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Section: 62

## Lab 2: Matrix Explorations

Spring 2022

As a convenience, this **answer template** is provided if you wish to easily submit your work. Be sure to save it as a PDF before submitting online! Only one submission is allowed.

### Question 1: Solve a Linear System by Row Reducing the Augmented Matrix

The unique solution is:  $\vec{x} = \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 6 \\ 6 \\ 6 \end{bmatrix}$

( $x = 6, y = 6, z = 6$ )

### Question 2: Solve a Linear System with a Free Variable

a. Record the RAM from part a here. →

b. The solution is:  $\vec{x} = \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 2 - y \\ y(\text{free}) \\ 1 \end{bmatrix}$

( $x = 2 - y, y = y(\text{free}), z = 1$ )

1	1	0	2
0	0	1	1
0	0	0	0

### Question 3: Matrices in general do not commute.

Question 3a. Find the matrix below that commutes with A. Circle or highlight it.

i.  $B = \begin{bmatrix} 3 & 4 \\ 4 & 3 \end{bmatrix}$

ii.  $C = \begin{bmatrix} 1 & 2 \\ 2 & 2 \end{bmatrix}$

iii.  $D = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$

Question 3b. For  $B = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$  to commute with  $A = \begin{bmatrix} 1 & 2 \\ 2 & 1 \end{bmatrix}$ , the matrix B must have the form:

i.  $B = \begin{bmatrix} a & b \\ b & a \end{bmatrix}$

ii.  $B = \begin{bmatrix} a & b \\ -b & a \end{bmatrix}$

iii.  $B = \begin{bmatrix} a & b \\ b & -a \end{bmatrix}$

iv.  $B = \begin{bmatrix} a & b \\ -b & -a \end{bmatrix}$

Question 3c. For B to commute with the new matrix  $F = \begin{bmatrix} 1 & 2 \\ -2 & 1 \end{bmatrix}$ , B must have the form:

i.  $B = \begin{bmatrix} a & b \\ b & a \end{bmatrix}$

ii.  $B = \begin{bmatrix} a & b \\ -b & a \end{bmatrix}$

iii.  $B = \begin{bmatrix} a & b \\ b & -a \end{bmatrix}$

iv.  $B = \begin{bmatrix} a & b \\ -b & -a \end{bmatrix}$

### Question 4: Commuting Pairs of Matrices

Question 4: The number of commuting pairs is: 1

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**Question 5: Trace of a matrix product  $AB$** **Question 5a:** The trace of  $A = \text{magic}(3)$  is: **15****Question 5b:** The number of pairs satisfying  $\text{Tr}(AB) = \text{Tr}(BA)$  is: **All: 1,000****Question 5c:** The number of pairs satisfying  $\text{Tr}(AB) = \text{Tr}(A) \cdot \text{Tr}(B)$  is: **Varies, Usually around 210-ish**

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**Question 6: Determinant of a matrix product  $AB$ .****Preview of Determinant****Question 6:** The number of matrix pairs satisfying  $\det(AB) = \det(A) \det(B)$  is: **All: 10,000**

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**Question 7: Row Equivalent Matrices and the Reducing Matrix  $R$** **Question 7a.** The matrix row-equivalent to  $A$  is: **B****Question 7b.** Record your value for  $R$  here:  $R = \begin{bmatrix} 0.5 & 0.5 \\ 0.5 & -0.5 \end{bmatrix}$ 

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**Question 8: Solving Linear Systems  $A\vec{x} = \vec{b}$  using `linsolve(A, b)`****Question 8a.** Record the solution here:  $\vec{x} = \begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix}$ **Question 8b.** Record the RAM here.RREF of Augmented Matrix with `rref()`:

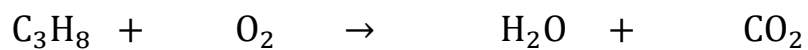
1	0	0	1
0	1	0	2
0	0	1	3

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**Questions 9-10: A Stoichiometry Example/Combustion of Propane****a.** Record the RAM here.

1	0	0	5
0	1	0	4
0	0	1	3

**b.** Balance the equation. Fill in a positive integer inside each box.**5****4****3**



**Ready to Submit?**

Be sure all ten questions are answered. When your lab is complete, be sure to submit four files:

1. Your **completed Answer Template** as a PDF file
2. A copy of your **original MALAB Script**
3. A copy of your **MATLAB Live Script**
4. A **PDF** copy of your **MATLAB Live Script** (Save-Export to PDF...)

The due date is the day after your lab section by **11:59pm** to receive full credit. You have one more day, to submit the lab (but with a small penalty), and then the window closes, and your grade will be zero.