## 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-perime parallelogram-area/a/area-of-parallelogram

• Factoring quadratics: https://www.khanacademy.org/math/algebra2/polynomial-functions/factoring-polynom

- 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

## Readiness Assurance Test

Choose the most appropriate response for each question.

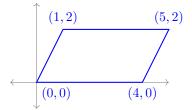
1) Find the area of the parallelogram with vertices (0,0), (4,0), (5,2), and (1,2).







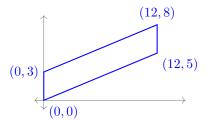




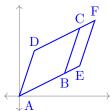
2) Find the area of the parallelogram with vertices (0,0), (12,5), (12,8), and (0,3).







3) The parallelogram ABCD has area 6. If AE is 50% longer than AB, what is the area of the parallelogram AEFD?



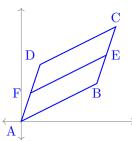
4) The parallelogram ABCD has area 6. If AD is twice as long as AF, what is the area of the parallelogram ABEF?











- 5) Let  $T: \mathbb{R}^2 \to \mathbb{R}$  be a linear transformation. Which of the following is equal to  $2T\left(\begin{bmatrix} a+b\\a+b \end{bmatrix}\right)$ ?
  - (a)  $T\left(\begin{bmatrix} a \\ a \end{bmatrix}\right) + T\left(\begin{bmatrix} a \\ b \end{bmatrix}\right) + T\left(\begin{bmatrix} b \\ a \end{bmatrix}\right) + T\left(\begin{bmatrix} b \\ b \end{bmatrix}\right)$  (c)  $T\left(\begin{bmatrix} a \\ b \end{bmatrix}\right)$
  - (b)  $T\left(\begin{bmatrix} a \\ b \end{bmatrix}\right) + T\left(\begin{bmatrix} b \\ a \end{bmatrix}\right)$ (d)  $2T \begin{pmatrix} a \\ b \end{pmatrix}$
- 6) Let  $T: \mathbb{R}^n \to \mathbb{R}^n$  be a linear transformation with standard matrix A. Which of the following is equivalent to the statement "A is an invertible matrix"?
  - (a) A is a square matrix
  - (b) The matrix equation AX = B has no solution for some  $n \times 1$  matrix B.
  - (c) RREF(A) has a column without a pivot
  - (d) T is both injective and surjective
- 7) What is the matrix corresponding to the linear transformation  $T: \mathbb{R}^3 \to \mathbb{R}^3$  given by

$$T\left(\begin{bmatrix} x \\ y \\ z \end{bmatrix}\right) = \begin{bmatrix} 3x + 2y - z \\ y + z \\ x + 7z \end{bmatrix}?$$

- (a)  $\begin{bmatrix} 3 & 0 & 1 \\ 2 & 1 & 0 \\ -1 & 1 & 7 \end{bmatrix}$  (b)  $\begin{bmatrix} 3 & 2 & -1 \\ 0 & 1 & 1 \\ 1 & 0 & 7 \end{bmatrix}$  (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) How many distinct real roots does the polynomial  $x^4 + 3x^3 + x^2 3x 2$  have? (Hint: all the roots are rational.)
  - (a) 4

(b) 3

(c) 2

- (d) 1
- 9) Which of the following is a root of the polynomial  $x^2 4x + 13$ ?
  - (a) 2 3i
- (b) 3 + 4i
- (c) 4 5i
- (d) 5 + 6i
- 10) Which of the following conditions imply that the quadratic polynomial  $ax^2 + bx + c$  has no real roots?
  - (a)  $b^2 4ac < 0$

(c)  $ac - 4b^2 < 0$ 

(b)  $a^2 + 4bc < 0$ 

(d)  $ab + 4c^2 < 0$