Cross product and determinant calculations

6 questions | 12 marks

Equivalent correct methods earn the corresponding marks.

1. Find $(1, 0, 1) \times (0, 2, 1)$. [2 marks]

Use $(0 \cdot 1 - 1 \cdot 2, 1 \cdot 0 - 1 \cdot 1, 1 \cdot 2 - 0 \cdot 0)$.

Check both input dot products are zero.

Answer: $(-2, -1, 2)$

2. Find $(0, 2, 1) \times (1, 0, 1)$. [2 marks]

Reverse the order of the previous cross product.

Negate every component.

Answer: $(2, 1, -2)$

3. Find $\mathbf{i} \times \mathbf{j}$ and $\mathbf{j} \times \mathbf{i}$. [2 marks]

The positive basis is right-handed.

Reversing the order negates the result.

Answer: $\mathbf{k}$ and $-\mathbf{k}$

4. Is $(3, 0, -1)$ perpendicular to $(1, 2, 3) \times (2, -1, 0)$? [2 marks]

The cross product is $(3, 6, -5)$.

Its dot product with $(3, 0, -1)$ is 14.

Answer: No.

5. Find the determinant with rows $(1, 2, 0)$, $(0, 1, 3)$, $(2, 0, 1)$. [2 marks]

Cross the last two rows: $(1, 6, -2)$.

Dot with the first: $1 + 12 = 13$.

Answer: 13

6. Find the volume spanned by $(2, 0, 0)$, $(0, 3, 0)$, $(0, 0, 4)$. [2 marks]

The determinant is $2 \cdot 3 \cdot 4 = 24$.

Take its absolute value for volume.

Answer: 24 cubic units