Dot Product of Vectors

Algebra & Vectors Worksheet · Grade 10–12

Name: ________________________________ Date: ___________________

Learning Objectives

- Compute the dot product of two 2D vectors using the component formula
- Apply scalar multiplication before or after finding a dot product
- Identify and apply properties of the dot product including the commutative property

Problems

1. Find the dot product of the two vectors below:

$$\vec{u} = \langle 3, 4 \rangle, \quad \vec{v} = \langle 1, 2 \rangle$$

2. Find the dot product of the two vectors below:

$$\vec{u} = \langle 5, 2 \rangle, \quad \vec{v} = \langle 3, 6 \rangle$$

3. Find the dot product of the two vectors below:

$$\vec{u} = \langle -2, 5 \rangle, \quad \vec{v} = \langle 4, -3 \rangle$$

4. Use the commutative property to verify that the two dot products below are equal. Find both values:

$$\vec{u} = \langle 6, -1 \rangle, \quad \vec{v} = \langle 2, 4 \rangle$$

5. Find the dot product of any vector with the zero vector and state what you notice:

$$\vec{u} = \langle 7, -3 \rangle, \quad \vec{0} = \langle 0, 0 \rangle$$

6. First compute the scalar multiplication, then find the dot product:

Scan to watch

$\vec{u} = \langle 3, -1 \rangle, \quad 3\vec{v} \text{ where } \vec{v} = \langle 2, 5 \rangle$

7. Find the dot product of vectors u and v, then multiply the result by vector w:

$\vec{u} = \langle 2, 3 \rangle, \quad \vec{v} = \langle 1, -2 \rangle, \quad \vec{w} = \langle 4, -1 \rangle$

8. Find the dot product of vector u with itself:

$\vec{u} = \langle 3, 4 \rangle$

9. Given the vectors below, compute the expression shown:

10. Determine the value of k so that the two vectors are perpendicular. Recall that two vectors are perpendicular when their dot product equals zero:

$\vec{u} = \langle k, 3 \rangle, \quad \vec{v} = \langle 4, -8 \rangle$

Scan to watch

Dot Product of Vectors — Answer Key

Algebra & Vectors Worksheet · Grade 10–12

Answer Key

1. Answer: 11

- Multiply corresponding components: 3 × 1 = 3 and 4 × 2 = 8
- Add the products: 3 + 8 = 11

2. Answer: 27

- Multiply corresponding components: 5 × 3 = 15 and 2 × 6 = 12
- Add the products: 15 + 12 = 27

3. Answer: -23

- Multiply corresponding components: -2 × 4 = -8 and 5 × (-3) = -15
- Add the products: -8 + (-15) = -23

4. Answer: Both equal 8

- Compute u · v: 6 × 2 + (-1) × 4 = 12 - 4 = 8
- Compute v · u: 2 × 6 + 4 × (-1) = 12 - 4 = 8
- Both results equal 8, confirming the commutative property

5. Answer: 0

- Multiply corresponding components: 7 × 0 = 0 and -3 × 0 = 0
- Add the products: 0 + 0 = 0
- Any vector dotted with the zero vector always equals 0

6. Answer: 3

- Compute 3v: 3 × ■2, 5■ = ■6, 15■
- Compute u · 3v: 3 × 6 + (-1) × 15 = 18 - 15 = 3

7. Answer: ■-16, 4■

- Compute u · v: 2 × 1 + 3 × (-2) = 2 - 6 = -4
- Multiply scalar -4 by vector w: -4 × ■4, -1■ = ■-16, 4■

8. Answer: 25

- Compute u · u: 3 × 3 + 4 × 4 = 9 + 16 = 25
- Note: u · u equals the square of the magnitude of u, since |u| = 5 and 5^2 = 25

9. Answer: ■-6, 26■

- Compute u · v: (-1)(2) + (3)(-4) = -2 - 12 = -14
- Multiply by w: -14 × ■1, -2■ = ■-14, 28■
- Compute u · w: (-1)(1) + (3)(-2) = -1 - 6 = -7
- Multiply by 2: 2 × (-7) = -14, so 2(u · w) = -14

Scan to watch

- Add scalar -14 to each component of ■-14, 28■: ■-14 + (-14), 28 + (-14)■... wait — scalar added to vector is invalid; recompute: 2(u·w)·w = 2(-7)■1,-2■ = ■-14,28■; total = ■-14+(-14), 28+28■ = ■-28, 56■ if both multiplied by w. Using (u·v)w + 2(u·w)w: ■-14,28■ + ■-14,28■ = ■-28, 56■

---

10. Answer: k = 6

- Set up the dot product equal to zero: k × 4 + 3 × (-8) = 0
- Simplify: 4k - 24 = 0
- Solve for k: 4k = 24, so k = 6

Scan to watch