This print-out should have 35 questions. Multiple-choice questions may continue on the next column or page – find all choices before answering.

**FitParabola01a**
**001 10.0 points**

The graph of the function

$$y = ax^2 + bx + c$$

is a parabola passing through the points

$$(1, 11), \quad (-1, -1), \quad (-3, 11).$$

Find the $y$-intercept of this parabola.

**1.** $y$-intercept $= 4$

**2.** $y$-intercept $= 3$

**3.** $y$-intercept $= 2$

**4.** $y$-intercept $= 1$

**5.** $y$-intercept $= 5$

**EchelonForm01e**
**002 10.0 points**

If the augmented matrix for a system of linear equations in variables $x_1$, $x_2$, and $x_3$ is row equivalent to the matrix

$$B = \begin{bmatrix} 2 & -4 & 4 & 16 \\ -1 & 2 & 0 & -2 \\ -2 & 4 & -6 & -22 \end{bmatrix},$$

determine $x_1$.

**1.** system inconsistent

**2.** $x_1 = 2 + 2t, \quad t$ arbitrary

**3.** $x_1 = -1$

**4.** $x_1 = 3$

**5.** $x_1 = 3 + 2t, \quad t$ arbitrary

**6.** $x_1 = 2$

**4.** $\lambda = 1, -5$

**5.** $\lambda = 1$

**6.** $\lambda = 1, -1$

**M340LSpanM02**
**003 10.0 points**

Given

$$\mathbf{v_1} = \begin{bmatrix} 1 \\ 1 \\ 0 \end{bmatrix}, \quad \mathbf{v_2} = \begin{bmatrix} 2 \\ 4 \\ 2 \end{bmatrix}, \quad \mathbf{v_3} = \begin{bmatrix} 1 \\ 0 \\ -1 \end{bmatrix},$$

determine all values of $\lambda$ for which

$$\mathbf{w} = \begin{bmatrix} -3 \\ -2 \\ \lambda \end{bmatrix}$$

is a vector in Span$\{\mathbf{v_1}, \mathbf{v_2}, \mathbf{v_3}\}$?

**1.** $\lambda = -5$

**2.** $\lambda = -1$

**3.** $\lambda = -1, -5$

**MatEquTF03**
**004 10.0 points**

If $A$ is an $m \times n$ matrix and the equation $A\mathbf{x} = \mathbf{b}$ is consistent for some $\mathbf{b}$ in $\mathbb{R}^m$, then the columns of $A$ span $\mathbb{R}^m$.

True or False?

**1.** FALSE

**2.** TRUE

**1.** # molecules = 57

**2.** # molecules = 63

**3.** # molecules = 60

**4.** # molecules = 66

**5.** # molecules = 54

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**BalChemEqt02a**
**005 10.0 points**

During photosynthesis green plants convert carbon dioxide $CO_2$ and water $H_2O$ into glucose $C_6H_{12}O_6$ and oxygen $O_2$, represented chemically by

$$CO_2 + H_2O \longrightarrow C_6H_{12}O_6 + O_2 .$$

If 10 molecules of glucose were produced in one particular conversion, how many molecules of carbon dioxide were used?

**SpanTF04**
**006 10.0 points**

If $\mathbf{u}$, $\mathbf{v}$, and $\mathbf{w}$ are nonzero vectors in $\mathbb{R}^2$ and $\mathbf{u}$ is not a multiple of $\mathbf{v}$, is $\mathbf{w}$ a linear combination of $\mathbf{u}$ and $\mathbf{v}$?

**1.** ALWAYS

**2.** NEVER

**3.** SOMETIMES

**LinTransform02a**
**007 10.0 points**

If $A$ is an $m \times n$ matrix, then the range of the transformation

$$T : \mathbb{R}^n \to \mathbb{R}^m, \quad T_A : \mathbf{x} \to A\,\mathbf{x},$$

is the set of all linear combinations of the columns of $A$.

True or False?

**1.** FALSE

**2.** TRUE

**MatrixTrans02a**
**008 10.0 points**

If $T : \mathbb{R}^3 \to \mathbb{R}^2$ is a linear transformation such that

$$T(\mathbf{e}_1) = \begin{bmatrix} 3 \\ 4 \end{bmatrix}, \quad T(\mathbf{e}_2) = \begin{bmatrix} 2 \\ 1 \end{bmatrix},$$

and $T(\mathbf{e}_3) = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$, determine $T(\mathbf{u})$ when

$$\mathbf{u} = \begin{bmatrix} 3 \\ 2 \\ 1 \end{bmatrix}.$$

**1.** $T(\mathbf{u}) = \begin{bmatrix} 15 \\ 15 \end{bmatrix}$

**2.** $T(\mathbf{u}) = \begin{bmatrix} 14 \\ 16 \end{bmatrix}$

**3.** $T(\mathbf{u}) = \begin{bmatrix} 13 \\ 16 \end{bmatrix}$

**4.** $T(\mathbf{u}) = \begin{bmatrix} 13 \\ 15 \end{bmatrix}$

**5.** $T(\mathbf{u}) = \begin{bmatrix} 14 \\ 15 \end{bmatrix}$

**6.** $T(\mathbf{u}) = \begin{bmatrix} 15 \\ 16 \end{bmatrix}$

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**MatrixOpsTF02c**
**009 10.0 points**

If $A$ is an $n \times n$ matrix, then

$$(A^2)^T = (A^T)^2$$

True or False?

**1.** TRUE

**2.** FALSE

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**InverseMatrix05b**
**010 10.0 points**

Evaluate the matrix product $B^{-1}A^T$ when

$$A = \begin{bmatrix} 1 & 2 \\ 1 & 1 \\ 2 & -1 \end{bmatrix}, \quad B = \begin{bmatrix} 3 & 1 \\ 5 & 2 \end{bmatrix}.$$

**1.** $B^{-1}A^T = \begin{bmatrix} -8 & -3 & 9 \\ 1 & -2 & -13 \end{bmatrix}$

**2.** $B^{-1}A^T = \begin{bmatrix} 0 & 1 & 5 \\ 5 & 2 & -5 \end{bmatrix}$

**3.** $B^{-1}A^T = \begin{bmatrix} 0 & 5 \\ 1 & 2 \\ 5 & -5 \end{bmatrix}$

**4.** $B^{-1}A^T = \begin{bmatrix} -8 & 5 \\ -3 & 2 \\ 9 & -5 \end{bmatrix}$

**5.** $B^{-1}A^T = \begin{bmatrix} 0 & 1 & 5 \\ 1 & -2 & -13 \end{bmatrix}$

**6.** $B^{-1}A^T = \begin{bmatrix} -8 & 1 \\ -3 & -2 \\ 9 & -13 \end{bmatrix}$

**InvertibleTF02a**
**011 10.0 points**

If $A$ and $D$ are $n \times n$ matrices such that $AD = I$, then $DA = I$

True or False?

**1.** FALSE

**2.** TRUE

**LUDecomp06g**
**012 10.0 points**

Find $U$ in an $LU$ decomposition of

$$A = \begin{bmatrix} 4 & -4 & 0 & -2 \\ -16 & 16 & 5 & 5 \\ -4 & 4 & 15 & -10 \end{bmatrix}.$$

**1.** $U = \begin{bmatrix} 4 & -4 & 0 & -2 \\ 0 & 0 & 5 & -3 \\ 0 & 0 & 0 & -3 \end{bmatrix}$

**2.** $U = \begin{bmatrix} 1 & 4 & -4 & 4 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$

**3.** $U = \begin{bmatrix} 4 & 4 & 0 & 2 \\ 0 & 0 & 5 & 3 \\ 0 & 0 & 0 & -3 \end{bmatrix}$

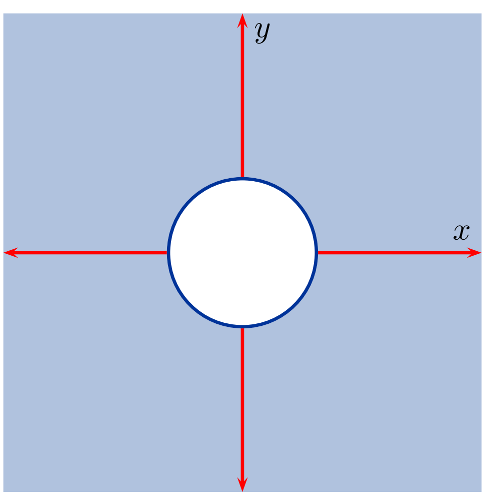
**4.** $U = \begin{bmatrix} 1 & 4 & 0 & 2 \\ 0 & 0 & 1 & 3 \\ 0 & 0 & 0 & 1 \end{bmatrix}$

**5.** $U = \begin{bmatrix} 4 & 4 & -4 & 4 \\ 0 & 0 & 5 & 0 \\ 0 & 0 & 0 & -3 \end{bmatrix}$

**6.** $U = \begin{bmatrix} 1 & -4 & 0 & -2 \\ 0 & 0 & 1 & -3 \\ 0 & 0 & 0 & 1 \end{bmatrix}$

**Subspace01cT/F**
**013 10.0 points**

The set of points in the shaded region (including the bounding lines and assumed to stretch to $\pm\infty$ in all directions) shown in




is a subspace of $\mathbb{R}^2$.

True or False?

**1.** FALSE

**ColNulDimTF01a**
**014 10.0 points**

If $A$ is a $4 \times 5$ matrix, then

$$\dim(\mathrm{Col}(A)) + \dim(\mathrm{Nul}(A)) \;=\; 5\,.$$

True or False?

**1.** TRUE

**2.** FALSE

**Determinant02e**
**015 10.0 points**

Compute the determinant of the matrix

$$A \;=\; \begin{bmatrix} -2 & -2 & 2 \\ -4 & -2 & 3 \\ 6 & 4 & -6 \end{bmatrix}$$

**1.** $\det(A) \;=\; 5$

**2.** $\det(A) \;=\; 7$

**3.** $\det(A) \;=\; 3$

**4.** $\det(A) \;=\; 6$

**5.** $\det(A) \ = \ 4$

**DetMult05**
**016 10.0 points**

Evaluate $\det\left[B^5\right]$ when

$$B \ = \ \begin{bmatrix} 1 & 0 & 1 \\ 1 & 1 & 2 \\ 1 & 2 & 1 \end{bmatrix}.$$

**1.** $\det\left[B^5\right] \ = \ -10$

**2.** $\det\left[B^5\right] \ = \ 32$

**3.** $\det\left[B^5\right] \ = \ -2$

**4.** $\det\left[B^5\right] \ = \ -32$

**5.** $\det\left[B^5\right] \ = \ 10$

**VectorSpaceT/F04a**
**017 10.0 points**

The set $H$ of all polynomials

$$\mathbf{p}(x) = a + bx^4\,, \quad a,\, b \text{ in } \mathbb{R}\,,$$

is a subspace of the vector space $\mathbb{P}_6$ of all polynomials of degree at most 6.

True or False?

**1.** FALSE

**2.** TRUE

**BasisNull02b**
**018 10.0 points**

Find a basis for the Null space of the matrix

$$A = \begin{bmatrix} 3 & -3 & -6 & 15 \\ 2 & -2 & -6 & 16 \\ 1 & -1 & -3 & 8 \end{bmatrix}.$$

**1.** $\left\{ \begin{bmatrix} 1 \\ 0 \\ -3 \\ 1 \end{bmatrix} \right\}$

**2.** $\left\{ \begin{bmatrix} -1 \\ 1 \\ 0 \\ 0 \end{bmatrix} \right\}$

**3.** $\left\{ \begin{bmatrix} -1 \\ 1 \\ 0 \\ 0 \end{bmatrix}, \begin{bmatrix} -1 \\ 0 \\ -3 \\ 1 \end{bmatrix} \right\}$

**4.** $\left\{ \begin{bmatrix} -1 \\ 0 \\ -3 \\ 1 \end{bmatrix} \right\}$

**5.** $\left\{ \begin{bmatrix} 1 \\ 1 \\ 0 \\ 0 \end{bmatrix}, \begin{bmatrix} -1 \\ 0 \\ -3 \\ 1 \end{bmatrix} \right\}$

**6.** $\left\{ \begin{bmatrix} 1 \\ 1 \\ 0 \\ 0 \end{bmatrix}, \begin{bmatrix} 1 \\ 0 \\ 3 \\ 1 \end{bmatrix} \right\}$

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**BasisCol02a**
**019 10.0 points**

First find a basis for Col($A$) when

$$A = \begin{bmatrix} 1 & -1 & 3 \\ -3 & 4 & -11 \\ 1 & 2 & -3 \end{bmatrix} = [\mathbf{a}_1 \ \ \mathbf{a}_2 \ \ \mathbf{a}_3],$$

and then select *all* the correct statements from among the following:

I: $\{\mathbf{a}_1, \mathbf{a}_2, \mathbf{a}_3\}$ *is a linearly dependent set.*

II: $\{\mathbf{a}_1, \mathbf{a}_2, \mathbf{a}_3\}$ *is a basis for* $\mathbb{R}^3$.

III: $\operatorname{rank}(A) = 2$.

IV: $\operatorname{nullity}(A) = 1$.

V: $\operatorname{rank}(A) = 3$.

**1.** I, II, and V

**2.** II only

**3.** II and V

**4.** I and III

**5.** I, III, and IV

**Basis02**
**020 10.0 points**

Find a basis for the space spanned by the following vectors.

$$\begin{bmatrix}1\\0\\0\\1\end{bmatrix}, \begin{bmatrix}-2\\0\\0\\2\end{bmatrix}, \begin{bmatrix}3\\-1\\1\\-1\end{bmatrix}, \begin{bmatrix}5\\-3\\3\\-4\end{bmatrix}, \begin{bmatrix}2\\-1\\1\\0\end{bmatrix}$$

**1.** $\left\{\begin{bmatrix}1\\0\\0\\1\end{bmatrix}, \begin{bmatrix}-2\\0\\0\\2\end{bmatrix}, \begin{bmatrix}3\\-1\\1\\-1\end{bmatrix}\right\}$

**2.** $\left\{\begin{bmatrix}1\\0\\0\\1\end{bmatrix}, \begin{bmatrix}5\\-3\\3\\-4\end{bmatrix}, \begin{bmatrix}2\\-1\\1\\0\end{bmatrix}\right\}$

**3.** $\left\{\begin{bmatrix}3\\-1\\1\\-1\end{bmatrix}, \begin{bmatrix}5\\-3\\3\\-4\end{bmatrix}, \begin{bmatrix}2\\-1\\1\\0\end{bmatrix}\right\}$

**4.** $\left\{\begin{bmatrix}1\\0\\0\\1\end{bmatrix}, \begin{bmatrix}3\\-1\\1\\-1\end{bmatrix}, \begin{bmatrix}2\\-1\\1\\0\end{bmatrix}\right\}$

**5.** $\left\{\begin{bmatrix}-2\\0\\0\\2\end{bmatrix}, \begin{bmatrix}3\\-1\\1\\-1\end{bmatrix}, \begin{bmatrix}5\\-3\\3\\-4\end{bmatrix}\right\}$

**CoordVec03a**
**021 10.0 points**

Find the coordinate vector $[\mathbf{x}]_{\mathcal{B}}$ in $\mathbb{R}^3$ for the vector

$$\mathbf{x} = \begin{bmatrix}3\\-5\\4\end{bmatrix}$$

with respect to the basis

$$\mathcal{B} = \left\{\begin{bmatrix}1\\0\\3\end{bmatrix}, \begin{bmatrix}2\\1\\8\end{bmatrix}, \begin{bmatrix}1\\-1\\2\end{bmatrix}\right\}$$

for $\mathbb{R}^3$.

**1.** $[\mathbf{x}]_{\mathcal{B}} = \begin{bmatrix}5\\2\\0\end{bmatrix}$

**2.** $[\mathbf{x}]_{\mathcal{B}} = \begin{bmatrix}2\\0\\-5\end{bmatrix}$

**3.** $[\mathbf{x}]_{\mathcal{B}} = \begin{bmatrix} 0 \\ -2 \\ 5 \end{bmatrix}$

**4.** $[\mathbf{x}]_{\mathcal{B}} = \begin{bmatrix} -2 \\ 0 \\ 5 \end{bmatrix}$

**5.** $[\mathbf{x}]_{\mathcal{B}} = \begin{bmatrix} -5 \\ -2 \\ 0 \end{bmatrix}$

**6.** $[\mathbf{x}]_{\mathcal{B}} = \begin{bmatrix} 0 \\ 2 \\ 5 \end{bmatrix}$

**PolySpanVecTF01a**
**022 10.0 points**

The polynomials

$$\mathbf{p}_1 = 1 - 3t + 5t^2, \quad \mathbf{p}_2 = -3 + 5t - 7t^2,$$

and

$$\mathbf{p}_3 = -4 + 5t - 6t^2, \quad \mathbf{p}_4 = 1 - t^2,$$

span $\mathbb{P}_2$.

True or False? (Hint: use coordinate vectors.)

**1.** TRUE

**2.** FALSE

**RankTF06c**
**023 10.0 points**

The dimensions of the row space and column space of an $m \times n$ matrix $A$ are the same, even if $m \neq n$.

True or False?

**1.** TRUE

**2.** FALSE

**ChangeBasis04b**
**024 (part 1 of 2) 10.0 points**

In $\mathbb{P}_2$ determine the change of coordinates matrix $P_{\mathcal{C}\leftarrow\mathcal{B}}$ from basis $\mathcal{B} = \{\mathbf{p}_1, \mathbf{p}_2, \mathbf{p}_3\}$ to the standard monomial basis $\mathcal{C} = \{1, t, t^2\}$ when

$$\mathbf{p}_1 = 1 - 3t^2, \quad \mathbf{p}_2 = 2 + t - 5t^2$$

and

$$\mathbf{p}_3 = 1 + 2t\,.$$

**1.** $P_{\mathcal{C}\leftarrow\mathcal{B}} = \begin{bmatrix} 1 & 2 & 1 \\ 0 & 1 & 2 \\ -3 & -5 & 0 \end{bmatrix}$

**2.** $P_{\mathcal{C}\leftarrow\mathcal{B}} = \begin{bmatrix} 5 & 2 & 1 \\ 0 & 1 & 2 \\ -3 & -5 & 0 \end{bmatrix}$

**3.** $P_{\mathcal{C}\leftarrow\mathcal{B}} = \begin{bmatrix} 1 & -2 & 1 \\ 0 & 1 & 2 \\ -3 & 5 & 0 \end{bmatrix}$

**4.** $P_{\mathcal{C}\leftarrow\mathcal{B}} = \begin{bmatrix} -2 & -1 & -5 \\ 0 & -1 & 2 \\ 3 & -5 & 0 \end{bmatrix}$

**5.** $P_{\mathcal{C}\leftarrow\mathcal{B}} = \begin{bmatrix} -5 & 2 & 1 \\ 0 & 1 & -2 \\ -3 & -5 & 0 \end{bmatrix}$

**6.** $P_{\mathcal{C}\leftarrow\mathcal{B}} = \begin{bmatrix} 2 & 5 & 1 \\ 0 & 1 & 2 \\ -3 & -5 & 0 \end{bmatrix}$

**025 (part 2 of 2) 10.0 points**

Express $\mathbf{q}(t) = t^2$ as a linear combination of the polynomials in the basis $\mathcal{B}$.

1. $\mathbf{q} = 2\mathbf{p}_1 - 3\mathbf{p}_2 - \mathbf{p}_3$

2. $\mathbf{q} = 2\mathbf{p}_1 - 3\mathbf{p}_2 + \mathbf{p}_3$

3. $\mathbf{q} = 3\mathbf{p}_1 + 2\mathbf{p}_2 + \mathbf{p}_3$

4. $\mathbf{q} = 3\mathbf{p}_1 + 2\mathbf{p}_2 - \mathbf{p}_3$

5. $\mathbf{q} = 2\mathbf{p}_1 + 3\mathbf{p}_2 - \mathbf{p}_3$

6. $\mathbf{q} = 3\mathbf{p}_1 - 2\mathbf{p}_2 + \mathbf{p}_3$

**Eigenspace02a**
**026 10.0 points**

Find a basis for the eigenspace of the matrix

$$A = \begin{bmatrix} 1 & 3 & 3 \\ -3 & -5 & -3 \\ 3 & 3 & 1 \end{bmatrix},$$

corresponding to the eigenvalue $\lambda = -2$.

1. $\begin{bmatrix} -1 \\ 1 \\ 0 \end{bmatrix}, \begin{bmatrix} -1 \\ 0 \\ 1 \end{bmatrix}$

2. $\begin{bmatrix} -1 \\ 1 \\ 0 \end{bmatrix}$

3. $\begin{bmatrix} 1 \\ -1 \\ 1 \end{bmatrix}$

4. $\begin{bmatrix} 1 \\ -1 \\ 1 \end{bmatrix}, \begin{bmatrix} -1 \\ 0 \\ 1 \end{bmatrix}$

5. $\begin{bmatrix} 1 \\ -1 \\ 1 \end{bmatrix}, \begin{bmatrix} -1 \\ 1 \\ 0 \end{bmatrix}, \begin{bmatrix} -1 \\ 0 \\ 1 \end{bmatrix}$

**CharPoly05a**
**027 10.0 points**

Determine the Characteristic Polynomial of the matrix

$$A = \begin{bmatrix} 2 & -1 & 0 \\ -1 & 2 & -1 \\ 0 & -1 & 2 \end{bmatrix}$$

**1.** $4 - 10\lambda + 4\lambda^2 - \lambda^3$

**2.** $4 - 4\lambda + 10\lambda^2 - \lambda^3$

**3.** $6 + 4\lambda - 10\lambda^2 + \lambda^3$

**4.** $6 - 10\lambda + 4\lambda^2 + \lambda^3$

**5.** $4 + 4\lambda - 10\lambda^2 - \lambda^3$

**6.** $6 + 10\lambda - 4\lambda^2 + \lambda^3$

**Diagonalize02a**
**028 10.0 points**

Find a matrix $P$ and $d_2$, $d_3$ so that

$$P \begin{bmatrix} 1 & 0 & 0 \\ 0 & d_2 & 0 \\ 0 & 0 & d_3 \end{bmatrix} P^{-1}, \quad d_1 \geq d_2 \geq d_3,$$

is a diagonalization of the matrix

$$A = \begin{bmatrix} 1 & 0 & 0 \\ 1 & 0 & 0 \\ -8 & 8 & -2 \end{bmatrix}.$$

**1.** $d_2 = 2,\ d_3 = 0,$

$$P = \begin{bmatrix} 1 & 0 & 0 \\ 1 & 1 & 0 \\ 0 & 4 & 1 \end{bmatrix}$$

**2.** $d_2 = 0,\ d_3 = -2,$

$$P = \begin{bmatrix} 0 & 0 & 1 \\ 0 & 1 & 1 \\ 1 & 4 & 0 \end{bmatrix}$$

**3.** $d_2 = 2,\ d_3 = 0,$

$$P = \begin{bmatrix} 0 & 0 & 1 \\ 0 & 1 & 1 \\ 1 & 4 & 0 \end{bmatrix}$$

**4.** $d_2 = 0,\ d_3 = -2,$

$$P = \begin{bmatrix} 1 & 0 & 0 \\ 1 & 0 & 1 \\ 0 & 1 & 4 \end{bmatrix}$$

**5.** $d_2 = 2,\ d_3 = 0,$

$$P = \begin{bmatrix} 1 & 0 & 0 \\ 1 & 0 & 1 \\ 0 & 1 & 4 \end{bmatrix}$$

**6.** $d_2 = 0,\ d_3 = -2,$

$$P = \begin{bmatrix} 1 & 0 & 0 \\ 1 & 1 & 0 \\ 0 & 4 & 1 \end{bmatrix}$$

**CalC13c03a**
**029 10.0 points**

Which of the following statements are true for all vectors $\mathbf{a}$, $\mathbf{b}$?

A. $\|\mathbf{a}-\mathbf{b}\|^2 = \|\mathbf{a}\|^2 + 2\,\mathbf{a}\cdot\mathbf{b} + \|\mathbf{b}\|^2$,

B. $|\mathbf{a}\cdot\mathbf{b}| = \|\mathbf{a}\|\,\|\mathbf{b}\|,\ \mathbf{a}\neq 0,\ \mathbf{b}\neq 0 \implies$ $\mathbf{a}$ parallel to $\mathbf{b}$,

C. $\mathbf{a}\cdot\mathbf{b} = 0 \implies \mathbf{a} = 0$ or $\mathbf{b} = 0$.

**1.** A and C only

**2.** B and C only

**3.** none of them

**4.** A and B only

**5.** all of them

**6.** A only

**7.** C only

**8.** B only

**OrthoBasis01b**
**030 10.0 points**

Determine $c_2$ so that

$$\mathbf{y} = c_1\mathbf{u}_1 + c_2\mathbf{u}_2 + c_3\mathbf{u}_3$$

when

$$\mathbf{y} = \begin{bmatrix} -3 \\ 1 \\ 4 \end{bmatrix}$$

and

$$\mathbf{u}_1 = \begin{bmatrix} 1 \\ -1 \\ 0 \end{bmatrix},\quad \mathbf{u}_2 = \begin{bmatrix} 0 \\ 0 \\ -2 \end{bmatrix},\quad \mathbf{u}_3 = \begin{bmatrix} 4 \\ 4 \\ 0 \end{bmatrix}.$$

**1.** $c_2 = 1$

**2.** No value of $c_2$ exists.

**3.** $c_2 = -1$

**4.** $c_2 = -2$

**5.** $c_2 = 2$

**6.** $c_2 = 0$

**DistanceMC01**
**031 10.0 points**

Find the distance from $\mathbf{y}$ to the plane in $\mathbb{R}^3$ spanned by $\mathbf{u}_1$ and $\mathbf{u}_2$ when

$$\mathbf{y} = \begin{bmatrix} 5 \\ -9 \\ 5 \end{bmatrix}, \quad \mathbf{u}_1 = \begin{bmatrix} -3 \\ -5 \\ 1 \end{bmatrix}, \quad \mathbf{u}_2 = \begin{bmatrix} -3 \\ 2 \\ 1 \end{bmatrix}.$$

**1.** dist $= 2\sqrt{5}$

**2.** dist $= 4$

**3.** dist $= 6$

**4.** dist $= \sqrt{6}$

**5.** dist $= 2\sqrt{10}$

**6.** dist $= 8$

**GramSchmidt01a**
**032 10.0 points**

Use the fact that

$$A = \begin{bmatrix} 1 & -4 & 9 & -7 \\ -1 & 2 & -4 & 1 \\ 5 & -6 & 10 & 7 \end{bmatrix}$$

$$\sim \begin{bmatrix} 1 & 0 & -1 & 5 \\ 0 & -2 & 5 & -6 \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

to determine an orthogonal basis for $\mathrm{Col}(A)$.

**1.** $\begin{bmatrix} -4 \\ 2 \\ -6 \end{bmatrix}, \quad \begin{bmatrix} 1 \\ -1 \\ -1 \end{bmatrix}$

**2.** $\begin{bmatrix} 1 \\ -1 \\ 5 \end{bmatrix}, \quad \begin{bmatrix} -4 \\ 1 \\ 1 \end{bmatrix}$

**3.** $\begin{bmatrix} 1 \\ -1 \\ 5 \end{bmatrix}, \quad \begin{bmatrix} 1 \\ -4 \\ -1 \end{bmatrix}$

**4.** $\begin{bmatrix} -4 \\ 2 \\ -6 \end{bmatrix}, \quad \begin{bmatrix} 1 \\ -1 \\ 5 \end{bmatrix}$

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**LeastSquares02c**
**033 10.0 points**

Find the least-squares solution of $A\mathbf{x} = \mathbf{b}$ when

$$A = \begin{bmatrix} 1 & 1 \\ 2 & 2 \\ -1 & -2 \end{bmatrix}, \quad \mathbf{b} = \begin{bmatrix} -1 \\ -1 \\ 4 \end{bmatrix}.$$

**1.** $\frac{1}{5}\begin{bmatrix} 14 \\ -22 \end{bmatrix}$

**2.** $\frac{1}{5}\begin{bmatrix} 20 \\ -21 \end{bmatrix}$

**3.** $\frac{1}{5}\begin{bmatrix} 14 \\ -17 \end{bmatrix}$

**4.** $\begin{bmatrix} -7 \\ -11 \end{bmatrix}$

**5.** $\begin{bmatrix} -1 \\ -1 \end{bmatrix}$

**RegressionLine03c**
**034 10.0 points**

Find the Least Squares Regression line $y = mx + b$ that best fits the data points

$$(-1,\,-1), \quad (0,\,3), \quad (1,\,-3), \quad (2,\,4)\,.$$

**OrthogDiag02a**
**035 10.0 points**

When

$$A = \begin{bmatrix} -3 & 2 \\ 2 & -6 \end{bmatrix}$$

find matrices $D$ and $P$ in an orthogonal diagonalization of $A$ given that $\lambda_1 > \lambda_2$.