TRINITY COLLEGE

Year 11 Mathematics Specialist
Test 5 2019

Calculator Free

Matrices

STUDENT'S NAME _____

DATE: Monday 26 August **TIME:** 15 minutes **MARKS**: 18

INSTRUCTIONS:

Standard Items: Pens, pencils, drawing templates, eraser

Questions or parts of questions worth more than 2 marks require working to be shown to receive full marks.

---

1. (5 marks)

Determine the 2×2 transformation matrix representing:

(a) a 45° anticlockwise rotation about the origin [2]

(b) a reflection in the line $y = \sqrt{3}\,x$ [3]

2. (3 marks)

For what value(s) of k is the matrix $\begin{bmatrix} 2k & 4 \\ 16 & k-4 \end{bmatrix}$ singular?

3. (3 marks)

All points on the line $y = 2x - 3$ are transformed by $\begin{bmatrix} 1 & 2 \\ 1 & 0 \end{bmatrix}$. Determine the equation of the image line.

4. (7 marks)

Given $A = \begin{bmatrix} 3 & -2 \\ 1 & -1 \end{bmatrix}$ and $B = \begin{bmatrix} -1 & 1 \\ -2 & 4 \end{bmatrix}$

Use the matrices shown above to determine:

(a) 5A – 3I (where I is the identity matrix) [2]

(b) B^{-1} [2]

(c) matrix C: BC = A [3]

TRINITY COLLEGE

Year 11 Mathematics Specialist
Test 5 2019

Calculator Assumed

Matrices

STUDENT'S NAME _____

DATE: Monday 26 August **TIME:** 35 minutes **MARKS**: 35

INSTRUCTIONS:

Standard Items: Pens, pencils, drawing templates, eraser

Questions or parts of questions worth more than 2 marks require working to be shown to receive full marks.

---

5. (4 marks)

Determine X where $\begin{bmatrix} 2 & 3 \\ -2 & -1 \end{bmatrix} X + \begin{bmatrix} 2 \\ -1 \end{bmatrix} = X + \begin{bmatrix} 7 \\ 1 \end{bmatrix}$

6. (14 marks)

Consider *Figure 1* on the grid below with vertices, $P_1(-1,1), Q_1(2,0), R_1(3,3)$ and $S_1(2,4)$.

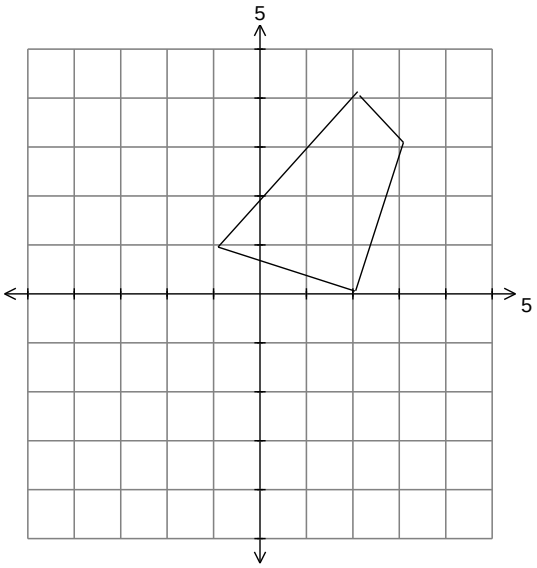

Figure 1

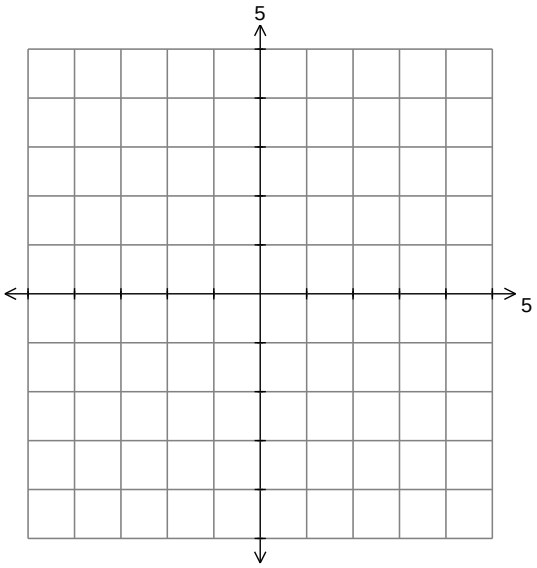

Figure 2

(a) The original 4 points are transformed to the points, P_2, Q_2, R_2 and S_2 by the matrix $A = \begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix}$.

(i) Plot these new points on the blank grid above on the right, indicating clearly the coordinates of each point and join them to find *Figure 2.* [4]

(ii) Describe the transformation produced by the matrix A. [1]

(b) The points P_2, Q_2, R_2 and S_2 are then transformed to the points P_3, Q_3, R_3 and S_3 by a transformation matrix that dilates the shape by a scale factor of 2 in the direction of the x-axis and a scale factor of 3 in the direction of the y-axis forming *Figure 3.* Find the matrix B that will effect this transformation and give the coordinates of P3 and Q3. [4]

(c) Write down a matrix C that transforms the original points P_1, Q_1, R_1 and S_1 directly to the points P_3, Q_3, R_3 and S_3. [2]

(d) Write down a matrix D that transforms the points P_3, Q_3, R_3 and S_3 directly back to the original points P_1, Q_1, R_1 and S_1. [1]

(e) If *Figure 3* has an area of 108 units^2, determine the area of *Figure 1.* [2]

7. (9 marks)

Let $A = \begin{bmatrix} -6 & 4 \\ 5 & -3 \end{bmatrix}$ and $B = \begin{bmatrix} 3 & 4 \\ 5 & 6 \end{bmatrix}$.

(a) Given that $A^{-1} = kB$, determine the value of k. [2]

(b) The equations $4y = 6x + 4$ and $5x = 3y$ can be expressed as a matrix equation in the form $AX = C$.

(i) State the matrices X and C. [2]

(ii) Write down a matrix equation to determine X in terms of B and C. [2]

(c) Determine the matrix D, if $(B - D)B = 2A$. [3]

8. (7 marks)

During the school vacations, the cinema puts on special programs for children. A cinema runs three sessions. The matrix S shows the attendances for Monday.

$$\mathbf{S} = \begin{matrix} Adult & Child \\ \begin{bmatrix} 150 & 250 \\ 160 & 250 \\ 70 & 180 \end{bmatrix} & \begin{matrix} Early \\ Lunch \\ Afternoon \end{matrix} \end{matrix}$$

Now the matrix of charges is given by

$$\mathbf{C} = \begin{matrix} \$ \\ \begin{bmatrix} 9 \\ 5 \end{bmatrix} & \begin{matrix} Adults \\ Children \end{matrix} \end{matrix}$$

(a) Determine the product matrix **R** which gives the box-office receipts for each session on Monday. [2]

(b) Pre-multiply **R** by the matrix $\begin{bmatrix} 1 & 1 & 1 \end{bmatrix}$ to obtain the matrix **T**. [2]

(c) What information is contained in **T**? [1]

(d) Determine the total receipts matrix for Tuesday if the matrix of charges for Tuesday remains the same as for Monday and the attendance matrix is given below. [2]

$$\begin{matrix} Adult & Child \\ \begin{bmatrix} 120 & 240 \\ 150 & 210 \\ 80 & 200 \end{bmatrix} & \begin{matrix} Early \\ Lunch \\ Afternoon \end{matrix} \end{matrix}$$