

1–7 Find the cross product $\mathbf{a} \times \mathbf{b}$ and verify that it is orthogonal to both \mathbf{a} and \mathbf{b} .

1. $\mathbf{a} = \langle 6, 0, -2 \rangle$, $\mathbf{b} = \langle 0, 8, 0 \rangle$

4. $\mathbf{a} = \mathbf{j} + 7\mathbf{k}$, $\mathbf{b} = 2\mathbf{i} - \mathbf{j} + 4\mathbf{k}$

7. $\mathbf{a} = \langle t, t^2, t^3 \rangle$, $\mathbf{b} = \langle 1, 2t, 3t^2 \rangle$

8. If $\mathbf{a} = \mathbf{i} - 2\mathbf{k}$ and $\mathbf{b} = \mathbf{j} + \mathbf{k}$, find $\mathbf{a} \times \mathbf{b}$. Sketch \mathbf{a} , \mathbf{b} , and $\mathbf{a} \times \mathbf{b}$ as vectors starting at the origin.

13. State whether each expression is meaningful. If not, explain why. If so, state whether it is a vector or a scalar.

(a) $\mathbf{a} \cdot (\mathbf{b} \times \mathbf{c})$

(b) $\mathbf{a} \times (\mathbf{b} \cdot \mathbf{c})$

(c) $\mathbf{a} \times (\mathbf{b} \times \mathbf{c})$

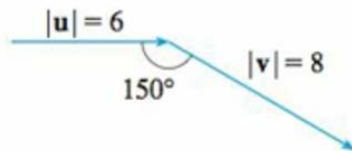
(d) $(\mathbf{a} \cdot \mathbf{b}) \times \mathbf{c}$

(e) $(\mathbf{a} \cdot \mathbf{b}) \times (\mathbf{c} \cdot \mathbf{d})$

(f) $(\mathbf{a} \times \mathbf{b}) \cdot (\mathbf{c} \times \mathbf{d})$

14–15 Find $|\mathbf{u} \times \mathbf{v}|$ and determine whether $\mathbf{u} \times \mathbf{v}$ is directed into the page or out of the page.

15.



20. Find two unit vectors orthogonal to both $\mathbf{i} + \mathbf{j} + \mathbf{k}$ and $2\mathbf{i} + \mathbf{k}$.

22. Show that $(\mathbf{a} \times \mathbf{b}) \cdot \mathbf{b} = 0$ for all vectors \mathbf{a} and \mathbf{b} in V_3 .

27. Find the area of the parallelogram with vertices $A(-2, 1)$, $B(0, 4)$, $C(4, 2)$, and $D(2, -1)$.

35–36 Find the volume of the parallelepiped with adjacent edges PQ , PR , and PS .

35. $P(2, 0, -1)$, $Q(4, 1, 0)$, $R(3, -1, 1)$, $S(2, -2, 2)$

41. A wrench 30 cm long lies along the positive y -axis and grips a bolt at the origin. A force is applied in the direction $\langle 0, 3, -4 \rangle$ at the end of the wrench. Find the magnitude of the force needed to supply 100 N·m of torque to the bolt.

44. (a) Let P be a point not on the plane that passes through the points Q , R , and S . Show that the distance d from P to the plane is

$$d = \frac{|(\mathbf{a} \times \mathbf{b}) \cdot \mathbf{c}|}{|\mathbf{a} \times \mathbf{b}|}$$

where $\mathbf{a} = \vec{QR}$, $\mathbf{b} = \vec{QS}$, and $\mathbf{c} = \vec{QP}$.

(b) Use the formula in part (a) to find the distance from the point $P(2, 1, 4)$ to the plane through the points $Q(1, 0, 0)$, $R(0, 2, 0)$, and $S(0, 0, 3)$.

37. Use the scalar triple product to verify that the vectors $\mathbf{u} = \mathbf{i} + 5\mathbf{j} - 2\mathbf{k}$, $\mathbf{v} = 3\mathbf{i} - \mathbf{j}$, and $\mathbf{w} = 5\mathbf{i} + 9\mathbf{j} - 4\mathbf{k}$ are coplanar.