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davidcorzo@ufm.edu (
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MC 113, section A, Spring 2020

12.3 Producto Punto y 12.4 Producto Cruz (Homework)

INSTRUCTOR
Christiaan Ketelaar
Universidad Francisco Marroquin

Current Score

QUESTION	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
POINTS	2/2 ✓	2/2 ✓	1/1 ✓	1/1 ✓	1/1 ✓	–/1	–/2	–/2	–/2	–/2	–/1	–/2	–/2	–/1	–/2	–/1	–/2	–/1

TOTAL SCORE

7/39 17.9%

Due Date Past Due

TUE, FEB 11, 2020
11:58 PM CST

Request Extension

Assignment Submission & Scoring

Assignment Submission

For this assignment, you submit answers by question parts. The number of submissions remaining for each question part only changes if you submit or change the answer.

Assignment Scoring

Your last submission is used for your score.

The due date for this assignment has passed.

Your work can be viewed below, but no changes can be made.

Important! Before you view the answer key, decide whether or not you plan to request an extension. Your Instructor may not grant you an extension if you have viewed the answer key. Automatic extensions are not granted if you have viewed the answer key.

Request Extension

1. 2/2 points Previous Answers SCALC8 12.3.001. My Notes Ask Your Teacher

Which of the following expressions are meaningful? Which are meaningless? Explain.

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

$(\mathbf{a} \cdot \mathbf{b}) \cdot \mathbf{c}$ has no meaning ✓ no meaning because it is the dot product of a scalar and a vector ✓ a scalar and a vector .

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

$(\mathbf{a} \cdot \mathbf{b})\mathbf{c}$ has meaning ✓ meaning because it is a scalar multiple of a vector ✓ a vector .

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

$|\mathbf{a}|(\mathbf{b} \cdot \mathbf{c})$ has meaning ✓ meaning because it is the product of two scalars ✓ two scalars .

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

$\mathbf{a} \cdot (\mathbf{b} + \mathbf{c})$ has meaning ✓ meaning because it is the dot product of two vectors ✓ two vectors .

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

$\mathbf{a} \cdot \mathbf{b} + \mathbf{c}$ has no meaning ✓ no meaning because it is the sum of a scalar and a vector ✓ a scalar and a vector .

(f) $|\mathbf{a}| \cdot (\mathbf{b} + \mathbf{c})$

$|\mathbf{a}| \cdot (\mathbf{b} + \mathbf{c})$ has no meaning ✓ no meaning because it is the dot product of a scalar and a vector ✓ a scalar and a vector .

Solution or Explanation

(a) $\mathbf{a} \cdot \mathbf{b}$ is a scalar, and the dot product is defined only for vectors, so $(\mathbf{a} \cdot \mathbf{b}) \cdot \mathbf{c}$ has no meaning.

(b) $(\mathbf{a} \cdot \mathbf{b})\ \mathbf{c}$ is a scalar multiple of a vector, so it does have meaning.

(c) Both $|\mathbf{a}|$ and $\mathbf{b} \cdot \mathbf{c}$ are scalars, so $|\mathbf{a}|\ (\mathbf{b} \cdot \mathbf{c})$ is an ordinary product of real numbers, and has meaning.

(d) Both $\mathbf{a}$ and $\mathbf{b} + \mathbf{c}$ are vectors, so the dot product $\mathbf{a} \cdot (\mathbf{b} + \mathbf{c})$ has meaning.

(e) $\mathbf{a} \cdot \mathbf{b}$ is a scalar, but $\mathbf{c}$ is a vector, and so the two quantities cannot be added and $\mathbf{a} \cdot \mathbf{b} + \mathbf{c}$ has no meaning.

(f) $|\mathbf{a}|$ is a scalar, and the dot product is defined only for vectors, so $|\mathbf{a}| \cdot (\mathbf{b} + \mathbf{c})$ has no meaning.

2. 2/2 points Previous Answers **SCALC8 12.4.013.** My Notes Ask Your Teacher

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

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

- ○ The expression is meaningful. It is a vector.
- ◉ The expression is meaningful. It is a scalar.
- ○ The expression is meaningless. The cross product is defined only for two vectors.
- ○ The expression is meaningless. The dot product is defined only for two vectors.

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

- ○ The expression is meaningful. It is a vector.
- ○ The expression is meaningful. It is a scalar.
- ◉ The expression is meaningless. The cross product is defined only for two vectors.
- ○ The expression is meaningless. The dot product is defined only for two vectors.

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

- ◉ The expression is meaningful. It is a vector.
- ○ The expression is meaningful. It is a scalar.
- ○ The expression is meaningless. The cross product is defined only for two vectors.
- ○ The expression is meaningless. The dot product is defined only for two vectors.

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

- ○ The expression is meaningful. It is a vector.
- ○ The expression is meaningful. It is a scalar.
- ○ The expression is meaningless. The cross product is defined only for two vectors.
- ◉ The expression is meaningless. The dot product is defined only for two vectors.

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

- ○ The expression is meaningful. It is a vector.
- ○ The expression is meaningful. It is a scalar.
- ◉ The expression is meaningless. The cross product is defined only for two vectors.
- ○ The expression is meaningless. The dot product is defined only for two vectors.

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

- ○ The expression is meaningful. It is a vector.
- ◉ The expression is meaningful. It is a scalar.
- ○ The expression is meaningless. The cross product is defined only for two vectors.
- ○ The expression is meaningless. The dot product is defined only for two vectors.

Solution or Explanation

(a) Since **b** × **c** is a vector, the dot product **a** · (**b** × **c**) is meaningful and is a scalar.

(b) **b** · **c** is a scalar, so **a** × (**b** · **c**) is meaningless, as the cross product is defined only for two *vectors*.

(c) Since **b** × **c** is a vector, the cross product **a** × (**b** × **c**) is meaningful and results in another vector.

(d) **b** · **c** is a scalar, so the dot product **a** · (**b** · **c**) is meaningless, as the dot product is defined only for two vectors.

(e) Since (**a** · **b**) and (**c** · **d**) are both scalars, the cross product (**a** · **b**) × (**c** · **d**) is meaningless.

(f) **a** × **b** and **c** × **d** are both vectors, so the dot product (**a** × **b**) · (**c** × **d**) is meaningful and is a scalar.

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3. 1/1 points | Previous Answers | **SCALC8 12.3.005.** | My Notes | Ask Your Teacher

Find **a** · **b**.

$$\mathbf{a} = \left\langle 3, 1, \frac{1}{3} \right\rangle, \quad \mathbf{b} = \langle 7, -5, -9 \rangle$$

$\boxed{13}$ ✓ 13

Solution or Explanation

$$\mathbf{a} \cdot \mathbf{b} = \left\langle 3, 1, \frac{1}{3} \right\rangle \cdot \langle 7, -5, -9 \rangle = (3)(7) + (1)(-5) + \left(\frac{1}{3}\right)(-9) = 13$$

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4. 1/1 points | Previous Answers | **SCALC8 12.3.006.** | My Notes | Ask Your Teacher

Find **a** · **b**.

$$\mathbf{a} = \langle p, -p, 3p \rangle, \quad \mathbf{b} = \langle 2q, q, -q \rangle$$

$$−2*pq*

✓ $\boxed{-2pq}$

Solution or Explanation

Click to View Solution

5. 1/1 points Previous Answers **SCALC8 12.3.008.** My Notes Ask Your Teacher

Find **a** · **b**.

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

$$−11

-11

Solution or Explanation

Click to View Solution

6. –/1 points **SCALC8 12.3.009.** My Notes Ask Your Teacher

Find **a** · **b**.

$|\mathbf{a}| = 6, \quad |\mathbf{b}| = 4$, the angle between **a** and **b** is 30°.

(No Response) $12\sqrt{3}$

Solution or Explanation

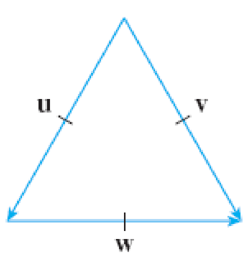
If θ is the angle between the vectors **a** and **b**, then

$$\mathbf{a} \cdot \mathbf{b} = |\mathbf{a}||\mathbf{b}|\cos(\theta).$$

By the theorem above, $\mathbf{a} \cdot \mathbf{b} = |\mathbf{a}||\mathbf{b}|\cos(\theta) = (6)(4)\cos(30°) = 24\left(\frac{\sqrt{3}}{2}\right) = 12\sqrt{3}$.

7. –/2 points **SCALC8 12.3.011.** My Notes Ask Your Teacher

If **u** is a unit vector, find **u** · **v** and **u** · **w**. (Assume **v** and **w** are also unit vectors.)



$\mathbf{u} \cdot \mathbf{v}$ = (No Response) 1/2

$\mathbf{u} \cdot \mathbf{w}$ = (No Response) -1/2

Solution or Explanation

u, **v**, and **w** are all unit vectors, so the triangle is an equilateral triangle. Thus the angle between **u** and **v** is 60° and $\mathbf{u} \cdot \mathbf{v} = |\mathbf{u}||\mathbf{v}| \cos 60° = (1)(1)\left(\frac{1}{2}\right) = \frac{1}{2}$. If **w** is moved so it has the same initial point as **u**, we can see that the angle between them is 120° and we have $\mathbf{u} \cdot \mathbf{w} = |\mathbf{u}||\mathbf{w}| \cos 120° = (1)(1)\left(-\frac{1}{2}\right) = -\frac{1}{2}$.

8. –/2 points SCALC8 12.4.001. My Notes Ask Your Teacher

Find the cross product **a** × **b**.

$\mathbf{a} = \langle 4, 5, 0 \rangle, \quad \mathbf{b} = \langle 1, 0, 3 \rangle$

(No Response) $15\mathbf{i} - 12\mathbf{j} - 5\mathbf{k}$

Verify that it is orthogonal to both **a** and **b**.

$(\mathbf{a} \times \mathbf{b}) \cdot \mathbf{a} =$ (No Response) 0

$(\mathbf{a} \times \mathbf{b}) \cdot \mathbf{b} =$ (No Response) 0

Solution or Explanation

$$\mathbf{a} \times \mathbf{b} = \begin{vmatrix} \mathbf{i} & \mathbf{j} & \mathbf{k} \\ 4 & 5 & 0 \\ 1 & 0 & 3 \end{vmatrix} = \begin{vmatrix} 5 & 0 \\ 0 & 3 \end{vmatrix}\mathbf{i} - \begin{vmatrix} 4 & 0 \\ 1 & 3 \end{vmatrix}\mathbf{j} + \begin{vmatrix} 4 & 5 \\ 1 & 0 \end{vmatrix}\mathbf{k}$$

$$= (15 - 0)\mathbf{i} - (12 - 0)\mathbf{j} + (0 - 5)\mathbf{k} = 15\mathbf{i} - 12\mathbf{j} - 5\mathbf{k}$$

Now $(\mathbf{a} \times \mathbf{b}) \cdot \mathbf{a} = \langle 15, -12, -5 \rangle \cdot \langle 4, 5, 0 \rangle = 60 - 60 + 0 = 0$ and $(\mathbf{a} \times \mathbf{b}) \cdot \mathbf{b} = \langle 15, -12, -5 \rangle \cdot \langle 1, 0, 3 \rangle = 15 + 0 - 15 = 0$, so $\mathbf{a} \times \mathbf{b}$ is orthogonal to both **a** and **b**.

9. –/2 points SCALC8 12.4.004. My Notes Ask Your Teacher

Find the cross product **a** × **b**.

$\mathbf{a} = 3\mathbf{i} + 3\mathbf{j} - 3\mathbf{k}, \quad \mathbf{b} = 3\mathbf{i} - 3\mathbf{j} + 3\mathbf{k}$

(No Response) $-18\mathbf{j} - 18\mathbf{k}$

Verify that it is orthogonal to both **a** and **b**.

$(\mathbf{a} \times \mathbf{b}) \cdot \mathbf{a} =$ (No Response) 0

$(\mathbf{a} \times \mathbf{b}) \cdot \mathbf{b} =$ (No Response) 0

Solution or Explanation

$$\mathbf{a} \times \mathbf{b} = \begin{vmatrix} \mathbf{i} & \mathbf{j} & \mathbf{k} \\ 3 & 3 & -3 \\ 3 & -3 & 3 \end{vmatrix} = \begin{vmatrix} 3 & -3 \\ -3 & 3 \end{vmatrix}\mathbf{i} - \begin{vmatrix} 3 & -3 \\ 3 & 3 \end{vmatrix}\mathbf{j} + \begin{vmatrix} 3 & 3 \\ 3 & -3 \end{vmatrix}\mathbf{k}$$

$$= (9 - 9)\mathbf{i} - [9 - (-9)]\mathbf{j} + (-9 - 9)\mathbf{k} = -18\mathbf{j} - 18\mathbf{k}$$

Since $(\mathbf{a} \times \mathbf{b}) \cdot \mathbf{a} = (-18\mathbf{j} - 18\mathbf{k}) \cdot (3\mathbf{i} + 3\mathbf{j} - 3\mathbf{k}) = 0 - 54 + 54 = 0$, $\mathbf{a} \times \mathbf{b}$ is orthogonal to **a**.

Since $(\mathbf{a} \times \mathbf{b}) \cdot \mathbf{b} = (-18\mathbf{j} - 18\mathbf{k}) \cdot (3\mathbf{i} - 3\mathbf{j} + 3\mathbf{k}) = 0 + 54 - 54 = 0$, $\mathbf{a} \times \mathbf{b}$ is orthogonal to **b**.

10. –/2 points SCALC8 12.4.007. My Notes Ask Your Teacher

Find the cross product **a** × **b**.

$\mathbf{a} = \langle t, 2, 1/t \rangle, \quad \mathbf{b} = \langle t^2, t^2, 1 \rangle$

(No Response) $(2-t)\mathbf{i} + (t^3 - 2t^2)\mathbf{k}$

Verify that it is orthogonal to both **a** and **b**.

$(\mathbf{a} \times \mathbf{b}) \cdot \mathbf{a} =$ (No Response) 0

$(\mathbf{a} \times \mathbf{b}) \cdot \mathbf{b} =$ (No Response) 0

Solution or Explanation

$$\mathbf{a} \times \mathbf{b} = \begin{vmatrix} \mathbf{i} & \mathbf{j} & \mathbf{k} \\ t & 2 & 1/t \\ t^2 & t^2 & 1 \end{vmatrix} = \begin{vmatrix} 2 & 1/t \\ t^2 & 1 \end{vmatrix}\mathbf{i} - \begin{vmatrix} t & 1/t \\ t^2 & 1 \end{vmatrix}\mathbf{j} + \begin{vmatrix} t & 2 \\ t^2 & t^2 \end{vmatrix}\mathbf{k}$$

$$= (2-t)\mathbf{i} - (t-t)\mathbf{j} + (t^3 - 2t^2)\mathbf{k} = (2-t)\mathbf{i} + (t^3 - 2t^2)\mathbf{k}$$

Since $(\mathbf{a} \times \mathbf{b}) \cdot \mathbf{a} = \langle 2-t, 0, t^3 - 2t^2 \rangle \cdot \langle t, 2, 1/t \rangle = 2t - t^2 + 0 + t^2 - 2t = 0$, **a** × **b** is orthogonal to **a**.

Since $(\mathbf{a} \times \mathbf{b}) \cdot \mathbf{b} = \langle 2-t, 0, t^3 - 2t^2 \rangle \cdot \langle t^2, t^2, 1 \rangle = 2t^2 - t^3 + 0 + t^3 - 2t^2 = 0$, **a** × **b** is orthogonal to **b**.

11. –/1 points SCALC8 12.4.011. My Notes Ask Your Teacher

Find the vector, not with determinants, but by using properties of cross products.

$(\mathbf{j} - \mathbf{k}) \times (\mathbf{k} - \mathbf{i})$

(No Response) $\mathbf{i} + \mathbf{j} + \mathbf{k}$

Solution or Explanation

Click to View Solution

12. –/2 points SCALC8 12.3.017. My Notes Ask Your Teacher

Find the angle between the vectors. (First find an exact expression and then approximate to the nearest degree.)

$\mathbf{a} = \langle 1, -4, 1\rangle, \quad \mathbf{b} = \langle 0, 9, -9\rangle$

exact (No Response) $\cos^{-1}\left(-\frac{5}{6}\right)$

approximate (No Response) 146 °

Solution or Explanation

$|\mathbf{a}| = \sqrt{1^2 + (-4)^2 + 1^2} = \sqrt{18} = 3\sqrt{2}, \quad |\mathbf{b}| = \sqrt{0^2 + 9^2 + (-9)^2} = \sqrt{162} = 9\sqrt{2},$ and

$\mathbf{a} \cdot \mathbf{b} = (1)(0) + (-4)(9) + (1)(-9) = -45$. Using the Corollary in the text, we have

$$\cos(\theta) = \frac{\mathbf{a} \cdot \mathbf{b}}{|\mathbf{a}||\mathbf{b}|} = \frac{-45}{3\sqrt{2} \cdot 9\sqrt{2}} = -\frac{45}{54} = -\frac{5}{6}$$

and the angle between **a** and **b** is $\theta = \cos^{-1}\left(-\frac{5}{6}\right) \approx 146°$.

13. –/2 points **SCALC8 12.3.023.** My Notes Ask Your Teacher

Determine whether the given vectors are orthogonal, parallel, or neither.

(a) $\mathbf{a} = \langle 9, 3\rangle, \quad \mathbf{b} = \langle -2, 6\rangle$

- orthogonal
- parallel
- neither

(b) $\mathbf{a} = \langle 8, 7, -2\rangle, \quad \mathbf{b} = \langle 3, -1, 7\rangle$

- orthogonal
- parallel
- neither

(c) $\mathbf{a} = -12\mathbf{i} + 8\mathbf{j} + 4\mathbf{k}, \quad \mathbf{b} = 9\mathbf{i} - 6\mathbf{j} - 3\mathbf{k}$

- orthogonal
- parallel
- neither

(d) $\mathbf{a} = 4\mathbf{i} - \mathbf{j} + 4\mathbf{k}, \quad \mathbf{b} = 5\mathbf{i} + 12\mathbf{j} - 2\mathbf{k}$

- orthogonal
- parallel
- neither

Solution or Explanation

(a) $\mathbf{a} \cdot \mathbf{b} = (9)(-2) + (3)(6) = 0,$ so **a** and **b** are orthogonal (and not parallel).

(b) $\mathbf{a} \cdot \mathbf{b} = (8)(3) + (7)(-1) + (-2)(7) = 3 \neq 0,$ so **a** and **b** are not orthogonal. Also, since **a** is not a scalar multiple of **b**, **a** and **b** are not parallel.

(c) $\mathbf{a} \cdot \mathbf{b} = (-12)(9) + (8)(-6) + (4)(-3) = -168 \neq 0,$ so **a** and **b** are not orthogonal. Because $\mathbf{a} = -\frac{4}{3}\mathbf{b},$ **a** and **b** are parallel.

(d) $\mathbf{a} \cdot \mathbf{b} = (4)(5) + (-1)(12) + (4)(-2) = 0,$ so **a** and **b** are orthogonal (and not parallel).

14. –/1 points **SCALC8 12.3.027.** My Notes Ask Your Teacher

Find a unit vector that is orthogonal to both $\mathbf{i} + \mathbf{j}$ and $\mathbf{i} + \mathbf{k}$.

(No Response) $\frac{1}{\sqrt{3}}\mathrm{i} - \frac{1}{\sqrt{3}}\mathrm{j} - \frac{1}{\sqrt{3}}\mathrm{k}$

Solution or Explanation

Click to View Solution

15. –/2 points SCALC8 12.3.034. My Notes Ask Your Teacher

Find the direction cosines and direction angles of the vector. (Give the direction angles correct to the nearest degree.)

$\langle 7, 5, -5 \rangle$

$\cos(\alpha) =$ (No Response) $\frac{7}{3\sqrt{11}}$

$\cos(\beta) =$ (No Response) $\frac{5}{3\sqrt{11}}$

$\cos(\gamma) =$ (No Response) $-\frac{5}{3\sqrt{11}}$

$\alpha =$ (No Response) 45 °

$\beta =$ (No Response) 60 °

$\gamma =$ (No Response) 120 °

Solution or Explanation

Click to View Solution

16. –/1 points SCALC8 12.3.038. My Notes Ask Your Teacher

If a vector has direction angles $\alpha = \pi/4$ and $\beta = \pi/3$, find the third direction angle γ.

$\gamma =$ (No Response) $\frac{\pi}{3}$

Solution or Explanation

Click to View Solution

17. –/2 points SCALC8 12.3.039. My Notes Ask Your Teacher

Find the scalar and vector projections of **b** onto **a**.

$\mathbf{a} = \langle -3, 4 \rangle, \quad \mathbf{b} = \langle 2, 4 \rangle$

scalar projection of **b** onto **a** (No Response) 2

vector projection of **b** onto **a** (No Response) $\left\langle -\frac{6}{5}, \frac{8}{5} \right\rangle$

Solution or Explanation

$|\mathbf{a}| = \sqrt{(-3)^2 + 4^2} = \sqrt{25} = 5$. The scalar projection of **b** onto **a** is $\text{comp}_{\mathbf{a}}\mathbf{b} = \dfrac{\mathbf{a} \cdot \mathbf{b}}{|\mathbf{a}|} = \dfrac{-3 \cdot 2 + 4 \cdot 4}{5} = 2$ and the vector projection of **b** onto **a** is $\text{proj}_{\mathbf{a}}\mathbf{b} = \left(\dfrac{\mathbf{a} \cdot \mathbf{b}}{|\mathbf{a}|}\right)\dfrac{\mathbf{a}}{|\mathbf{a}|} = 2 \cdot \frac{1}{5}\langle -3, 4 \rangle = \left\langle -\frac{6}{5}, \frac{8}{5} \right\rangle$.

18. –/1 points SCALC8 12.3.049.MI. My Notes Ask Your Teacher

Find the work done by a force $\mathbf{F} = 8\mathbf{i} - 6\mathbf{j} + 5\mathbf{k}$ that moves an object from the point $(0, 6, 8)$ to the point $(2, 12, 20)$ along a straight line. The distance is measured in meters and the force in newtons.

(No Response) 40 J

Solution or Explanation

Click to View Solution

19. –/1 points SCALC8 12.3.050. My Notes Ask Your Teacher

A tow truck drags a stalled car along a road. The chain makes an angle of 30° with the road and the tension in the chain is 1500 N. How much work is done by the truck in pulling the car 1 km?

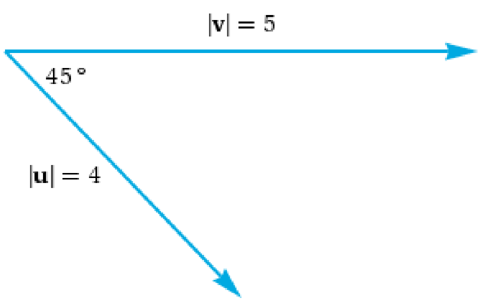
(No Response) $750,000\sqrt{3}$ J

Solution or Explanation

Click to View Solution

20. –/2 points SCALC8 12.4.014. My Notes Ask Your Teacher

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



$|\mathbf{u} \times \mathbf{v}| =$ (No Response) $10\sqrt{2}$

- $\mathbf{u} \times \mathbf{v}$ is directed into the screen.
- $\mathbf{u} \times \mathbf{v}$ is directed out of the screen.

Solution or Explanation

Using this theorem, we have $|\mathbf{u} \times \mathbf{v}| = |\mathbf{u}||\mathbf{v}| \sin(\theta) = (4)(5) \sin(45°) = 20 \cdot \frac{\sqrt{2}}{2} = 10\sqrt{2}$. By the right-hand rule, $\mathbf{u} \times \mathbf{v}$ is directed out of the screen.

21. –/2 points SCALC8 12.4.017. My Notes Ask Your Teacher

If **a** = ⟨2, −1, 4⟩ and **b** = ⟨9, 2, 1⟩, find the following.

a × **b** = (No Response) $-9\mathbf{i} + 34\mathbf{j} + 13\mathbf{k}$

b × **a** = (No Response) $9\mathbf{i} - 34\mathbf{j} - 13\mathbf{k}$

Solution or Explanation

$$\mathbf{a} \times \mathbf{b} = \begin{vmatrix} \mathbf{i} & \mathbf{j} & \mathbf{k} \\ 2 & -1 & 4 \\ 9 & 2 & 1 \end{vmatrix} = \begin{vmatrix} -1 & 4 \\ 2 & 1 \end{vmatrix}\mathbf{i} - \begin{vmatrix} 2 & 4 \\ 9 & 1 \end{vmatrix}\mathbf{j} + \begin{vmatrix} 2 & -1 \\ 9 & 2 \end{vmatrix}\mathbf{k} = (-1 - 8)\mathbf{i} - (2 - 36)\mathbf{j} + [4 - (-9)]\mathbf{k} = -9\mathbf{i} + 34\mathbf{j} + 13\mathbf{k}$$

$$\mathbf{b} \times \mathbf{a} = \begin{vmatrix} \mathbf{i} & \mathbf{j} & \mathbf{k} \\ 9 & 2 & 1 \\ 2 & -1 & 4 \end{vmatrix} = \begin{vmatrix} 2 & 1 \\ -1 & 4 \end{vmatrix}\mathbf{i} - \begin{vmatrix} 9 & 1 \\ 2 & 4 \end{vmatrix}\mathbf{j} + \begin{vmatrix} 9 & 2 \\ 2 & -1 \end{vmatrix}\mathbf{k} = [8 - (-1)]\mathbf{i} - (36 - 2)\mathbf{j} + (-9 - 4)\mathbf{k} = 9\mathbf{i} - 34\mathbf{j} - 13\mathbf{k}$$

By this theorem, we know **a** × **b** = −**b** × **a** is always true.

22. –/2 points SCALC8 12.4.027. My Notes Ask Your Teacher

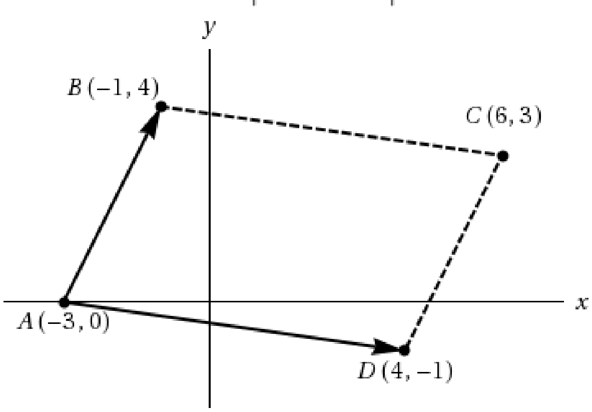
Find the area of the parallelogram with vertices $A(-3, 0)$, $B(-1, 4)$, $C(6, 3)$, and $D(4, -1)$.

(No Response) 30

Solution or Explanation

By plotting the vertices, we can see that the parallelogram is determined by the vectors $\overrightarrow{AB} = \langle 2, 4\rangle$ and $\overrightarrow{AD} = \langle 7, -1\rangle$. We know that the area of the parallelogram determined by two vectors is equal to the length of the cross product of these vectors. In order to compute the cross product, we consider the vector $\overrightarrow{AB}$ as the three-dimensional vector $\langle 2, 4, 0\rangle$ (and similarly for $\overrightarrow{AD}$), and then the area of parallelogram *ABCD* is

$$|\overrightarrow{AB} \times \overrightarrow{AD}| = \left\| \begin{vmatrix} \mathbf{i} & \mathbf{j} & \mathbf{k} \\ 2 & 4 & 0 \\ 7 & -1 & 0 \end{vmatrix} \right\| = |(0 - 0)\mathbf{i} - (0 - 0)\mathbf{j} + (-2 - 28)\mathbf{k}| = |-30\mathbf{k}| = 30.$$



23. –/2 points SCALC8 12.4.031. My Notes Ask Your Teacher

Consider the points below.

$P(0, -4, 0)$, $Q(5, 1, -2)$, $R(5, 3, 1)$

(a) Find a nonzero vector orthogonal to the plane through the points *P*, *Q*, and *R*.

(No Response) $19\mathbf{i} - 15\mathbf{j} + 10\mathbf{k}$

(b) Find the area of the triangle *PQR*.

(No Response) $7\sqrt{\frac{7}{2}}$

Solution or Explanation

Click to View Solution

24. –/1 points SCALC8 12.4.033. My Notes Ask Your Teacher

Find the volume of the parallelepiped determined by the vectors **a**, **b**, and **c**.

$\mathbf{a} = \langle 1, 2, 2\rangle, \quad \mathbf{b} = \langle -1, 1, 2\rangle, \quad \mathbf{c} = \langle 5, 1, 2\rangle$

(No Response) 12 cubic units

Solution or Explanation

Recalling that the volume of the parallelepiped determined by the vectors **a**, **b**, and **c** is the magnitude of their scalar triple product, $V = |\mathbf{a} \cdot (\mathbf{b} \times \mathbf{c})|$, one obtains

$$\mathbf{a} \cdot (\mathbf{b} \times \mathbf{c}) = \begin{vmatrix} 1 & 2 & 2 \\ -1 & 1 & 2 \\ 5 & 1 & 2 \end{vmatrix} = 1\begin{vmatrix} 1 & 2 \\ 1 & 2 \end{vmatrix} - 2\begin{vmatrix} -1 & 2 \\ 5 & 2 \end{vmatrix} + 2\begin{vmatrix} -1 & 1 \\ 5 & 1 \end{vmatrix} = 1 \cdot (2 - 2) - 2 \cdot (-2 - 10) + 2 \cdot (-1 - 5) = 12.$$

Thus the volume of the parallelepiped is 12 cubic units.

25. –/1 points SCALC8 12.4.037. My Notes Ask Your Teacher

Use the scalar triple product to determine if the vectors $\mathbf{u} = \mathbf{i} + 5\mathbf{j} - 3\mathbf{k}$, $\mathbf{v} = 3\mathbf{i} - \mathbf{j}$, and $\mathbf{w} = 6\mathbf{i} + 14\mathbf{j} - 9\mathbf{k}$ are coplanar.

- Yes, they are coplanar.
- No, they are not coplanar.

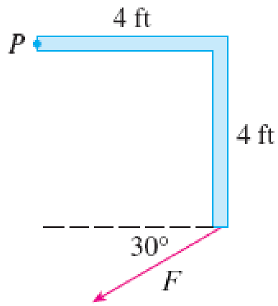
Solution or Explanation

Click to View Solution

26. –/0 points SCALC8 12.4.509.XP. My Notes Ask Your Teacher

Find the magnitude of the torque about P if an F = 20-lb force is applied as shown. (Round your answer to the nearest whole number.)

(No Response) 109 ft-lb



Solution or Explanation

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