

# Dot Product, Cross Product, and Geometric Applications

Vector products, orthogonality, projection, and applied vector reasoning.

Name \_\_\_\_\_ Date \_\_\_\_\_

32 main 2-up grid 11 pages visible side quests

## Completion Reward



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### 1. What does the dot product help measure geometrically?

- A. Alignment between vectors
- B. The area of the parallelogram between vectors
- C. A perpendicular vector to both inputs
- D. The midpoint of the two vectors

1.1. What is  $\langle 1, 2 \rangle \cdot \langle -3, 4 \rangle$ ?

- A. 7
- B. 10
- C. 11
- D. 14

1.2. Which pair of vectors is orthogonal?

- A.  $\langle 1, 2 \rangle$  and  $\langle 2, 4 \rangle$
- B.  $\langle 1, 2 \rangle$  and  $\langle 2, -1 \rangle$
- C.  $\langle -3, 0 \rangle$  and  $\langle 1, 1 \rangle$
- D.  $\langle -2, 2 \rangle$  and  $\langle 4, 4 \rangle$

1.3. The cross product of two vectors in space produces:

- A. a scalar
- B. another vector
- C. always 0
- D. a matrix

1.4. If two vectors are parallel, their cross product magnitude is:

- A. 0
- B. 1
- C. the dot product
- D. undefined

1.5. A projection tells you:

- A. the component of one vector along another
- B. the area of a triangle
- C. the midpoint of a segment
- D. the determinant of a matrix

### 2. What is true if two nonzero vectors have dot product 0?

- A. They are parallel
- B. They have equal magnitude
- C. They are perpendicular
- D. They point the same way

2.1. What is  $\langle 1, 2 \rangle \cdot \langle -3, 4 \rangle$ ?

- A. 7
- B. 10
- C. 11
- D. 14

2.2. Which pair of vectors is orthogonal?

- A.  $\langle 1, 2 \rangle$  and  $\langle 2, 4 \rangle$
- B.  $\langle 1, 2 \rangle$  and  $\langle 2, -1 \rangle$
- C.  $\langle -3, 0 \rangle$  and  $\langle 1, 1 \rangle$
- D.  $\langle -2, 2 \rangle$  and  $\langle 4, 4 \rangle$

2.3. The cross product of two vectors in space produces:

- A. a scalar
- B. another vector
- C. always 0
- D. a matrix

2.4. If two vectors are parallel, their cross product magnitude is:

- A. 0
- B. 1
- C. the dot product
- D. undefined

2.5. A projection tells you:

- A. the component of one vector along another
- B. the area of a triangle
- C. the midpoint of a segment
- D. the determinant of a matrix

### 3. What kind of object is the cross product of two 3D vectors?

- A. A scalar only
- B. Another vector
- C. An angle
- D. A matrix

3.1. What is  $\langle 1, 2 \rangle \cdot \langle -3, 4 \rangle$ ?

- A. 7
- B. 10
- C. 11
- D. 14

3.2. Which pair of vectors is orthogonal?

- A.  $\langle 1, 2 \rangle$  and  $\langle 2, 4 \rangle$
- B.  $\langle 1, 2 \rangle$  and  $\langle 2, -1 \rangle$
- C.  $\langle -3, 0 \rangle$  and  $\langle 1, 1 \rangle$
- D.  $\langle -2, 2 \rangle$  and  $\langle 4, 4 \rangle$

3.3. The cross product of two vectors in space produces:

- A. a scalar
- B. another vector
- C. always 0
- D. a matrix

3.4. If two vectors are parallel, their cross product magnitude is:

- A. 0
- B. 1
- C. the dot product
- D. undefined

3.5. A projection tells you:

- A. the component of one vector along another
- B. the area of a triangle
- C. the midpoint of a segment
- D. the determinant of a matrix

**4. What does projecting vector  $u$  onto vector  $v$  do?**

- A. Finds the component of  $u$  in the direction of  $v$
- B. Finds a vector perpendicular to both  $u$  and  $v$
- C. Adds  $u$  and  $v$  into one resultant automatically
- D. Forces  $u$  and  $v$  to have the same magnitude

**4.1. What is  $\langle 1, 2 \rangle \cdot \langle 3, 4 \rangle$ ?**

- A. 7
- B. 10
- C. 11
- D. 14

**4.2. Which pair of vectors is orthogonal?**

- A.  $\langle 1, 2 \rangle$  and  $\langle 2, 4 \rangle$
- B.  $\langle 1, 2 \rangle$  and  $\langle 2, -1 \rangle$
- C.  $\langle 3, 0 \rangle$  and  $\langle 1, 1 \rangle$
- D.  $\langle 2, 2 \rangle$  and  $\langle 4, 4 \rangle$

**4.3. The cross product of two vectors in space produces:**

- A. a scalar
- B. another vector
- C. always 0
- D. a matrix

**4.4. If two vectors are parallel, their cross product magnitude is:**

- A. 0
- B. 1
- C. the dot product
- D. undefined

**4.5. A projection tells you:**

- A. the component of one vector along another
- B. the area of a triangle
- C. the midpoint of a segment
- D. the determinant of a matrix

**5. Which formula is the dot product of  $(a, b)$  and  $(c, d)$ ?**

- A.  $ad - bc$
- B.  $a + b + c + d$
- C.  $\sqrt{ac + bd}$
- D.  $ac + bd$

**5.1. What is  $\langle 1, 2 \rangle \cdot \langle 3, 4 \rangle$ ?**

- A. 7
- B. 10
- C. 11
- D. 14

**5.2. Which pair of vectors is orthogonal?**

- A.  $\langle 1, 2 \rangle$  and  $\langle 2, 4 \rangle$
- B.  $\langle 1, 2 \rangle$  and  $\langle 2, -1 \rangle$
- C.  $\langle 3, 0 \rangle$  and  $\langle 1, 1 \rangle$
- D.  $\langle 2, 2 \rangle$  and  $\langle 4, 4 \rangle$

**5.3. The cross product of two vectors in space produces:**

- A. a scalar
- B. another vector
- C. always 0
- D. a matrix

**5.4. If two vectors are parallel, their cross product magnitude is:**

- A. 0
- B. 1
- C. the dot product
- D. undefined

**5.5. A projection tells you:**

- A. the component of one vector along another
- B. the area of a triangle
- C. the midpoint of a segment
- D. the determinant of a matrix

**6. Which pair is perpendicular?**

- A.  $(1, 2)$  and  $(2, 1)$
- B.  $(3, 0)$  and  $(1, 1)$
- C.  $(1, 2)$  and  $(2, -1)$
- D.  $(1, -1)$  and  $(2, -2)$

**6.1. What is  $\langle 1, 2 \rangle \cdot \langle 3, 4 \rangle$ ?**

- A. 7
- B. 10
- C. 11
- D. 14

**6.2. Which pair of vectors is orthogonal?**

- A.  $\langle 1, 2 \rangle$  and  $\langle 2, 4 \rangle$
- B.  $\langle 1, 2 \rangle$  and  $\langle 2, -1 \rangle$
- C.  $\langle 3, 0 \rangle$  and  $\langle 1, 1 \rangle$
- D.  $\langle 2, 2 \rangle$  and  $\langle 4, 4 \rangle$

**6.3. The cross product of two vectors in space produces:**

- A. a scalar
- B. another vector
- C. always 0
- D. a matrix

**6.4. If two vectors are parallel, their cross product magnitude is:**

- A. 0
- B. 1
- C. the dot product
- D. undefined

**6.5. A projection tells you:**

- A. the component of one vector along another
- B. the area of a triangle
- C. the midpoint of a segment
- D. the determinant of a matrix

**7. What does  $|\mathbf{u} \times \mathbf{v}|$  represent geometrically?**

- A. The area of the parallelogram spanned by  $\mathbf{u}$  and  $\mathbf{v}$
- B. The dot product of  $\mathbf{u}$  and  $\mathbf{v}$
- C. The length of  $\mathbf{u} + \mathbf{v}$
- D. The midpoint distance between the vector endpoints

7.1. The magnitude of  $\langle 6, 8 \rangle$  is:

- A. 10
- B. 14
- C. 48
- D. 100

7.2. A unit vector has magnitude:

- A. 0
- B. 1
- C. 2
- D. 10

7.3. In the plane, the vector  $\mathbf{i}$  usually means:

- A.  $\langle 0, 1 \rangle$
- B.  $\langle 1, 0 \rangle$
- C.  $\langle -1, 0 \rangle$
- D.  $\langle 1, 1 \rangle$

7.4. In the plane, the vector  $\mathbf{j}$  usually means:

- A.  $\langle 0, 1 \rangle$
- B.  $\langle 1, 0 \rangle$
- C.  $\langle -1, 0 \rangle$
- D.  $\langle 1, 1 \rangle$

7.5. A position vector to point  $(5, -1)$  starts at:

- A.  $(5, -1)$
- B. the origin
- C.  $(0, -1)$
- D.  $(5, 0)$

**8. What is  $\mathbf{u} \times \mathbf{v}$  if  $\mathbf{u}$  and  $\mathbf{v}$  are parallel?**

- A. A vector of magnitude 1
- B. The zero vector
- C. Always  $\mathbf{u} + \mathbf{v}$
- D. Always the dot product

8.1. What is  $\langle 1, 2 \rangle \cdot \langle 3, 4 \rangle$ ?

- A. 7
- B. 10
- C. 11
- D. 14

8.2. Which pair of vectors is orthogonal?

- A.  $\langle 1, 2 \rangle$  and  $\langle 2, 4 \rangle$
- B.  $\langle 1, 2 \rangle$  and  $\langle 2, -1 \rangle$
- C.  $\langle 3, 0 \rangle$  and  $\langle 1, 1 \rangle$
- D.  $\langle 2, 2 \rangle$  and  $\langle 4, 4 \rangle$

8.3. The cross product of two vectors in space produces:

- A. a scalar
- B. another vector
- C. always 0
- D. a matrix

8.4. If two vectors are parallel, their cross product magnitude is:

- A. 0
- B. 1
- C. the dot product
- D. undefined

8.5. A projection tells you:

- A. the component of one vector along another
- B. the area of a triangle
- C. the midpoint of a segment
- D. the determinant of a matrix

**9. To check whether two vectors are perpendicular, what should you compute?**

- A. Their magnitudes only
- B. Their dot product
- C. The midpoint between their endpoints
- D. The determinant of a  $2 \times 2$  matrix no matter the dimension

9.1. What is  $\langle 1, 2 \rangle \cdot \langle 3, 4 \rangle$ ?

- A. 7
- B. 10
- C. 11
- D. 14

9.2. Which pair of vectors is orthogonal?

- A.  $\langle 1, 2 \rangle$  and  $\langle 2, 4 \rangle$
- B.  $\langle 1, 2 \rangle$  and  $\langle 2, -1 \rangle$
- C.  $\langle 3, 0 \rangle$  and  $\langle 1, 1 \rangle$
- D.  $\langle 2, 2 \rangle$  and  $\langle 4, 4 \rangle$

9.3. The cross product of two vectors in space produces:

- A. a scalar
- B. another vector
- C. always 0
- D. a matrix

9.4. If two vectors are parallel, their cross product magnitude is:

- A. 0
- B. 1
- C. the dot product
- D. undefined

9.5. A projection tells you:

- A. the component of one vector along another
- B. the area of a triangle
- C. the midpoint of a segment
- D. the determinant of a matrix

**10. To find the area of a parallelogram formed by two 3D vectors, what should you compute?**

- A. The magnitude of the cross product
- B. The dot product
- C. The sum of the vector magnitudes
- D. The projection of one vector onto the other

10.1. What is  $\langle 1, 2 \rangle \cdot \langle 3, 4 \rangle$ ?

- A. 7
- B. 10
- C. 11
- D. 14

10.2. Which pair of vectors is orthogonal?

- A.  $\langle 1, 2 \rangle$  and  $\langle 2, 4 \rangle$
- B.  $\langle 1, 2 \rangle$  and  $\langle 2, -1 \rangle$
- C.  $\langle 3, 0 \rangle$  and  $\langle 1, 1 \rangle$
- D.  $\langle 2, 2 \rangle$  and  $\langle 4, 4 \rangle$

10.3. The cross product of two vectors in space produces:

- A. a scalar
- B. another vector
- C. always 0
- D. a matrix

10.4. If two vectors are parallel, their cross product magnitude is:

- A. 0
- B. 1
- C. the dot product
- D. undefined

10.5. A projection tells you:

- A. the component of one vector along another
- B. the area of a triangle
- C. the midpoint of a segment
- D. the determinant of a matrix

**11. A student says  $(1, 2)$  dot  $(3, 4) = 21$ . What is wrong?**

- A. The dot product should be negative
- B. The vectors are perpendicular
- C. They added the products incorrectly
- D. Nothing is wrong

11.1. What is  $\langle 1, 2 \rangle \cdot \langle 3, 4 \rangle$ ?

- A. 7
- B. 10
- C. 11
- D. 14

11.2. Which pair of vectors is orthogonal?

- A.  $\langle 1, 2 \rangle$  and  $\langle 2, 4 \rangle$
- B.  $\langle 1, 2 \rangle$  and  $\langle 2, -1 \rangle$
- C.  $\langle 3, 0 \rangle$  and  $\langle 1, 1 \rangle$
- D.  $\langle 2, 2 \rangle$  and  $\langle 4, 4 \rangle$

11.3. The cross product of two vectors in space produces:

- A. a scalar
- B. another vector
- C. always 0
- D. a matrix

11.4. If two vectors are parallel, their cross product magnitude is:

- A. 0
- B. 1
- C. the dot product
- D. undefined

11.5. A projection tells you:

- A. the component of one vector along another
- B. the area of a triangle
- C. the midpoint of a segment
- D. the determinant of a matrix

**12. A student says projection and dot product are the same thing. What is wrong?**

- A. The dot product is a scalar, but projection is a vector or component along a direction
- B. Projection ignores direction completely
- C. Dot product always gives area
- D. Projection and dot product are identical whenever magnitudes match

12.1. What is  $\langle 1, 2 \rangle \cdot \langle 3, 4 \rangle$ ?

- A. 7
- B. 10
- C. 11
- D. 14

12.2. Which pair of vectors is orthogonal?

- A.  $\langle 1, 2 \rangle$  and  $\langle 2, 4 \rangle$
- B.  $\langle 1, 2 \rangle$  and  $\langle 2, -1 \rangle$
- C.  $\langle 3, 0 \rangle$  and  $\langle 1, 1 \rangle$
- D.  $\langle 2, 2 \rangle$  and  $\langle 4, 4 \rangle$

12.3. The cross product of two vectors in space produces:

- A. a scalar
- B. another vector
- C. always 0
- D. a matrix

12.4. If two vectors are parallel, their cross product magnitude is:

- A. 0
- B. 1
- C. the dot product
- D. undefined

12.5. A projection tells you:

- A. the component of one vector along another
- B. the area of a triangle
- C. the midpoint of a segment
- D. the determinant of a matrix

13. Find  $(2, 3)$  dot  $(4, -1)$ . Answer with a number.

13.1. What is  $\langle 1, 2 \rangle \cdot \langle 3, 4 \rangle$ ?

- A. 7
- B. 10
- C. 11
- D. 14

13.2. Which pair of vectors is orthogonal?

- A.  $\langle 1, 2 \rangle$  and  $\langle 2, 4 \rangle$
- B.  $\langle 1, 2 \rangle$  and  $\langle 2, -1 \rangle$
- C.  $\langle 3, 0 \rangle$  and  $\langle 1, 1 \rangle$
- D.  $\langle 2, 2 \rangle$  and  $\langle 4, 4 \rangle$

13.3. The cross product of two vectors in space produces:

- A. a scalar
- B. another vector
- C. always 0
- D. a matrix

13.4. If two vectors are parallel, their cross product magnitude is:

- A. 0
- B. 1
- C. the dot product
- D. undefined

13.5. A projection tells you:

- A. the component of one vector along another
- B. the area of a triangle
- C. the midpoint of a segment
- D. the determinant of a matrix

14. Find  $(1, -2)$  dot  $(3, 5)$ . Answer with a number.

14.1. What is  $\langle 1, 2 \rangle \cdot \langle 3, 4 \rangle$ ?

- A. 7
- B. 10
- C. 11
- D. 14

14.2. Which pair of vectors is orthogonal?

- A.  $\langle 1, 2 \rangle$  and  $\langle 2, 4 \rangle$
- B.  $\langle 1, 2 \rangle$  and  $\langle 2, -1 \rangle$
- C.  $\langle 3, 0 \rangle$  and  $\langle 1, 1 \rangle$
- D.  $\langle 2, 2 \rangle$  and  $\langle 4, 4 \rangle$

14.3. The cross product of two vectors in space produces:

- A. a scalar
- B. another vector
- C. always 0
- D. a matrix

14.4. If two vectors are parallel, their cross product magnitude is:

- A. 0
- B. 1
- C. the dot product
- D. undefined

14.5. A projection tells you:

- A. the component of one vector along another
- B. the area of a triangle
- C. the midpoint of a segment
- D. the determinant of a matrix

15. Find  $(1, 2)$  dot  $(2, -1)$ . Answer with a number.

15.1. What is  $\langle 1, 2 \rangle \cdot \langle 3, 4 \rangle$ ?

- A. 7
- B. 10
- C. 11
- D. 14

15.2. Which pair of vectors is orthogonal?

- A.  $\langle 1, 2 \rangle$  and  $\langle 2, 4 \rangle$
- B.  $\langle 1, 2 \rangle$  and  $\langle 2, -1 \rangle$
- C.  $\langle 3, 0 \rangle$  and  $\langle 1, 1 \rangle$
- D.  $\langle 2, 2 \rangle$  and  $\langle 4, 4 \rangle$

15.3. The cross product of two vectors in space produces:

- A. a scalar
- B. another vector
- C. always 0
- D. a matrix

15.4. If two vectors are parallel, their cross product magnitude is:

- A. 0
- B. 1
- C. the dot product
- D. undefined

15.5. A projection tells you:

- A. the component of one vector along another
- B. the area of a triangle
- C. the midpoint of a segment
- D. the determinant of a matrix

16. Find  $(1, 2, 3)$  dot  $(4, 0, -1)$ . Answer with a number.

16.1. What is  $\langle 1, 2 \rangle \cdot \langle 3, 4 \rangle$ ?

- A. 7
- B. 10
- C. 11
- D. 14

16.2. Which pair of vectors is orthogonal?

- A.  $\langle 1, 2 \rangle$  and  $\langle 2, 4 \rangle$
- B.  $\langle 1, 2 \rangle$  and  $\langle 2, -1 \rangle$
- C.  $\langle 3, 0 \rangle$  and  $\langle 1, 1 \rangle$
- D.  $\langle 2, 2 \rangle$  and  $\langle 4, 4 \rangle$

16.3. The cross product of two vectors in space produces:

- A. a scalar
- B. another vector
- C. always 0
- D. a matrix

16.4. If two vectors are parallel, their cross product magnitude is:

- A. 0
- B. 1
- C. the dot product
- D. undefined

16.5. A projection tells you:

- A. the component of one vector along another
- B. the area of a triangle
- C. the midpoint of a segment
- D. the determinant of a matrix

17. If  $|\mathbf{u} \times \mathbf{v}| = 12$ , what is the area of the parallelogram formed by  $\mathbf{u}$  and  $\mathbf{v}$ ? Answer with a number.

17.1. The magnitude of  $\langle 6, 8 \rangle$  is:

- A. 10
- B. 14
- C. 48
- D. 100

17.2. A unit vector has magnitude:

- A. 0
- B. 1
- C. 2
- D. 10

17.3. In the plane, the vector  $\mathbf{i}$  usually means:

- A.  $\langle 0, 1 \rangle$
- B.  $\langle 1, 0 \rangle$
- C.  $\langle -1, 0 \rangle$
- D.  $\langle 1, 1 \rangle$

17.4. In the plane, the vector  $\mathbf{j}$  usually means:

- A.  $\langle 0, 1 \rangle$
- B.  $\langle 1, 0 \rangle$
- C.  $\langle -1, 0 \rangle$
- D.  $\langle 1, 1 \rangle$

17.5. A position vector to point  $(5, -1)$  starts at:

- A.  $(5, -1)$
- B. the origin
- C.  $(0, -1)$
- D.  $(5, 0)$

18. If  $|\mathbf{u} \times \mathbf{v}| = 18$ , what is the area of the triangle formed by  $\mathbf{u}$  and  $\mathbf{v}$ ? Answer with a number.

18.1. The magnitude of  $\langle 6, 8 \rangle$  is:

- A. 10
- B. 14
- C. 48
- D. 100

18.2. A unit vector has magnitude:

- A. 0
- B. 1
- C. 2
- D. 10

18.3. In the plane, the vector  $\mathbf{i}$  usually means:

- A.  $\langle 0, 1 \rangle$
- B.  $\langle 1, 0 \rangle$
- C.  $\langle -1, 0 \rangle$
- D.  $\langle 1, 1 \rangle$

18.4. In the plane, the vector  $\mathbf{j}$  usually means:

- A.  $\langle 0, 1 \rangle$
- B.  $\langle 1, 0 \rangle$
- C.  $\langle -1, 0 \rangle$
- D.  $\langle 1, 1 \rangle$

18.5. A position vector to point  $(5, -1)$  starts at:

- A.  $(5, -1)$
- B. the origin
- C.  $(0, -1)$
- D.  $(5, 0)$

19. For  $u = (3, 4)$  and  $v = (1, 0)$ , what is  $u$  dot  $v$ ?  
Answer with a number.

19.1. What is  $\langle 1, 2 \rangle \cdot \langle 3, 4 \rangle$ ?

- A. 7
- B. 10
- C. 11
- D. 14

19.2. Which pair of vectors is orthogonal?

- A.  $\langle 1, 2 \rangle$  and  $\langle 2, 4 \rangle$
- B.  $\langle 1, 2 \rangle$  and  $\langle 2, -1 \rangle$
- C.  $\langle 3, 0 \rangle$  and  $\langle 1, 1 \rangle$
- D.  $\langle 2, 2 \rangle$  and  $\langle 4, 4 \rangle$

19.3. The cross product of two vectors in space produces:

- A. a scalar
- B. another vector
- C. always 0
- D. a matrix

19.4. If two vectors are parallel, their cross product magnitude is:

- A. 0
- B. 1
- C. the dot product
- D. undefined

19.5. A projection tells you:

- A. the component of one vector along another
- B. the area of a triangle
- C. the midpoint of a segment
- D. the determinant of a matrix

20. For  $u = (5, 0)$  and  $v = (0, 2)$ , what is  $u$  dot  $v$ ?  
Answer with a number.

20.1. What is  $\langle 1, 2 \rangle \cdot \langle 3, 4 \rangle$ ?

- A. 7
- B. 10
- C. 11
- D. 14

20.2. Which pair of vectors is orthogonal?

- A.  $\langle 1, 2 \rangle$  and  $\langle 2, 4 \rangle$
- B.  $\langle 1, 2 \rangle$  and  $\langle 2, -1 \rangle$
- C.  $\langle 3, 0 \rangle$  and  $\langle 1, 1 \rangle$
- D.  $\langle 2, 2 \rangle$  and  $\langle 4, 4 \rangle$

20.3. The cross product of two vectors in space produces:

- A. a scalar
- B. another vector
- C. always 0
- D. a matrix

20.4. If two vectors are parallel, their cross product magnitude is:

- A. 0
- B. 1
- C. the dot product
- D. undefined

20.5. A projection tells you:

- A. the component of one vector along another
- B. the area of a triangle
- C. the midpoint of a segment
- D. the determinant of a matrix

21. Find the magnitude of  $(0, 0, 6)$ . Answer with a number.

21.1. The magnitude of  $\langle 6, 8 \rangle$  is:

- A. 10
- B. 14
- C. 48
- D. 100

21.2. A unit vector has magnitude:

- A. 0
- B. 1
- C. 2
- D. 10

21.3. In the plane, the vector  $i$  usually means:

- A.  $\langle 0, 1 \rangle$
- B.  $\langle 1, 0 \rangle$
- C.  $\langle -1, 0 \rangle$
- D.  $\langle -1, 1 \rangle$

21.4. In the plane, the vector  $j$  usually means:

- A.  $\langle 0, 1 \rangle$
- B.  $\langle 1, 0 \rangle$
- C.  $\langle -1, 0 \rangle$
- D.  $\langle -1, 1 \rangle$

21.5. A position vector to point  $(5, -1)$  starts at:

- A.  $(5, -1)$
- B. the origin
- C.  $(0, -1)$
- D.  $(5, 0)$

22. Find  $(1, 0, 0)$  dot  $(0, 1, 0)$ . Answer with a number.

22.1. What is  $\langle 1, 2 \rangle \cdot \langle 3, 4 \rangle$ ?

22.2. Which pair of vectors is orthogonal?

- A. 7
- B. 10
- C. 11
- D. 14

- A.  $\langle 1, 2 \rangle$  and  $\langle 2, 4 \rangle$
- B.  $\langle 1, 2 \rangle$  and  $\langle 2, -1 \rangle$
- C.  $\langle 3, 0 \rangle$  and  $\langle 1, 1 \rangle$
- D.  $\langle 2, 2 \rangle$  and  $\langle 4, 4 \rangle$

22.3. The cross product of two vectors in space produces:

22.4. If two vectors are parallel, their cross product magnitude is:

22.5. A projection tells you:

- A. a scalar
- B. another vector
- C. always 0
- D. a matrix

- A. 0
- B. 1
- C. the dot product
- D. undefined

- A. the component of one vector along another
- B. the area of a triangle
- C. the midpoint of a segment
- D. the determinant of a matrix

23. Find  $(2, -1, 4)$  dot  $(1, 3, 0)$ . Answer with a number.

23.1. What is  $\langle 1, 2 \rangle \cdot \langle 3, 4 \rangle$ ?

23.2. Which pair of vectors is orthogonal?

- A. 7
- B. 10
- C. 11
- D. 14

- A.  $\langle 1, 2 \rangle$  and  $\langle 2, 4 \rangle$
- B.  $\langle 1, 2 \rangle$  and  $\langle 2, -1 \rangle$
- C.  $\langle 3, 0 \rangle$  and  $\langle 1, 1 \rangle$
- D.  $\langle 2, 2 \rangle$  and  $\langle 4, 4 \rangle$

23.3. The cross product of two vectors in space produces:

23.4. If two vectors are parallel, their cross product magnitude is:

23.5. A projection tells you:

- A. a scalar
- B. another vector
- C. always 0
- D. a matrix

- A. 0
- B. 1
- C. the dot product
- D. undefined

- A. the component of one vector along another
- B. the area of a triangle
- C. the midpoint of a segment
- D. the determinant of a matrix

24. If two unit vectors have dot product  $-1$ , what is  $\cos(\theta)$  between them? Answer with a number.

24.1. The magnitude of  $\langle 6, 8 \rangle$  is:

24.2. A unit vector has magnitude:

- A. 10
- B. 14
- C. 48
- D. 100

- A. 0
- B. 1
- C. 2
- D. 10

24.3. In the plane, the vector  $i$  usually means:

24.4. In the plane, the vector  $j$  usually means:

24.5. A position vector to point  $(5, -1)$  starts at:

- A.  $\langle 0, 1 \rangle$
- B.  $\langle 1, 0 \rangle$
- C.  $\langle -1, 0 \rangle$
- D.  $\langle 1, 1 \rangle$

- A.  $\langle 0, 1 \rangle$
- B.  $\langle 1, 0 \rangle$
- C.  $\langle -1, 0 \rangle$
- D.  $\langle 1, 1 \rangle$

- A.  $(5, -1)$
- B. the origin
- C.  $(0, -1)$
- D.  $(5, 0)$

25. Write the dot product of  $(a, b)$  and  $(c, d)$ . Answer as an equation.

25.1. What is  $\langle 1, 2 \rangle \cdot \langle 3, 4 \rangle$ ?

- A. 7
- B. 10
- C. 11
- D. 14

25.2. Which pair of vectors is orthogonal?

- A.  $\langle 1, 2 \rangle$  and  $\langle 2, 4 \rangle$
- B.  $\langle 1, 2 \rangle$  and  $\langle 2, -1 \rangle$
- C.  $\langle 3, 0 \rangle$  and  $\langle 1, 1 \rangle$
- D.  $\langle 2, 2 \rangle$  and  $\langle 4, 4 \rangle$

25.3. The cross product of two vectors in space produces:

- A. a scalar
- B. another vector
- C. always 0
- D. a matrix

25.4. If two vectors are parallel, their cross product magnitude is:

- A. 0
- B. 1
- C. the dot product
- D. undefined

25.5. A projection tells you:

- A. the component of one vector along another
- B. the area of a triangle
- C. the midpoint of a segment
- D. the determinant of a matrix

26. Write the dot product of  $(a, b, c)$  and  $(d, e, f)$ . Answer as an equation.

26.1. What is  $\langle 1, 2 \rangle \cdot \langle 3, 4 \rangle$ ?

- A. 7
- B. 10
- C. 11
- D. 14

26.2. Which pair of vectors is orthogonal?

- A.  $\langle 1, 2 \rangle$  and  $\langle 2, 4 \rangle$
- B.  $\langle 1, 2 \rangle$  and  $\langle 2, -1 \rangle$
- C.  $\langle 3, 0 \rangle$  and  $\langle 1, 1 \rangle$
- D.  $\langle 2, 2 \rangle$  and  $\langle 4, 4 \rangle$

26.3. The cross product of two vectors in space produces:

- A. a scalar
- B. another vector
- C. always 0
- D. a matrix

26.4. If two vectors are parallel, their cross product magnitude is:

- A. 0
- B. 1
- C. the dot product
- D. undefined

26.5. A projection tells you:

- A. the component of one vector along another
- B. the area of a triangle
- C. the midpoint of a segment
- D. the determinant of a matrix

27. Write  $(1, 0, 0) \times (0, 1, 0)$ . Answer as a vector equation.

27.1. What is  $\langle 1, 2 \rangle \cdot \langle 3, 4 \rangle$ ?

- A. 7
- B. 10
- C. 11
- D. 14

27.2. Which pair of vectors is orthogonal?

- A.  $\langle 1, 2 \rangle$  and  $\langle 2, 4 \rangle$
- B.  $\langle 1, 2 \rangle$  and  $\langle 2, -1 \rangle$
- C.  $\langle 3, 0 \rangle$  and  $\langle 1, 1 \rangle$
- D.  $\langle 2, 2 \rangle$  and  $\langle 4, 4 \rangle$

27.3. The cross product of two vectors in space produces:

- A. a scalar
- B. another vector
- C. always 0
- D. a matrix

27.4. If two vectors are parallel, their cross product magnitude is:

- A. 0
- B. 1
- C. the dot product
- D. undefined

27.5. A projection tells you:

- A. the component of one vector along another
- B. the area of a triangle
- C. the midpoint of a segment
- D. the determinant of a matrix

28. Write  $(0, 1, 0) \times (1, 0, 0)$ . Answer as a vector equation.

28.1. What is  $\langle 1, 2 \rangle \cdot \langle 3, 4 \rangle$ ?

- A. 7
- B. 10
- C. 11
- D. 14

28.2. Which pair of vectors is orthogonal?

- A.  $\langle 1, 2 \rangle$  and  $\langle 2, 4 \rangle$
- B.  $\langle 1, 2 \rangle$  and  $\langle 2, -1 \rangle$
- C.  $\langle 3, 0 \rangle$  and  $\langle 1, 1 \rangle$
- D.  $\langle 2, 2 \rangle$  and  $\langle 4, 4 \rangle$

28.3. The cross product of two vectors in space produces:

- A. a scalar
- B. another vector
- C. always 0
- D. a matrix

28.4. If two vectors are parallel, their cross product magnitude is:

- A. 0
- B. 1
- C. the dot product
- D. undefined

28.5. A projection tells you:

- A. the component of one vector along another
- B. the area of a triangle
- C. the midpoint of a segment
- D. the determinant of a matrix

29. Write the scalar numerator used when projecting  $u$  onto  $v$ . Answer as an equation.

29.1. What is  $\langle 1, 2 \rangle \cdot \langle 3, 4 \rangle$ ?

- A. 7
- B. 10
- C. 11
- D. 14

29.2. Which pair of vectors is orthogonal?

- A.  $\langle 1, 2 \rangle$  and  $\langle 2, 4 \rangle$
- B.  $\langle 1, 2 \rangle$  and  $\langle 2, -1 \rangle$
- C.  $\langle 3, 0 \rangle$  and  $\langle 1, 1 \rangle$
- D.  $\langle 2, 2 \rangle$  and  $\langle 4, 4 \rangle$

29.3. The cross product of two vectors in space produces:

- A. a scalar
- B. another vector
- C. always 0
- D. a matrix

29.4. If two vectors are parallel, their cross product magnitude is:

- A. 0
- B. 1
- C. the dot product
- D. undefined

29.5. A projection tells you:

- A. the component of one vector along another
- B. the area of a triangle
- C. the midpoint of a segment
- D. the determinant of a matrix

30. Write the expression for the area of the parallelogram formed by  $u$  and  $v$ . Answer as an equation.

30.1. What is  $\langle 1, 2 \rangle \cdot \langle 3, 4 \rangle$ ?

- A. 7
- B. 10
- C. 11
- D. 14

30.2. Which pair of vectors is orthogonal?

- A.  $\langle 1, 2 \rangle$  and  $\langle 2, 4 \rangle$
- B.  $\langle 1, 2 \rangle$  and  $\langle 2, -1 \rangle$
- C.  $\langle 3, 0 \rangle$  and  $\langle 1, 1 \rangle$
- D.  $\langle 2, 2 \rangle$  and  $\langle 4, 4 \rangle$

30.3. The cross product of two vectors in space produces:

- A. a scalar
- B. another vector
- C. always 0
- D. a matrix

30.4. If two vectors are parallel, their cross product magnitude is:

- A. 0
- B. 1
- C. the dot product
- D. undefined

30.5. A projection tells you:

- A. the component of one vector along another
- B. the area of a triangle
- C. the midpoint of a segment
- D. the determinant of a matrix

31. Which value is  $(2, 3)$  dot  $(4, -1)$ ?

- A. 11
- B. -5
- C. -11
- D. 5

31.1. What is  $\langle 1, 2 \rangle \cdot \langle 3, 4 \rangle$ ?

- A. 7
- B. 10
- C. 11
- D. 14

31.2. Which pair of vectors is orthogonal?

- A.  $\langle 1, 2 \rangle$  and  $\langle 2, 4 \rangle$
- B.  $\langle 1, 2 \rangle$  and  $\langle 2, -1 \rangle$
- C.  $\langle 3, 0 \rangle$  and  $\langle 1, 1 \rangle$
- D.  $\langle 2, 2 \rangle$  and  $\langle 4, 4 \rangle$

31.3. The cross product of two vectors in space produces:

- A. a scalar
- B. another vector
- C. always 0
- D. a matrix

31.4. If two vectors are parallel, their cross product magnitude is:

- A. 0
- B. 1
- C. the dot product
- D. undefined

31.5. A projection tells you:

- A. the component of one vector along another
- B. the area of a triangle
- C. the midpoint of a segment
- D. the determinant of a matrix

32. If the dot product of two unit vectors is 1, what is true about them?

- A. They are perpendicular
- B. They point in opposite directions
- C. They point in the same direction
- D. Their magnitudes are 0

32.1. The magnitude of  $\langle 6, 8 \rangle$  is:

- A. 10
- B. 14
- C. 48
- D. 100

32.2. A unit vector has magnitude:

- A. 0
- B. 1
- C. 2
- D. 10

32.3. In the plane, the vector  $i$  usually means:

- A.  $\langle 0, 1 \rangle$
- B.  $\langle 1, 0 \rangle$
- C.  $\langle -1, 0 \rangle$
- D.  $\langle 1, 1 \rangle$

32.4. In the plane, the vector  $j$  usually means:

- A.  $\langle 0, 1 \rangle$
- B.  $\langle 1, 0 \rangle$
- C.  $\langle -1, 0 \rangle$
- D.  $\langle 1, 1 \rangle$

32.5. A position vector to point  $(5, -1)$  starts at:

- A.  $(5, -1)$
- B. the origin
- C.  $(0, -1)$
- D.  $(5, 0)$