Vectors: Dot and Cross Product, Angle and Area

Magnitudes, dot product, angle between, cross product and parallelogram area of two 3-D vectors, and the projection of one on the other.

Method: Vector algebra (Kreyszig, Advanced Engineering Mathematics, 10th ed. (Wiley), ch. 9)

Input parameters

Unit system: SI

Parameter	Value	Unit
a, x component	3.0000	
a, y component	-2.0000	
a, z component	1.0000	
b, x component	1.0000	
b, y component	4.0000	
b, z component	2.0000	

Calculated results

Parameter	Value	Unit
Magnitude of a	3.7417	
Magnitude of b	4.5826	
Dot product	-3.0000	
Angle between	100.08	°
Cross product, x	-8.0000	
Cross product, y	-5.0000	
Cross product, z	14.000	
Parallelogram area	16.882	
Projection of a on b	-0.65465	

Notes for this case

- Angle from atan2(|a × b|, a · b), accurate for nearly parallel vectors. Moment of a force M = r × F; work W = F · d.

Formula and method

$$a \cdot b = |a||b|\cos\theta, \quad a \times b = (a_y b_z - a_z b_y,\ a_z b_x - a_x b_z,\ a_x b_y - a_y b_x)$$

Variables

a_x	a, x component	-
a_y	a, y component	-
a_z	a, z component	-
b_x	b, x component	-
b_y	b, y component	-
b_z	b, z component	-
	a	$
	b	$
$a \cdot b$	Dot product	-
θ	Angle between	rad
$(a \times b)_x$	Cross product, x	-

$(a \times b)_y$	Cross product, y	-
$(a \times b)_z$	Cross product, z	-
	a\times b	$
$a \cdot \widehat{b}$	Projection of a on b	-

Method and standards

Vector products.

Assumptions and limits

- 3-D Cartesian vectors.

References

- Vector algebra (Kreyszig, Advanced Engineering Mathematics, 10th ed. (Wiley), ch. 9)

Report details

Report reference	FCC-ZNK0-9DCG (the same inputs always give the same reference)
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Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/general/geometry/vector-dot-cross-product

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.