

Readiness Assurance Outcomes

Before beginning this module, each student should be able to...

- Calculate the area of a parallelogram.
- Find the matrix corresponding to a linear transformation of Euclidean spaces (**Standard(s) A1**).
- Recall and use the definition of a linear transformation (**Standard(s) A2**).
- Find all roots of quadratic polynomials (including complex ones), and be able to use the rational root theorem to find all rational roots of a higher degree polynomial.
- Interpret the statement “ A is an invertible matrix” in many equivalent ways in different contexts.

Readiness Assurance Resources

The following resources will help you prepare for this module.

- Finding the area of a parallelogram: <https://www.khanacademy.org/math/basic-geo/basic-geo-area-and-perimeter/parallelogram-area/a/area-of-parallelogram>
- Factoring quadratics: <https://www.khanacademy.org/math/algebra2/polynomial-functions/factoring-polynomials/v/factoring-polynomials-1>
- Finding complex roots of quadratics: <https://www.khanacademy.org/math/algebra2/polynomial-functions/quadratic-equations-with-complex-numbers/v/complex-roots-from-the-quadratic-formula>
- Finding all roots of polynomials: <https://www.khanacademy.org/math/algebra2/polynomial-functions/finding-zeros-of-polynomials/v/finding-roots-or-zeros-of-polynomial-1>
- The Rational Root Theorem: https://artofproblemsolving.com/wiki/index.php?title=Rational_Root_Theorem

(a) 1

(b) 2

(c) 3

(d) 4



5) Let $T : \mathbb{R}^2 \rightarrow \mathbb{R}$ be a linear transformation. Which of the following is equal to $T \left(\begin{bmatrix} a+b \\ a+b \end{bmatrix} \right)$?

(a) $T \left(\begin{bmatrix} a \\ b \end{bmatrix} \right)$ (c) $T \left(\begin{bmatrix} a \\ b \end{bmatrix} \right) + T \left(\begin{bmatrix} b \\ a \end{bmatrix} \right)$ (b) $2T \left(\begin{bmatrix} a \\ b \end{bmatrix} \right)$ (d) $T \left(\begin{bmatrix} a \\ a \end{bmatrix} \right) + T \left(\begin{bmatrix} a \\ b \end{bmatrix} \right) + T \left(\begin{bmatrix} b \\ a \end{bmatrix} \right) + T \left(\begin{bmatrix} b \\ b \end{bmatrix} \right)$

6) Let $T : \mathbb{R}^n \rightarrow \mathbb{R}^n$ be a linear transformation with associated matrix $A \in M_n(\mathbb{R})$. Three of the four answer choices are equivalent to each other; which one is not equivalent to the other three?

(a) A is not an invertible matrix(b) T has a non-trivial kernel(c) $\det(A) \neq 0$ (d) $A\vec{x} = \vec{b}$ has multiple solutions for all $\vec{b} \in \mathbb{R}^n$.

7) What is the matrix corresponding to the linear transformation $T : \mathbb{R}^3 \rightarrow \mathbb{R}^3$ given by $T \left(\begin{bmatrix} x \\ y \\ z \end{bmatrix} \right) =$

$$\begin{bmatrix} 3x + 2y - z \\ y + z \\ x + 7z \end{bmatrix}?$$

(a) $\begin{bmatrix} 3 & 2 & -1 \\ 0 & 1 & 1 \\ 1 & 0 & 7 \end{bmatrix}$

(b) $\begin{bmatrix} 3 & 0 & 1 \\ 2 & 1 & 0 \\ -1 & 1 & 7 \end{bmatrix}$

(c) $\begin{bmatrix} 3 & 2 & -1 \\ 1 & 1 & 0 \\ 1 & 7 & 0 \end{bmatrix}$

(d) $\begin{bmatrix} 3 & 1 & 1 \\ 2 & 1 & 7 \\ -1 & 0 & 0 \end{bmatrix}$

8) Which of the following conditions imply that the quadratic polynomial $ax^2 + bx + c$ has no real roots?

(a) $a < 0$ (b) $b^2 - 4ac < 0$ (c) $ac - b^2 < 0$ (d) $ab + c^2 < 0$

9) Which of the following is a root of the polynomial $x^2 - 4x + 13$?

(a) $1 + 2i$

(b) $2 - 3i$

(c) $3 + 4i$

(d) $4 - 5i$

10) How many roots does the polynomial $x^4 + 3x^3 + x^2 - 3x - 2$ have?

(a) 1

(b) 2

(c) 3

(d) 4