Multiple Choice Questions: Matrices and Determinants

Exercise 3.3 (Class 11 Mathematics)

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MCQs

1. Evaluate the determinant $\begin{vmatrix} 2 & 1 & 0 \\ 1 & 1 & 0 \\ 0 & 0 & 1 \end{vmatrix}$.

(a) 1

(b) 2

(c) 3

(d) 0

2. Without expansion, show that $\begin{vmatrix} 1 & 2 & 3 \\ 2 & 4 & 6 \\ 3 & 6 & 9 \end{vmatrix}$ equals:

(a) 0

(b) 1

(c) 6

(d) 9

3. If $\begin{vmatrix} a & b & c \\ b & c & a \\ c & a & b \end{vmatrix} = 0$, what is a possible relation among a, b, c?

(a) $a + b + c = 0$

(b) $a = b = c$

(c) $a^2 + b^2 + c^2 = 0$

(d) No relation exists

4. The determinant $\begin{vmatrix} a+l & a & a \\ a & a+l & a \\ a & a & a+l \end{vmatrix}$ equals:

(a) $l^2(3a + l)$

(b) $l^3(3a + l)$

(c) $a^2(3l + a)$

(d) $a^3(3l + a)$

5. For a 3x3 matrix A, if $|kA| = 27|A|$, what is the value of k^3?

(a) 9
(b) 27
(c) 3
(d) 81

6. The determinant $\begin{vmatrix} 1 & 1 & 1 \\ x & y & z \\ yz & zx & xy \end{vmatrix}$ is equal to:

(a) $(x-y)(y-z)(z-x)$
(b) $(x+y)(y+z)(z+x)$
(c) $(x-y)(y-z)(z-x)/xyz$
(d) $(x+y+z)(x-y)(y-z)$

7. If A is a singular matrix, what is $|A|$?

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

8. Find λ such that $\begin{vmatrix} 1 & \lambda & 2 \\ 2 & 3 & 1 \\ 3 & 2 & 1 \end{vmatrix} = 0$.

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

9. The determinant $\begin{vmatrix} b+c & a & a \\ b & c+a & b \\ c & c & a+b \end{vmatrix}$ equals:

(a) abc
(b) $2abc$
(c) $3abc$
(d) $4abc$

10. For matrices A and B, if $(AB)^{-1}$ exists, it equals:

(a) $A^{-1}B^{-1}$
(b) $B^{-1}A^{-1}$
(c) AB^{-1}
(d) BA^{-1}

11. The determinant $\begin{vmatrix} a & b+c & a+b \\ b & c+a & b+c \\ c & a+b & c+a \end{vmatrix}$ equals:

(a) $a^3+b^3+c^3$

(b) $a^3+b^3+c^3-3abc$

(c) $a^3+b^3+c^3+3abc$

(d) $a^3+b^3+c^3-abc$

12. If $A = \begin{bmatrix} 2 & 1 \\ 1 & 1 \end{bmatrix}$, what is $|A|$?

(a) 1

(b) 2

(c) 3

(d) 4

13. The determinant $\begin{vmatrix} r\cos\phi & 1 & -\sin\phi \\ 0 & 1 & 0 \\ r\sin\phi & 0 & \cos\phi \end{vmatrix}$ equals:

(a) r

(b) r^2

(c) $\cos\phi$

(d) $\sin\phi$

14. If $A^tA = 0$, what can be said about A?

(a) A is non-singular

(b) A is singular

(c) A is symmetric

(d) A is invertible

15. The determinant $\begin{vmatrix} 1 & 1 & 1 \\ a & b & c \\ a^2 & b^2 & c^2 \end{vmatrix}$ equals:

(a) $(a-b)(b-c)(c-a)$

(b) $(a+b)(b+c)(c+a)$

(c) $(a-b)(b-c)(c-a)/abc$

(d) $(a+b+c)(a-b)(b-c)$

16. For a matrix A, if $(A^{-1})^t = (A^t)^{-1}$, this property holds for:

(a) Only 2x2 matrices

(b) Only singular matrices

(c) All square matrices

(d) Only non-singular matrices

17. The determinant $\begin{vmatrix} a+\lambda & b & c \\ a & b+\lambda & c \\ a & b & c+\lambda \end{vmatrix}$ equals:

(a) $\lambda^2(a+b+c+\lambda)$
(b) $\lambda^3(a+b+c+\lambda)$
(c) $\lambda(a+b+c+\lambda)$
(d) $\lambda^2(a+b+c)$

18. If A is a 3x3 matrix and $|A| = 4$, what is $|2A|$?

(a) 8
(b) 16
(c) 32
(d) 64

19. The determinant $\begin{vmatrix} b & -1 & a \\ a & b & 0 \\ 1 & a & b \end{vmatrix}$ equals:

(a) $a^3 + b^3$
(b) $a^3 - b^3$
(c) $a^2 + b^2$
(d) $a^2 - b^2$

20. If A and B are non-singular, then $(A^{-1})^{-1}$ equals:

(a) A
(b) A^{-1}
(c) B
(d) B^{-1}

Answers and Explanations

1. **Answer: b**
   Expand by third column: $1 \cdot \begin{vmatrix} 2 & 1 \\ 1 & 1 \end{vmatrix} = 1 \cdot (2-1) = 1 \cdot 1 = 1$. Incorrect options miscalculate or assume zero.

2. **Answer: a**
   Rows are proportional ($R_2 = 2R_1$, $R_3 = 3R_1$), so determinant is zero. Other options assume non-zero values.

3. **Answer: a**
   Determinant is zero if $a+b+c=0$ (sum of rows equals zero vector). Other options do not satisfy.

4. **Answer: a**
   As per PDF Q3(iii), $\begin{vmatrix} a+l & a & a \\ a & a+l & a \\ a & a & a+l \end{vmatrix} = l^2(3a+l)$. Others are incorrect simplifications.

5. **Answer: b**
   For 3x3 matrix, $|kA| = k^3|A|$. Given $|kA| = 27|A|$, $k^3 = 27$. Other options miscalculate k.

6. **Answer: a**
   As per PDF Q3(iv), equals $\begin{vmatrix} 1 & 1 & 1 \\ x & y & z \\ x^2 & y^2 & z^2 \end{vmatrix} = (x-y)(y-z)(z-x)$. Others are incorrect.

7. **Answer: a**
   Singular matrix has $|A| = 0$. Other options apply to non-singular matrices.

8. **Answer: c**
   Set determinant to zero: $1(3 \cdot 1 - 2 \cdot 1) - \lambda(2 \cdot 1 - 3 \cdot 1) + 2(2 \cdot 2 - 3 \cdot 3) = 1 - \lambda(-1) + 2(-5) = 0 \implies \lambda = 3$.

9. **Answer: d**
   As per PDF Q3(v), determinant equals $4abc$. Other options are incorrect reductions.

10. **Answer: b**
    As per PDF Q17(i), $(AB)^{-1} = B^{-1}A^{-1}$. Other options reverse order or misapply.

11. **Answer: b**
    As per PDF Q3(viii), equals $a^3+b^3+c^3-3abc$. Others include incorrect terms.

12. **Answer: a**
    $|A| = 2 \cdot 1 - 1 \cdot 1 = 2 - 1 = 1$. Others miscalculate.

13. **Answer: a**
    As per PDF Q3(vii), equals $r(\cos^2\phi + \sin^2\phi) = r$. Others are incorrect.

14. **Answer: b**
    If $A^tA = 0$, $|A^tA| = |A|^2 = 0 \implies |A| = 0$, so A is singular. Others are false.

15. **Answer: a**
    As per PDF Q3(x), equals $(a-b)(b-c)(c-a)$. Others include incorrect factors.

16. **Answer: c**
    As per PDF Q16, $(A^{-1})^t = (A^t)^{-1}$ holds for all square matrices. Others are too restrictive.

17. **Answer: a**
    As per PDF Q3(ix), equals $\lambda^2(a+b+c+\lambda)$. Others misapply λ terms.

18. **Answer: d**
    For 3x3 matrix, $|2A| = 2^3|A| = 8 \cdot 4 = 64$. Others miscalculate scalar factor.

19. **Answer: a**
    As per PDF Q3(vi), equals $a^3 + b^3$. Others are incorrect identities.

20. **Answer: a**
    As per PDF Q17(ii), $(A^{-1})^{-1} = A$. Others misapply inverse properties.