

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

---

**MatrixOpsTF01b**  
**001 10.0 points**

When

$$A = [\mathbf{a}_1 \ \mathbf{a}_2 \ \dots \ \mathbf{a}_n]$$

and  $B$  are matrices such that the product  $AB$  is defined, then

$$AB = [B\mathbf{a}_1 \ B\mathbf{a}_2 \ \dots \ B\mathbf{a}_n].$$

True or False?

1. FALSE
2. TRUE

---

**InverseProp01a**  
**002 10.0 points**

Which of the following shows that if  $A$  is an invertible  $n \times n$  matrix and  $B$  is any  $n \times n$  matrix such that  $BA = I$ , then  $B = A^{-1}$ .

1. Left-multiply each side of the equation  $I = BA$  by  $A^{-1}$ . Then

$$A^{-1} = A^{-1}BA = BI = B,$$

so  $B = A^{-1}$ .

2. Subtract  $A^{-1}$  from both sides of the equation  $I = BA$ . Then

$$I - A^{-1} = BA - A^{-1},$$

so  $A^{-1} = BI = B$ .

3. Add  $A^{-1}$  to both sides of the equation  $I = BA$ . Then

$$I + A^{-1} = BA + A^{-1},$$

so  $A^{-1} = BI = B$ .

4. Right-multiply each side of the equation  $I = BA$  by  $A^{-1}$ . Then

$$A^{-1} = BAA^{-1} = BI = B,$$

so  $B = A^{-1}$ .

---

**InverseTF02a**  
**003 10.0 points**

If  $A$  is an  $n \times n$  invertible matrix, then the same sequence of elementary row operations that row reduces  $A$  to the identity  $I_n$  also reduces  $A^{-1}$  to  $I_n$ .

True or False?

1. FALSE
2. TRUE

4. i

5. None of these.

6. All of these.

---

**Invertible01**  
**004    10.0 points**

$A$  is an  $n \times n$  matrix. Which of the following statements are equivalent to  $A$  being invertible?

- (i) *There is no  $n \times n$  matrix  $C$  such that  $CA = I$ .*
- (ii) *The equation  $A\mathbf{x} = \mathbf{0}$  has infinitely many solutions.*
- (iii) *The linear transformation  $\mathbf{x} \rightarrow A\mathbf{x}$  is not one-to-one.*

1. i and ii

2. i and iii

3. ii

---

**LUDecomp2x3b**

**005    10.0 points**

Determine the Lower Triangular matrix  $L$  in an  $LU$ -Decomposition of

$$A = \begin{bmatrix} 3 & 2 & 0 \\ -9 & -6 & 1 \end{bmatrix}.$$

1.  $L = \begin{bmatrix} 1 & 0 \\ -3 & 1 \end{bmatrix}$

2.  $L = \begin{bmatrix} 3 & 0 \\ 9 & 1 \end{bmatrix}$

3.  $L = \begin{bmatrix} 1 & 0 \\ 3 & 1 \end{bmatrix}$

4.  $L = \begin{bmatrix} 3 & 0 \\ 3 & 1 \end{bmatrix}$

5.  $L = \begin{bmatrix} 3 & 0 \\ -3 & 1 \end{bmatrix}$

6.  $L = \begin{bmatrix} 3 & 0 \\ -9 & 1 \end{bmatrix}$

---

**NullSpace01a**  
**006 10.0 points**

Find a matrix  $A$  so that  $\text{Nul}(A)$  is the set of all vectors

$$H = \left\{ \begin{bmatrix} a \\ b \\ c \\ d \end{bmatrix} : \begin{array}{l} a - b = 2c, \\ 3a = c - 4d, \end{array} \right\}$$

in  $\mathbb{R}^4$ .

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

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

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

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

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

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

---

**Rank02b**  
**007 10.0 points**

Determine the rank of the matrix

$$A = \begin{bmatrix} 1 & -1 & 2 \\ -3 & 4 & -8 \\ 3 & -6 & 12 \end{bmatrix}.$$

1.  $\text{rank}(A) = 4$

2.  $\text{rank}(A) = 2$

3.  $\text{rank}(A) = 3$

4.  $\text{rank}(A) = 1$

5.  $\text{rank}(A) = 5$

---

**DetInverseT/F01a**  
**009 10.0 points**

The matrix

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

is invertible.

True or False?

1. TRUE
2. FALSE

---

**DetElemOps01TF**  
**008 10.0 points**

When the matrix

$$B = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$$

is obtained from

$$A = \begin{bmatrix} c & d \\ a & b \end{bmatrix}$$

by interchanging rows, then

$$\det[B] = \det[A].$$

True or False?

1. FALSE
2. TRUE

---

**SubspaceTF01**  
**010 10.0 points**

Let  $H$  be the set of points inside and on the unit circle in the  $xy$ -plane. That is, let

$$H = \left\{ \begin{bmatrix} x \\ y \end{bmatrix} : x^2 + y^2 \leq 1 \right\}.$$

$H$  is a subspace of  $\mathbb{R}^2$ . True or false?

1. FALSE
2. TRUE

---

**BasisNull02a**  
**011    10.0 points**

Find a basis for the Null space of the matrix

$$A = \begin{bmatrix} 3 & -3 & 6 & -15 \\ -1 & -2 & 7 & -1 \\ 3 & -2 & 3 & -13 \end{bmatrix}.$$

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

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

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

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

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

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

---

**LinIndSetsTF01b**  
**012    10.0 points**

When  $\mathbf{b}_1, \mathbf{b}_2, \dots, \mathbf{b}_p$  are vectors in  $\mathbb{R}^n$  and

$$H = \text{Span}\{\mathbf{b}_1, \mathbf{b}_2, \dots, \mathbf{b}_p\},$$

then  $\{\mathbf{b}_1, \mathbf{b}_2, \dots, \mathbf{b}_p\}$  is a basis for  $H$ .

True or False?

1. TRUE

2. FALSE

---

**CoordVec01a**  
**013    10.0 points**

Find the vector  $\mathbf{x}$  in  $\mathbb{R}^2$  having coordinate vector

$$[\mathbf{x}]_{\mathcal{B}} = \begin{bmatrix} 8 \\ -5 \end{bmatrix}$$

with respect to the basis

$$\mathcal{B} = \left\{ \begin{bmatrix} 4 \\ 5 \end{bmatrix}, \begin{bmatrix} 6 \\ 7 \end{bmatrix} \right\}$$

for  $\mathbb{R}^2$ .

1.  $\mathbf{x} = \begin{bmatrix} 2 \\ 5 \end{bmatrix}$

2.  $\mathbf{x} = \begin{bmatrix} -5 \\ -2 \end{bmatrix}$

3.  $\mathbf{x} = \begin{bmatrix} 5 \\ 2 \end{bmatrix}$

4. no such  $\mathbf{x}$  exists

5.  $\mathbf{x} = \begin{bmatrix} -2 \\ -5 \end{bmatrix}$

---

**DimSubspace01a**  
**014    10.0 points**

Determine the dimension of the subspace

$$\text{Span} \left\{ \begin{bmatrix} 1 \\ 0 \\ 2 \end{bmatrix}, \begin{bmatrix} 3 \\ 1 \\ 1 \end{bmatrix}, \begin{bmatrix} 9 \\ 4 \\ -2 \end{bmatrix}, \begin{bmatrix} -7 \\ -3 \\ 1 \end{bmatrix} \right\}$$

of  $\mathbb{R}^3$ .

1.  $\dim = 3$

2.  $\dim = 4$

3.  $\dim = 2$

4.  $\dim = 1$

5.  $\dim = 5$

---

**RankTF06b**  
**015    10.0 points**

If  $B$  is an echelon form of an  $m \times n$  matrix  $A$ , and if  $B$  has three nonzero rows, then the first three row of  $A$  form a basis for  $\text{Row}(A)$ .

True or False?

1. TRUE

2. FALSE

