

## 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.

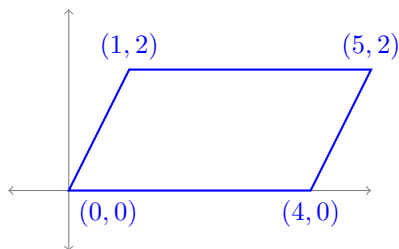
- Finding the area of a parallelogram: <https://www.khanacademy.org/math/basic-geo/basic-geo-area-and-perimeter/parallelogram-area/a/area-of-parallelogram>
- Factoring quadratics: <https://www.khanacademy.org/math/algebra2/polynomial-functions/factoring-polynomials/v/factoring-polynomials-1>
- Finding 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](https://artofproblemsolving.com/wiki/index.php?title=Rational_Root_Theorem)

## Readiness Assurance Test

Choose the most appropriate response for each question.

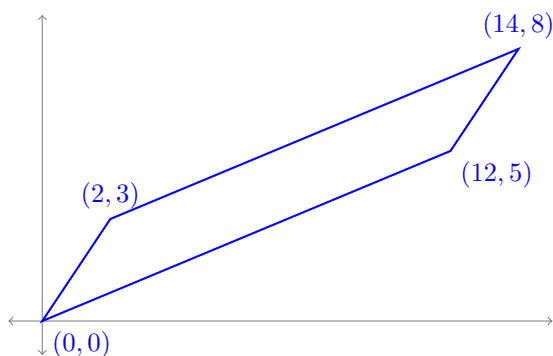
- 1) Find the area of the parallelogram with vertices  $(0, 0)$ ,  $(4, 0)$ ,  $(5, 2)$ , and  $(1, 2)$ .

- (a) 5
- (b) 6
- (c) 7
- (d) 8



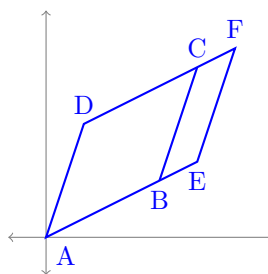
- 2) Find the area of the parallelogram with vertices  $(0, 0)$ ,  $(12, 5)$ ,  $(14, 8)$ , and  $(2, 3)$ .

- (a) 13
- (b) 26
- (c) 39
- (d) 52



- 3) The parallelogram ABCD has area 6. If AE is  $\frac{3}{2}$  the length of AB, what is the area of the parallelogram AEFD?

- (a) 9
- (b) 12
- (c) 15
- (d) 18



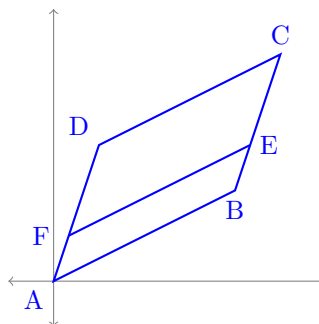
- 4) The parallelogram ABCD has area 6. If AF is one third as long as AD, what is the area of the parallelogram ABEF?

(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