NAME: ____

Matrices and Matrix Calculations - Spring 2017

Midterm Exam I, February 16, 2017

In all multiple choice problems you don't have to show your work. In all non-multiple choice problems you are required to show all your work and provide the necessary explanations everywhere to get full credit.

This print-out should have 17 questions. Multiple-choice questions may continue on the next column or page – find all choices before answering.

FinM4a24
001 10.0 points

Pandit is an aging dog who has to be kept on a strict diet containing, among other things, 3.9 grams of protein and 2.7 grams of fat. Two dog foods are available to Pandit's owner.

Food A has 7% protein and 3% fat, while

Food B has 6% protein and 6% fat.

How many grams of food A should Pandit's owner use in his diet?

1. # grams food $A = 30$

2. # grams food $A = 29$

3. # grams food $A = 31$

4. # grams food $A = 33$

5. # grams food $A = 32$

FitParabola01b
002 10.0 points

When the graph of the function

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

is the unique parabola passing through the points

$$(1, 6), \quad (-1, 2), \quad (-3, 6),$$

determine b.

1. $b = 5$

2. $b = 3$

3. $b = 4$

4. $b = 1$

5. $b = 2$

1. TRUE

2. FALSE

LinearSystemT/F01a
003 10.0 points

Elementary row operations on an augmented matrix never change the the solution set of the associated linear system.

True or False?

1. FALSE

2. TRUE

LinSysUniqueTF02
004 10.0 points

If a system of linear equations has no free variables, then it has a unique solution.

True or False?

RowReduceMan02a
005 10.0 points

The augmented matrix of a linear system of equations has been reduced by row operations to

$$\begin{bmatrix} 1 & 2 & -3 & 7 \\ 0 & 1 & -1 & 3 \\ 0 & 0 & 1 & -2 \end{bmatrix}.$$

(a) *Continue row operations to write the matrix in reduced row echelon form.*

(b) *Then determine the solution set of the original system.*

AxisIntersect01a
006 10.0 points

When P is the plane in $\mathbb{R}^3$ given in vector form by

$$\mathbf{x} = \begin{bmatrix} -3 \\ 2 \\ 2 \end{bmatrix} + s \begin{bmatrix} -1 \\ -2 \\ 1 \end{bmatrix} + t \begin{bmatrix} -2 \\ -3 \\ 4 \end{bmatrix},$$

determine where P intersects the z-axis.

1. $z = -20$

2. $z = -19$

3. $z = -17$

4. $z = -16$

5. $z = 18$

M340LSpanM02
007 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 λ for which

$$\mathbf{w} = \begin{bmatrix} -1 \\ -3 \\ \lambda \end{bmatrix}$$

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

1. $\lambda = 2, -4$

2. $\lambda = -4$

3. $\lambda = -2, 2$

4. $\lambda = -2$

5. $\lambda = 2$

6. $\lambda = -2, -4$

VectorEquTF01e
008 10.0 points

If $\mathbf{u}, \mathbf{v}$ are vectors in $\mathbb{R}^3$, when can Span$\{\mathbf{u}, \mathbf{v}\}$ be visualized as a plane through the origin in $\mathbb{R}^3$.

True or False?

1. NEVER

2. ALWAYS

3. SOMETIMES

Consistent01d
009 10.0 points

Describe geometrically the conditions on a vector $\mathbf{b}$ in $\mathbb{R}^2$ under which the equation

$$\begin{bmatrix} 3 & 1 \\ -12 & -4 \end{bmatrix} \mathbf{x} = \mathbf{b}$$

has a solution in $\mathbb{R}^2$.

1. any $\mathbf{b}$ not on line $y + 4x = 0$

2. arbitrary $\mathbf{b}$ in $\mathbb{R}^2$

3. $\mathbf{b}$ lies on line $y - 4x = 0$

4. $\mathbf{b}$ lies on line $y + 4x = 0$

5. any $\mathbf{b}$ not on line $y - 4x = 0$

MatEquTF02b
010 10.0 points

If the matrix equation $A\mathbf{x} = \mathbf{b}$ is consistent, then $\mathbf{b}$ is in the set spanned by the columns of A.

True or False?

1. FALSE

2. TRUE

SolSetsLinSysTF03
011 10.0 points

If the equation $A\mathbf{x} = \mathbf{b}$ has more than one solution, then so does the homogeneous equation $A\mathbf{x} = \mathbf{0}$.

True or False?

1. TRUE

2. FALSE

ThreePoints01a
012 10.0 points

Determine the linear equation of the unique plane in $\mathbb{R}^3$ containing the points

$$P(1,\, 1,\, 3), \quad Q(-2,\, -1,\, -4),$$

and

$$R(3,\, 5,\, 14)\,.$$

1. $6x - 19y - 8z = 1$

2. $6x + 19y + 8z + 1 = 0$

3. $6x + 19y - 8z + 1 = 0$

4. $6x + 19y - 8z = 1$

5. $6x - 19y + 8z = 1$

6. $6x - 19y + 8z + 1 = 0$

BalChemEqt01a
013 10.0 points

When butane C_4H_{10} burns in the presence of oxygen O_2 it produces carbon dioxide CO_2 and water H_2O, represented chemically by

$$C_4H_{10} + O_2 \longrightarrow CO_2 + H_2O\,.$$

If 35 molecules of water were produced in one particular reaction, how many molecules of butane were burned in that reaction?

1. # molecules $= 8$

2. # molecules $= 7$

3. # molecules $= 9$

4. # molecules $= 5$

5. # molecules $= 6$

LinIndependMan01a
014 10.0 points

Find all values h for which the vectors

$$\begin{bmatrix} 2 \\ -2 \\ 4 \end{bmatrix}, \quad \begin{bmatrix} 4 \\ -6 \\ 7 \end{bmatrix}, \quad \begin{bmatrix} -2 \\ 2 \\ h \end{bmatrix}$$

are linearly independent.

LinIndepTF01c
015 10.0 points

The columns of any 4×5 matrix are linearly dependent.

True or False?

1. FALSE

2. TRUE

LinTransform01e
016 10.0 points

A transformation $T : \mathbb{R}^n \to \mathbb{R}^m$ is linear if and only if

$$T(c_1\mathbf{v}_1 + c_2\mathbf{v}_2) \;=\; c_1T(\mathbf{v}_1) + c_2T(\mathbf{v}_2)$$

for all vectors $\mathbf{v}_1$, $\mathbf{v}_2$ in $\mathbb{R}^n$ and all scalars c_1, c_2.

True or False?

1. FALSE

2. TRUE

MatrixTrans01a
017 10.0 points

Determine the Standard Matrix for the transformation rotating the plane counterclockwise about the origin through 60°.

1. $A \;=\; \dfrac{1}{2}\begin{bmatrix} \sqrt{3} & -1 \\ 1 & \sqrt{3} \end{bmatrix}$

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

3. $A \;=\; \begin{bmatrix} \sqrt{3} & 1 \\ -1 & \sqrt{3} \end{bmatrix}$

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

5. $A \;=\; \dfrac{1}{2}\begin{bmatrix} \sqrt{3} & 1 \\ -1 & \sqrt{3} \end{bmatrix}$

6. $A \;=\; \dfrac{1}{2}\begin{bmatrix} 1 & \sqrt{3} \\ -\sqrt{3} & 1 \end{bmatrix}$