

## 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.

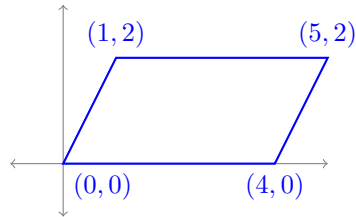
- Finding the area of a parallelogram: <https://www.khanacademy.org/math/basic-geo/basic-geo-area-and-perimeter/parallelogram-area/a/area-of-parallelogram>
- Factoring quadratics: <https://www.khanacademy.org/math/algebra2/polynomial-functions/factoring-polynomials/v/factoring-polynomials-1>
- Finding 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.

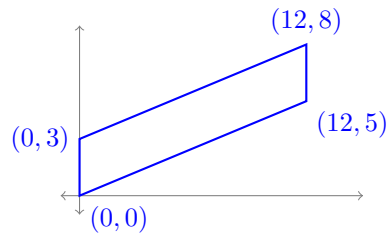
- 1) Find the area of the parallelogram with vertices  $(0, 0)$ ,  $(4, 0)$ ,  $(5, 2)$ , and  $(1, 2)$ .

- (a) 8
- (b) 10
- (c) 12
- (d) 14



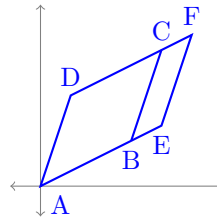
- 2) Find the area of the parallelogram with vertices  $(0, 0)$ ,  $(12, 5)$ ,  $(12, 8)$ , and  $(0, 3)$ .

- (a) 36
- (b) 54
- (c) 72
- (d) 96



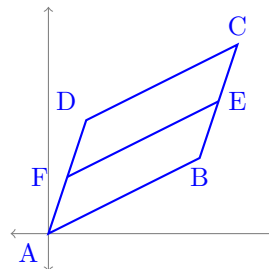
- 3) The parallelogram ABCD has area 6. If AE is 50% longer than AB, what is the area of the parallelogram AEFD?

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



- 4) The parallelogram ABCD has area 6. If AD is twice as long as AF, 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  $2T\left(\begin{bmatrix} a+b \\ a+b \end{bmatrix}\right)$ ?
- (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)  $2T\left(\begin{bmatrix} a \\ b \end{bmatrix}\right)$
- 6) Let  $T : \mathbb{R}^n \rightarrow \mathbb{R}^n$  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)  $\text{RREF}(A)$  has a column without a pivot  
(d)  $T$  is both injective and surjective
- 7) What is the matrix corresponding to the linear transformation  $T : \mathbb{R}^3 \rightarrow \mathbb{R}^3$  given by
- $$T\left(\begin{bmatrix} x \\ y \\ z \end{bmatrix}\right) = \begin{bmatrix} 3x + 2y - z \\ y + z \\ x + 7z \end{bmatrix}?$$
- (a)  $\begin{bmatrix} 3 & 0 & 1 \\ 2 & 1 & 0 \\ -1 & 1 & 7 \end{bmatrix}$       (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)  $ab + 4c^2 < 0$