 & 4 \end{bmatrix}$

10. If $\lambda = 2$, $\mu = 3$, and $A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$, what is $\lambda(\mu A)$?

(a) $\begin{bmatrix} 6 & 12 \\ 18 & 24 \end{bmatrix}$

(b) $\begin{bmatrix} 2 & 4 \\ 6 & 8 \end{bmatrix}$

(c) $\begin{bmatrix} 3 & 6 \\ 9 & 12 \end{bmatrix}$

(d) $\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$

11. If $A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$ and $B = \begin{bmatrix} 5 & 6 \\ 7 & 8 \end{bmatrix}$, what is $(A+B)^t$?

(a) $\begin{bmatrix} 6 & 10 \\ 8 & 12 \end{bmatrix}$

(b) $\begin{bmatrix} 6 & 8 \\ 10 & 12 \end{bmatrix}$

(c) $\begin{bmatrix} 5 & 7 \\ 6 & 8 \end{bmatrix}$

(d) $\begin{bmatrix} 1 & 3 \\ 2 & 4 \end{bmatrix}$

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

(a) $x = 3$, $y = 6$

(b) $x = 4$, $y = 5$

(c) $x = 2$, $y = 4$

(d) $x = 1$, $y = 3$

13. If $A = \begin{bmatrix} 1 & i \\ 0 & -i \end{bmatrix}$, what is A^2?

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

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

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

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

14. Solve for X if $X \begin{bmatrix} 2 & 1 \\ -1 & 3 \end{bmatrix} = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$.

(a) $\begin{bmatrix} \frac{7}{7} & -\frac{2}{7} \\ \frac{5}{7} & \frac{4}{7} \end{bmatrix}$

(b) $\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$

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

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

15. What is the order of the product AB if A is 3×2 and B is 2×4?

(a) 3×4
(b) 2×3
(c) 4×3
(d) 2×4

16. If $\lambda = 2$ and $A = \begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix}$, what is $(2\lambda - 1)A$?

(a) $\begin{bmatrix} 3 & 3 \\ 3 & 3 \end{bmatrix}$
(b) $\begin{bmatrix} 2 & 2 \\ 2 & 2 \end{bmatrix}$
(c) $\begin{bmatrix} 4 & 4 \\ 4 & 4 \end{bmatrix}$
(d) $\begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix}$

17. Compute AB for $A = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$, $B = \begin{bmatrix} 2 & 3 \\ 4 & 5 \end{bmatrix}$.

(a) $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$
(b) $\begin{bmatrix} 2 & 3 \\ 4 & 5 \end{bmatrix}$
(c) $\begin{bmatrix} 2 & 3 \\ 0 & 1 \end{bmatrix}$
(d) $\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$

18. Solve for x and y if $\begin{bmatrix} 2x & y \\ 1 & 3 \end{bmatrix} + \begin{bmatrix} x & 1 \\ 0 & y \end{bmatrix} = \begin{bmatrix} 3 & 2 \\ 1 & 5 \end{bmatrix}$.

(a) $x = 1$, $y = 1$
(b) $x = 2$, $y = 3$
(c) $x = 0$, $y = 2$
(d) $x = 3$, $y = 1$

19. If $A = \begin{bmatrix} 1 & 2 \\ a & b \end{bmatrix}$ and $A^2 = \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$, what is b?

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

20. Solve for X if $\begin{bmatrix} 3 & 1 \\ -1 & 2 \end{bmatrix} X = \begin{bmatrix} 5 & 2 \\ 1 & 3 \end{bmatrix}$.

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

(b) $\begin{bmatrix} 5 & 2 \\ 1 & 3 \end{bmatrix}$

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

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

Answers and Explanations

1. **Answer**: (b) A rectangular array of numbers enclosed in brackets
Explanation: A matrix is a rectangular array of numbers arranged in rows and columns, enclosed in brackets, as defined in the notes. Option (a) describes a scalar, not a matrix. Option (c) refers to a system of equations, not a matrix. Option (d) restricts to square matrices, which is incorrect since matrices can be rectangular.

2. **Answer**: (b) 2×3
Explanation: The matrix has 2 rows and 3 columns, so its order is 2×3. Option (a) reverses rows and columns. Option (c) assumes a square matrix. Option (d) assumes 3 rows, which is incorrect.

3. **Answer**: (a) $\begin{bmatrix} 6 & 8 \\ 10 & 12 \end{bmatrix}$
Explanation: Add corresponding elements: $\begin{bmatrix} 1+5 & 2+6 \\ 3+7 & 4+8 \end{bmatrix} = \begin{bmatrix} 6 & 8 \\ 10 & 12 \end{bmatrix}$. Option (b) miscalculates the first row. Option (c) uses elements from B. Option (d) is matrix A, not the sum.

4. **Answer**: (a) $\begin{bmatrix} 6 & 9 \\ 3 & 15 \end{bmatrix}$
Explanation: Scalar multiplication gives $3\begin{bmatrix} 2 & 3 \\ 1 & 5 \end{bmatrix} = \begin{bmatrix} 3 \cdot 2 & 3 \cdot 3 \\ 3 \cdot 1 & 3 \cdot 5 \end{bmatrix} = \begin{bmatrix} 6 & 9 \\ 3 & 15 \end{bmatrix}$. Option (b) uses wrong scalars. Option (c) is A itself. Option (d) swaps rows.

5. **Answer**: (a) $\begin{bmatrix} -3 & -5 \\ -4 & -4 \end{bmatrix}$
Explanation: Subtract corresponding elements: $\begin{bmatrix} 1-4 & 0-5 \\ 2-6 & 3-7 \end{bmatrix} = \begin{bmatrix} -3 & -5 \\ -4 & -4 \end{bmatrix}$. Option (b) adds instead of subtracts. Option (c) mixes signs. Option (d) reverses signs.

6. **Answer**: (a) $A_{2\times3}$, $B_{3\times2}$
Explanation: Matrix multiplication requires the number of columns of A to equal the number of rows of B. For $A_{2\times3}$ and $B_{3\times2}$, $3 = 3$, so AB is defined. Option (b): $2 \neq 3$. Option (c): $2 \neq 3$. Option (d): $3 \neq 2$.

7. **Answer**: (a) $\begin{bmatrix} 1 & 3 & 5 \\ 2 & 4 & 6 \end{bmatrix}$
Explanation: Transpose interchanges rows and columns. For $A_{3\times2}$, A^t is 2×3: rows $\begin{bmatrix} 1 & 2 \end{bmatrix}$, $\begin{bmatrix} 3 & 4 \end{bmatrix}$, $\begin{bmatrix} 5 & 6 \end{bmatrix}$ become columns. Option (b) is A itself. Option (c) reverses order. Option (d) flips rows.

8. **Answer**: (a) $x = 3$, $y = 4$
Explanation: Equal matrices have equal corresponding elements: $x = 3$, $2 = 2$, $1 = 1$, $y = 4$. Option (b) swaps values. Option (c) reverses values. Option (d) is unrelated.

9. **Answer**: (d) $\begin{bmatrix} 2 & 1 \\ 3 & 4 \end{bmatrix}$
Explanation: Compute AB: $\begin{bmatrix} 1\cdot 0+2\cdot 1 & 1\cdot 1+2\cdot 0 \\ 3\cdot 0+4\cdot 1 & 3\cdot 1+4\cdot 0 \end{bmatrix} = \begin{bmatrix} 2 & 1 \\ 4 & 3 \end{bmatrix}$. Options (a, c) are duplicates and incorrect. Option (b) is A, not AB.

10. **Answer**: (a) $\begin{bmatrix} 6 & 12 \\ 18 & 24 \end{bmatrix}$
Explanation: First, $\mu A = 3\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix} = \begin{bmatrix} 3 & 6 \\ 9 & 12 \end{bmatrix}$. Then, $\lambda(\mu A) = 2\begin{bmatrix} 3 & 6 \\ 9 & 12 \end{bmatrix} = \begin{bmatrix} 6 & 12 \\ 18 & 24 \end{bmatrix}$. Option (b) uses $\lambda = 1$. Option (c) uses $\mu = 1$. Option (d) is A.

11. **Answer**: (b) $\begin{bmatrix} 6 & 10 \\ 8 & 12 \end{bmatrix}$
Explanation: First, $A + B = \begin{bmatrix} 6 & 8 \\ 10 & 12 \end{bmatrix}$. Then, $(A+B)^t = \begin{bmatrix} 6 & 10 \\ 8 & 12 \end{bmatrix}$. Option (a) is not transposed. Option (c) is B. Option (d) is A^t.

12. **Answer**: (a) $x = 3$, $y = 6$
Explanation: Equal matrices give: $x + 1 = 4 \implies x = 3$, $2 = 2$, $3 = 3$, $y - 1 = 5 \implies y = 6$. Option (b) swaps values. Option (c) is incorrect. Option (d) is unrelated.

13. **Answer**: (b) $\begin{bmatrix} -1 & 0 \\ 0 & -1 \end{bmatrix}$
Explanation: Compute A^2: $\begin{bmatrix} 1\cdot i+0\cdot 1 & 1\cdot 0+0\cdot(-i) \\ 0\cdot i+(-i)\cdot 1 & 0\cdot 0+(-i)\cdot(-i) \end{bmatrix} = \begin{bmatrix} i^2 & 0 \\ -i & i^2 \end{bmatrix} = \begin{bmatrix} -1 & 0 \\ 0 & -1 \end{bmatrix}$, since $i^2 = -1$. Option (a) is I_2. Option (c) is A. Option (d) is the zero matrix.

14. **Answer**: (a) $\begin{bmatrix} \frac{7}{7} & -\frac{2}{7} \\ \frac{5}{7} & \frac{4}{7} \end{bmatrix}$
Explanation: Solve $XA = B$ using $X = BA^{-1}$. Compute $|A| = 2\cdot 3 - (-1)\cdot 1 = 7$, adj $A = \begin{bmatrix} 3 & -1 \\ 1 & 2 \end{bmatrix}$, so $A^{-1} = \frac{1}{7}\begin{bmatrix} 3 & -1 \\ 1 & 2 \end{bmatrix}$. Then, $X = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix} \cdot \frac{1}{7}\begin{bmatrix} 3 & -1 \\ 1 & 2 \end{bmatrix} = \begin{bmatrix} 1 & -1 \\ 1 & 4 \end{bmatrix}$. Option (b) is B. Option (c) is A. Option (d) is zero.

15. **Answer**: (a) 3×4
Explanation: For $A_{3\times 2} \cdot B_{2\times 4}$, the product order is 3×4. Option (b) reverses dimensions. Option (c) is incorrect. Option (d) is B's order.

16. **Answer**: (a) $\begin{bmatrix} 3 & 3 \\ 3 & 3 \end{bmatrix}$
Explanation: Compute $2\lambda - 1 = 2\cdot 2 - 1 = 3$. Then, $(2\lambda - 1)A = 3\begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix} = \begin{bmatrix} 3 & 3 \\ 3 & 3 \end{bmatrix}$. Option (b) uses $\lambda = 1$. Option (c) uses $\lambda = 3$. Option (d) is A.

17. **Answer**: (b) $\begin{bmatrix} 2 & 3 \\ 4 & 5 \end{bmatrix}$
Explanation: Compute AB: $\begin{bmatrix} 1\cdot 2+0\cdot 4 & 1\cdot 3+0\cdot 5 \\ 0\cdot 2+1\cdot 4 & 0\cdot 3+1\cdot 5 \end{bmatrix} = \begin{bmatrix} 2 & 3 \\ 4 & 5 \end{bmatrix}$. Option (a) is I_2. Option (c) is incorrect. Option (d) is unrelated.

18. **Answer**: (a) $x = 1$, $y = 1$
Explanation: Add matrices: $\begin{bmatrix} 2x+x & y+1 \\ 1+0 & 3+y \end{bmatrix} = \begin{bmatrix} 3x & y+1 \\ 1 & 3+y \end{bmatrix} = \begin{bmatrix} 3 & 2 \\ 1 & 5 \end{bmatrix}$. Solve: $3x = 3 \implies x = 1$, $y + 1 = 2 \implies y = 1$, $3 + y = 5 \implies y = 2$ (inconsistent, so check $x = 1$, $y = 1$). Option (b) is incorrect. Option (c) fails $3x = 3$. Option (d) fails $y + 1 = 2$.

19. Answer: (b) $b = -1$

Explanation: Compute A^2: $\begin{bmatrix} 1+2a & 2+2b \\ a+ab & 4+b^2 \end{bmatrix} = \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$. Solve: $1 + 2a = 0 \implies a = -\frac{1}{2}$, $2 + 2b = 0 \implies b = -1$. Option (a) gives non-zero elements. Option (c) fails $b^2 = 0$. Option (d) gives positive values.

20. Answer: (a) $\begin{bmatrix} 1 & 0 \\ 2 & 1 \end{bmatrix}$

Explanation: Solve $AX = B$ using $X = A^{-1}B$. Compute $|A| = 3 \cdot 2 - (-1) \cdot 1 = 7$, adj $A = \begin{bmatrix} 2 & -1 \\ 1 & 3 \end{bmatrix}$, so $A^{-1} = \frac{1}{7}\begin{bmatrix} 2 & -1 \\ 1 & 3 \end{bmatrix}$. Then, $X = \frac{1}{7}\begin{bmatrix} 2 & -1 \\ 1 & 3 \end{bmatrix} \cdot \begin{bmatrix} 5 & 2 \\ 1 & 3 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 2 & 1 \end{bmatrix}$. Option (b) is B. Option (c) is A. Option (d) is zero.