EngineeringRise

Scalar and vector products

Formulas and units, JEE Main. Status: Reviewed on 2026-11-20.

Result	Formula	Units or note
Dot product	a . b = |a||b| cos(theta) = a1 b1 + a2 b2 + a3 b3 Valid when: theta is the angle between the vectors placed tail to tail, 0 to 180 degrees	product of the units of a and b
Angle between vectors	cos(theta) = (a . b)/(|a||b|) Valid when: both vectors non-zero	degrees or radian
Perpendicular test	a . b = 0 (non-zero vectors) Valid when: both vectors non-zero	dimensionless
Projection	scalar: (a . b)/|b|; vector: ((a . b)/|b|^2) b Valid when: b is not the zero vector	units of a
Cross product (components)	a x b = (a2 b3 - a3 b2, a3 b1 - a1 b3, a1 b2 - a2 b1) Valid when: three-dimensional vectors in right-handed i, j, k components	product of the units
Cross product (magnitude)	|a x b| = |a||b| sin(theta); a x b = -(b x a); a x a = 0 Valid when: theta is the angle between the vectors, 0 to 180 degrees	product of the units
Area	parallelogram |a x b|; triangle (1/2)|AB x AC|; diagonals (1/2)|p x q| Valid when: the two vectors are not parallel (otherwise area is 0)	square units
Lagrange identity	|a x b|^2 + (a . b)^2 = |a|^2 |b|^2 Valid when: any two vectors in 3D	square of the units
Distance of a point from a line	|QP x d|/|d| (Q on the line, direction d) Valid when: Q is any point on the line; d is the direction vector, non-zero	length
Work and torque	W = F . d (joule); torque = r x F (newton metre) Valid when: F, d, r as vectors; F constant for work	J (N m)

Full lesson with worked examples:
https://www.engineeringrise.in/learn/learn/jee-main/mathematics/vector-algebra/scalar-and-vector-products

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