This print-out should have 15 questions. Multiple-choice questions may continue on the next column or page – find all choices before answering.

**001 10.0 points**

For which value(s) of $\lambda$ will the vectors

$$\mathbf{v_1} = \begin{bmatrix} 4 \\ 9 \\ 1 \end{bmatrix}, \quad \mathbf{v_2} = \begin{bmatrix} -2 \\ 3 \\ 2 \end{bmatrix}, \quad \mathbf{v_3} = \begin{bmatrix} 6 \\ 6 \\ \lambda + 2 \end{bmatrix},$$

be linearly dependent?

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

**2.** $\lambda = -3$

**3.** $\lambda \neq -3$

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

**5.** $\lambda \neq 1$

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

**002 5.0 points**

If $\mathbf{u}_1$, $\mathbf{u}_2$, $\mathbf{u}_3$ and $\mathbf{u}_4$ are vectors in $\mathbb{R}^7$ and $\mathbf{u}_2 = 0$, then the set $S = \{\mathbf{u}_1, \mathbf{u}_2, \mathbf{u}_3, \mathbf{u}_4\}$ is linearly dependent.

True or False?

**1.** TRUE

**2.** FALSE

**003 5.0 points**

The columns of a 5x6 matrix A are linearly dependent.

True or False?

**1.** FALSE

**2.** TRUE

**004 5.0 points**

If a set of vectors contains fewer vectors than there are entries in the vectors, then the set must be linearly independent.

True or False?

**1.** FALSE

**2.** TRUE

**005 10.0 points**

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

$$T\left(\begin{bmatrix} x_1 \\ x_2 \end{bmatrix}\right) = x_1 \begin{bmatrix} -1 \\ -2 \end{bmatrix} + x_2 \begin{bmatrix} 2 \\ 1 \end{bmatrix},$$

determine $T(\mathbf{x})$ when $\mathbf{x} = \begin{bmatrix} 1 \\ 3 \end{bmatrix}$.

**1.** $T(\mathbf{x}) = \begin{bmatrix} 6 \\ 1 \end{bmatrix}$

**2.** $T(\mathbf{x}) = \begin{bmatrix} 1 \\ 3 \end{bmatrix}$

**3.** $T(\mathbf{x}) = \begin{bmatrix} 5 \\ 1 \end{bmatrix}$

**4.** $T(\mathbf{x}) = \begin{bmatrix} 5 \\ 0 \end{bmatrix}$

**5.** $T(\mathbf{x}) = \begin{bmatrix} 6 \\ 0 \end{bmatrix}$

**006 10.0 points**

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

$$T\left(\begin{bmatrix} 1 \\ 0 \end{bmatrix}\right) = \begin{bmatrix} 1 \\ -1 \end{bmatrix}, \quad T\left(\begin{bmatrix} 0 \\ 1 \end{bmatrix}\right) = \begin{bmatrix} -2 \\ 2 \end{bmatrix},$$

determine $T(\mathbf{x})$ when $\mathbf{x} = \begin{bmatrix} 3 \\ 1 \end{bmatrix}$.

**1.** $T(\mathbf{x}) = \begin{bmatrix} 3 \\ 1 \end{bmatrix}$

**2.** $T(\mathbf{x}) = \begin{bmatrix} 1 \\ -2 \end{bmatrix}$

**3.** $T(\mathbf{x}) = \begin{bmatrix} 2 \\ -1 \end{bmatrix}$

**4.** $T(\mathbf{x}) = \begin{bmatrix} 2 \\ -2 \end{bmatrix}$

**5.** $T(\mathbf{x}) = \begin{bmatrix} 1 \\ -1 \end{bmatrix}$

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**007 10.0 points**

Let $T : \mathbb{R}^2 \to \mathbb{R}^2$ be the linear transformation such that

$$T(x_1, x_2) = (4x_1 + x_2, -2x_1 - 2x_2)\,.$$

Determine $A$ so that $T$ can be written as the matrix transformation $T_A : \mathbb{R}^2 \to \mathbb{R}^2$.

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

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

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

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

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**008 10.0 points**

Consider the matrix

$$A = \begin{bmatrix} 2 & 1 & 3 \\ 1 & -1 & 1 \end{bmatrix}$$

If a transformation $T\colon \mathrm{R}^3 \to \mathrm{R}^2$ is defined as $T(\mathbf{x}) = A\mathbf{x}$, is this transformation one-to-one or onto?

**1.** one-to-one

**2.** neither one-to-one nor onto

**3.** onto

**4.** both one-to-one and onto

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**009 10.0 points**

Consider the matrix

$$A = \begin{bmatrix} 3 & 1 & 1 \\ 1 & 2 & 1 \\ 1 & -1 & 0 \\ 1 & 0 & 1 \end{bmatrix}$$

If a transformation $T\colon \mathrm{R}^3 \to \mathrm{R}^4$ is defined as $T(\mathbf{x}) = A\mathbf{x}$, is this transformation one-to-one or onto?

**1.** onto

**2.** one-to-one

**3.** both one-to-one and onto

**4.** neither one-to-one nor onto

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**010 10.0 points**

Consider the matrix

$$A = \begin{bmatrix} 2 & 1 & 3 \\ 2 & -1 & -3 \\ -3 & 3 & 3 \end{bmatrix}$$

If a transformation $T\colon \mathrm{R}^3 \to \mathrm{R}^3$ is defined as $T(\mathbf{x}) = A\mathbf{x}$, is this transformation one-to-one or onto?

**1.** onto

**2.** neither one-to-one nor onto

**3.** both one-to-one and onto

**4.** one-to-one

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**011 10.0 points**

Consider the matrix

$$A = \begin{bmatrix} 1 & -2 & 3 \\ 3 & -3 & -3 \\ -1 & 1 & 1 \end{bmatrix}$$

If a transformation $T\colon \mathrm{R}^3 \to \mathrm{R}^3$ is defined as $T(\mathbf{x}) = A\mathbf{x}$, is this transformation one-to-one or onto?

**1.** both one-to-one and onto

**2.** neither one-to-one nor onto

**3.** onto

**4.** one-to-one

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**012 10.0 points**

Compute the expression $AB - BA$ when

$$A = \begin{bmatrix} 1 & 3 \\ 5 & 4 \end{bmatrix}, \quad B = \begin{bmatrix} -2 & 2 \\ 2 & -4 \end{bmatrix}.$$

**1.** $AB - BA = \begin{bmatrix} -16 & 4 \\ 16 & 4 \end{bmatrix}$

**2.** $AB - BA = \begin{bmatrix} -4 & 0 \\ 16 & 16 \end{bmatrix}$

**3.** $AB - BA = \begin{bmatrix} -4 & -12 \\ 0 & 4 \end{bmatrix}$

**4.** $AB - BA = \begin{bmatrix} -4 & -12 \\ 16 & 4 \end{bmatrix}$

**5.** $AB - BA = \begin{bmatrix} 16 & 0 \\ 16 & 4 \end{bmatrix}$

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**013 10.0 points**

Compute the product of the matrices

$$A = \begin{bmatrix} 3 & -4 & 2 \\ 3 & 4 & -3 \end{bmatrix}, \quad B = \begin{bmatrix} 2 & -2 \\ -5 & 3 \\ 3 & -4 \end{bmatrix}.$$

**1.** $\begin{bmatrix} -32 & -26 \\ -23 & -18 \end{bmatrix}$

**2.** $\begin{bmatrix} 32 & -26 \end{bmatrix}$

**3.** $\begin{bmatrix} 32 & 26 \\ 23 & 18 \end{bmatrix}$

**4.** $\begin{bmatrix} 32 & -26 \\ -23 & 18 \end{bmatrix}$

**5.** $\begin{bmatrix} 32 & -26 & -23 \\ -23 & 18 & 2 \end{bmatrix}$

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**014 10.0 points**

Determine the matrix product

$$\begin{bmatrix} 3 & 2 & -1 \\ 4 & 10 & 0 \\ 0 & 1 & 2 \end{bmatrix} \begin{bmatrix} 2 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 1 & 0 & 1 \end{bmatrix}$$

**1.** $\begin{bmatrix} 6 & 1 & 3 & -1 \\ 8 & 10 & 4 & 0 \\ 0 & 3 & 0 & 2 \end{bmatrix}$

**2.** It is undetermined.

**3.** $\begin{bmatrix} 1 & 3 & -1 \\ 8 & 10 & 4 \\ 3 & 0 & 2 \end{bmatrix}$

**4.** $\begin{bmatrix} 6 & 8 & 0 \\ 1 & 10 & 3 \\ 3 & 4 & 0 \\ -1 & 0 & 2 \end{bmatrix}$

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**015 10.0 points**

Compute the product $AB$ of the matrices

$$A = \begin{bmatrix} -2 & 1 & 1 \\ 1 & 4 & 1 \\ 3 & -2 & -1 \end{bmatrix}, \quad B = \begin{bmatrix} 2 & 3 & 2 \\ 5 & 2 & -2 \\ 3 & -4 & 2 \end{bmatrix}.$$

**1.** $AB = \begin{bmatrix} 3 & 25 & -7 \\ -8 & 5 & 9 \\ -4 & -4 & 5 \end{bmatrix}$

**2.** $AB = \begin{bmatrix} 4 & 25 & -7 \\ -8 & 7 & 9 \\ -4 & -4 & 8 \end{bmatrix}$

**3.** $AB = \begin{bmatrix} 4 & -8 & -4 \\ 25 & 7 & -4 \\ -7 & 9 & 8 \end{bmatrix}$

**4.** $AB = \begin{bmatrix} 3 & -8 & -4 \\ 25 & 5 & -4 \\ -7 & 9 & 5 \end{bmatrix}$