

Matrices and Systems of Equations: math test solutions, Grade 12 – download the PDF

Test solutions with the detailed point scale. Add up your points and spot what to review.

Suggested time: 45 minutes. Out of 20 points. Calculator allowed only when the problem says so.

1 Operations

/ 3 pts

$$2P = \begin{bmatrix} 8 & -2 \\ 4 & 0 \end{bmatrix}, \text{ so } 2P - Q = \begin{bmatrix} 5 & -7 \\ 6 & -1 \end{bmatrix} \text{ (1 pt).}$$

$$PQ = \begin{bmatrix} 4(3) + (-1)(-2) & 4(5) + (-1)(1) \\ 2(3) + 0 & 2(5) + 0 \end{bmatrix} = \begin{bmatrix} 14 & 19 \\ 6 & 10 \end{bmatrix} \text{ (2 pts).}$$

2 Determinants

/ 3 pts

(a) $7(1) - 3(2) = 1$ (1 pt).

(b) $1(1 \cdot 4 - (-1)(2)) - 0 + 2(3 \cdot 2 - 1 \cdot 0) = 6 + 12 = 18$ (2 pts).

3 Inverse and system

/ 3 pts

(a) $\det M = 15 - 14 = 1$, so $M^{-1} = \begin{bmatrix} 3 & -2 \\ -7 & 5 \end{bmatrix}$ (2 pts).

(b) $\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 3 & -2 \\ -7 & 5 \end{bmatrix} \begin{bmatrix} 4 \\ 9 \end{bmatrix} = \begin{bmatrix} 12 - 18 \\ -28 + 45 \end{bmatrix} = \begin{bmatrix} -6 \\ 17 \end{bmatrix}$ (1 pt).

4 Gaussian elimination

/ 4 pts

Rows: $(1, 2, 1 \mid 4)$, $(2, -1, 3 \mid -3)$, $(3, 1, -1 \mid 6)$.

$R_2 - 2R_1 = (0, -5, 1 \mid -11)$ and $R_3 - 3R_1 = (0, -5, -4 \mid -6)$ (2 pts).

$R_3 - R_2 = (0, 0, -5 \mid 5)$, so $z = -1$ (1 pt). Then $-5y - 1 = -11$ gives $y = 2$, and $x = 4 - 4 + 1 = 1$. Solution: $(1, 2, -1)$ (1 pt).

5 Cramer's Rule

/ 3 pts

$D = 3(-1) - 2(5) = -13$ (1 pt).

$D_x = 3(-1) - 2(-8) = 13$, so $x = -1$ (1 pt). $D_y = 3(-8) - 3(5) = -39$, so $y = 3$ (1 pt).

6 A transformation of a square

/ 4 pts

(a) $(x, y) \rightarrow (x + 2y, y)$: $O' = (0, 0)$, $A' = (2, 0)$, $B' = (6, 2)$, $C' = (4, 2)$ (2 pts).

(b) The area of the square is 4 and $\det S = 1$, so the image area is $|1| \cdot 4 = 4$ (2 pts).



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