1. We ask that you affirm your commitment to adhering to the Rutgers Honor Code on this quiz:

"On my honor, I have neither received nor given any unauthorized assistance on this exam."

Moreover, while the exam is taking place, you cannot use
Phones,
Calculators,
Computer algebra systems like Wolfram Alpha,
Anything else mentioned on the exam announcement.

You are allowed to use one hand-written page of notes.

☐ I agree with the honor code and the quiz directions
☐ I do not agree with the honor code and the quiz directions

Answer: I agree with the honor code and the quiz directions

2. RUTGERS MATH 251 OFFICIAL EXAM COPYRIGHT 2021 (39353)

Suppose that \( \mathbf{u}, \mathbf{v} \) are vectors such that

\[ \mathbf{u} \cdot \mathbf{u} = 2, \quad \mathbf{v} \cdot \mathbf{v} = 36 \]

RUTGERS MATH 251 OFFICIAL EXAM COPYRIGHT 2021 (39353)

a) The norm of \( \mathbf{u} \) is \( |\mathbf{u}| = \sqrt{\mathbf{u} \cdot \mathbf{u}} = \sqrt{2} \)

RUTGERS MATH 251 OFFICIAL EXAM COPYRIGHT 2021 (39353)

b) The norm of \( \mathbf{v} \) is \( |\mathbf{v}| = \sqrt{\mathbf{v} \cdot \mathbf{v}} = \sqrt{36} = 6 \)

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c) If \( (\mathbf{u} + \mathbf{v}) \cdot (\mathbf{u} - 2\mathbf{v}) = -70 \), the angle between \( \mathbf{u} \) and \( \mathbf{v} \) in radians is \( \pi/2 \).

Answers: \( \sqrt{2} \)

6
\( \pi \)
\( \pi/2 \)

\( \mathbf{u} \cdot \mathbf{v} - 2\mathbf{u} \cdot \mathbf{v} + \mathbf{v} \cdot \mathbf{v} - 2\mathbf{v} \cdot \mathbf{v} = -70 \)

\( 2 - \mathbf{u} \cdot \mathbf{v} - 7\mathbf{v} = -70 \)

\( -\mathbf{u} \cdot \mathbf{v} = 0 \)

\( \mathbf{u} \cdot \mathbf{v} = 0 \)

\( \mathbf{u}, \mathbf{v} \) are orthogonal
3. RUTGERS MATH 251 OFFICIAL EXAM COPYRIGHT 2021 (31816)

Suppose \( \mathbf{i} = <1,0>, \mathbf{j} = <0,1> \) are the standard unit vectors in \( \mathbb{R}^2 \).

RUTGERS MATH 251 OFFICIAL EXAM COPYRIGHT 2021 (31816)

a) Let \( \mathbf{v} \) represent the unit vector in the direction of the vector \( \mathbf{i} + \mathbf{j} = <1,1> \). Then.

\[
\mathbf{v} = <\frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}}>
\]

\[
\sqrt{v^2} = \frac{\sqrt{1^2 + 1^2}}{\sqrt{1^2 + 1^2}} = \frac{1}{\sqrt{2}} = <\frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}}>
\]

RUTGERS MATH 251 OFFICIAL EXAM COPYRIGHT 2021 (31816)

b) Suppose \( \mathbf{u} \) is the vector \( \mathbf{u} = <x,y> \).

Find the values of “x” and “y” if

\[
\text{proj}_y \mathbf{u} = 9 \mathbf{v}
\]

\[
\text{proj}_x \mathbf{u} = 4 \mathbf{j}
\]

\[
\mathbf{u} \cdot \mathbf{v} = 9
\]

\[
\mathbf{u} \cdot \mathbf{v} = 0
\]

Answers

\[
\frac{1}{\sqrt{2}}
\]

\[
\frac{1}{\sqrt{2}}
\]

\[
\sqrt{2} \cdot 9 - 4
\]

\[
4
\]

\[
\text{proj}_y \mathbf{u} = 9 \mathbf{v}
\]

\[
\text{proj}_x \mathbf{u} = 4 \mathbf{j}
\]

\[
y \mathbf{j} = 4 \mathbf{j}
\]

\[
\frac{x+y}{\sqrt{2}} = 9
\]

\[
x+y = 9 \sqrt{2}
\]

\[
\begin{align*}
x &= 9 \sqrt{2} - y
\end{align*}
\]
4. **UPLOAD PROBLEM:** REMEMBER YOU HAVE 20 MINUTES TO UPLOAD YOUR SOLUTION TO CANVAS AFTER FINISHING THE EXAM ON MYLAB

RUTGERS MATH 251 OFFICIAL EXAM COPYRIGHT 2021 (18457)

Consider the planes with equations

\[ 2x + 9y + 2z = 9 \]
\[- 2x + 2z = 0 \]

RUTGERS MATH 251 OFFICIAL EXAM COPYRIGHT 2021 (18457)

a) If \( P = (0, Y, Z) \) belongs to the intersection of both planes, then

\[
\begin{align*}
Y &= \underline{\phantom{0}} \\
Z &= \underline{\phantom{0}}
\end{align*}
\]

\[
\begin{align*}
9y + 2z &= 9 \\
2z &= 0 
\implies z &= 0
\end{align*}
\]

RUTGERS MATH 251 OFFICIAL EXAM COPYRIGHT 2021 (18457)

b) Find parametric equations for the line of intersection of the previous two planes. Write them in such a way that \( x = t \) is one of the parametric equations. The numbers that need to be entered in the boxes can include zero or one.

\[
\begin{align*}
x &= t \\
y &= \underline{\phantom{0}} + \phantom{0} \frac{4}{9} t \\
z &= \underline{\phantom{0}} + \phantom{0} t
\end{align*}
\]

Answers 1

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>(-2 \cdot 2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(\frac{9}{9})</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

\[
\nabla = \vec{m}_1 \times \vec{m}_2 = \begin{vmatrix} 
1 & 2 & 3 \\
2 & 0 & 2 \\
-2 & 9 & 2 \\
\end{vmatrix} = \vec{r}_1 = \langle 2, 9, 2 \rangle
\]

\[
\nabla \cdot \vec{m}_1 \times \vec{m}_2 = \langle 18, -8, 18 \rangle = \langle 18, -4 \sqrt{9}, 18 \rangle
\]
5. **UPLOAD PROBLEM:** REMEMBER YOU HAVE 20 MINUTES TO UPLOAD YOUR SOLUTION TO CANVAS AFTER FINISHING THE EXAM ON MYLAB

RUTGERS MATH 251 OFFICIAL EXAM COPYRIGHT 2021 (90200)

a) **Using vector techniques**, find the area of the triangle whose vertices are the points with coordinates

(3,0,0), (0,3,0), (0,0,2).

area =

RUTGERS MATH 251 OFFICIAL EXAM COPYRIGHT 2021 (90200)

b) Find an equation for the plane which contains the previous triangle

\[ x + y + z = 18 \]

Answers

\[ 0.5\sqrt{3 \cdot 2^2 + 3 \cdot 2^2 + 3 \cdot 3^2} \]

\[ 3 \cdot 2 \]

\[ 3 \cdot 2 \]

\[ 3 \cdot 3 \]

\[ \text{the normal vector is} \]

\[ \overrightarrow{PR} \times \overrightarrow{PR'} \]

\[ 9x + 6y + 6z = 18 \]