Student: Phong Vo
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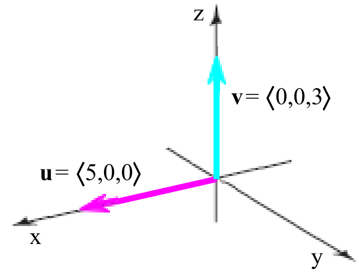
Instructor: Chuck Ormsby
Course: Multi-Variable and Vector Calculus -- Calculus III Spring 2018

Assignment: Section 12.4 Homework

1. Find the magnitude of the cross product of the vectors **u** and **v** given in the figure.



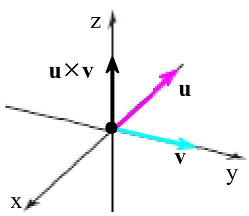
The magnitude of the cross product is 15 .
(Simplify your answer, including any radicals. Use integers or fractions for any numbers in the expression.)

2. Let $\mathbf{u} = \langle -3,0,0 \rangle$ and $\mathbf{v} = \langle 0,4,0 \rangle$. Compute $|\mathbf{u} \times \mathbf{v}|$. Then sketch **u**, **v**, and $\mathbf{u} \times \mathbf{v}$.

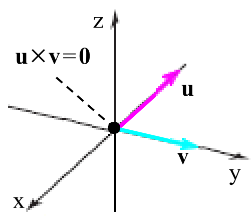
$|\mathbf{u} \times \mathbf{v}| =$ 12
(Simplify your answer, including any radicals. Use integers or fractions for any numbers in the expression.)

Choose the correct graph below.

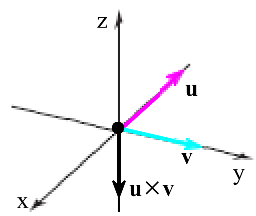
A.



B.



C. ✓

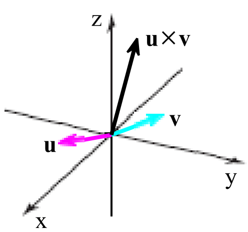


3. Let $\mathbf{u} = \langle 5,0,5 \rangle$ and $\mathbf{v} = \langle 5,5\sqrt{2},5 \rangle$. Compute $|\mathbf{u} \times \mathbf{v}|$. Then sketch **u**, **v**, and $\mathbf{u} \times \mathbf{v}$.

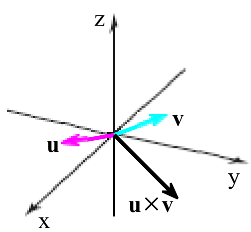
$|\mathbf{u} \times \mathbf{v}| =$ 50
(Simplify your answer, including any radicals. Use integers or fractions for any numbers in the expression.)

Choose the correct graph below.

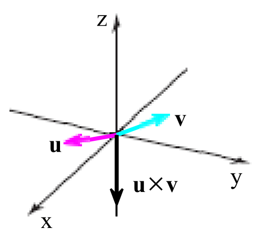
A. ✓



B.



C.



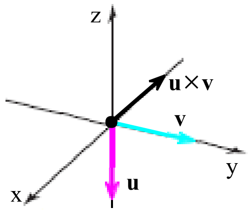
4. Compute the following cross product. Then make a sketch showing the two vectors and their cross product.

$-4\mathbf{k} \times 3\mathbf{j}$

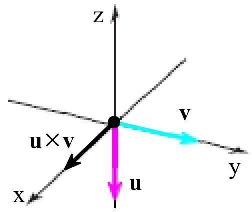
$-4\mathbf{k} \times 3\mathbf{j} = (\ 12\ )\mathbf{i} + (\ 0\ )\mathbf{j} + (\ 0\ )\mathbf{k}$
(Simplify your answers.)

Choose the correct graph below. Let **u** be the first vector, **v** be the second vector, and $\mathbf{u} \times \mathbf{v}$ be the cross product. Note that the vector lengths are not to scale.

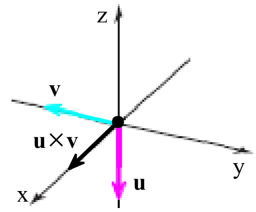
A.



B.



C.



5. Find the area of the parallelogram that has adjacent sides $\mathbf{u} = \mathbf{i} - 3\mathbf{j} + 3\mathbf{k}$ and $\mathbf{v} = 3\mathbf{j} - \mathbf{k}$.

The area of the parallelogram is $\sqrt{46}$.
(Type an exact answer, using radicals as needed.)

6. Find the area of the parallelogram that has adjacent sides $\mathbf{v} = 2\mathbf{i} + \mathbf{j} + 3\mathbf{k}$ and $\mathbf{w} = 4\mathbf{i} + \mathbf{j} - 2\mathbf{k}$.

The area of the parallelogram is $\sqrt{285}$.
(Type an exact answer, using radicals as needed.)

7. Find the cross products $\mathbf{u} \times \mathbf{v}$ and $\mathbf{v} \times \mathbf{u}$ for the vectors $\mathbf{u} = \langle 3,5,0 \rangle$ and $\mathbf{v} = \langle 0,3,-5 \rangle$.

$\mathbf{u} \times \mathbf{v} = (\ -25\ )\mathbf{i} + (\ 15\ )\mathbf{j} + (\ 9\ )\mathbf{k}$ (Simplify your answers.)

$\mathbf{v} \times \mathbf{u} = (\ 25\ )\mathbf{i} + (\ -15\ )\mathbf{j} + (\ -9\ )\mathbf{k}$ (Simplify your answers.)

8. Find the cross products $\mathbf{u} \times \mathbf{v}$ and $\mathbf{v} \times \mathbf{u}$ for the the vectors $\mathbf{u} = 3\mathbf{i} - \mathbf{j} - 3\mathbf{k}$ and $\mathbf{v} = \mathbf{i} + 3\mathbf{j} - 2\mathbf{k}$.

$\mathbf{u} \times \mathbf{v} = (\ 11\ )\mathbf{i} + (\ 3\ )\mathbf{j} + (\ 10\ )\mathbf{k}$ (Simplify your answers.)

$\mathbf{v} \times \mathbf{u} = (\ -11\ )\mathbf{i} + (\ -3\ )\mathbf{j} + (\ -10\ )\mathbf{k}$ (Simplify your answers.)

9. Find a vector normal to $\langle 0,1,2 \rangle$ and $\langle -2,2,0 \rangle$.

Choose the correct answer below.

- **A.** $\langle -4,-4,2 \rangle$
- **B.** $\langle -4,4,2 \rangle$
- **C.** $\langle 4,-4,2 \rangle$
- **D.** $\langle 4,4,2 \rangle$

10. Another operation with vectors is the scalar triple product, defined to be $\mathbf{u} \cdot (\mathbf{v} \times \mathbf{w})$ for vectors **u**, **v**, and **w** in $\mathbf{R}^3$. Express **u**, **v**, and **w** in terms of their components and show that $\mathbf{u} \cdot (\mathbf{v} \times \mathbf{w})$ equals the determinant shown on the right.

$$\begin{vmatrix} u_1 & u_2 & u_3 \\ v_1 & v_2 & v_3 \\ w_1 & w_2 & w_3 \end{vmatrix}$$

Which of the following is the correct expansion of both $\mathbf{u} \cdot (\mathbf{v} \times \mathbf{w})$ and $\begin{vmatrix} u_1 & u_2 & u_3 \\ v_1 & v_2 & v_3 \\ w_1 & w_2 & w_3 \end{vmatrix}$?

- **A.** $u_1\left(v_3w_2 - v_2w_3\right) + u_2\left(v_1w_3 - v_3w_1\right) + u_3\left(v_2w_1 - v_1w_2\right)$
- **B.** $u_1\left(v_2w_3 - v_3w_2\right) - u_2\left(v_1w_3 - v_3w_1\right) + u_3\left(v_1w_2 - v_2w_1\right)$
- **C.** $u_1\left(v_3w_2 - v_2w_3\right) - u_2\left(v_1w_3 - v_3w_1\right) + u_3\left(v_1w_2 - v_2w_1\right)$
- **D.** $u_1\left(v_2w_3 - v_3w_2\right) + u_2\left(v_1w_3 - v_3w_1\right) + u_3\left(v_1w_2 - v_2w_1\right)$