**Your Name:** Cole *first* Bardin *last* **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: $\vec{\mathbf{x}} = \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} \mathbf{6} \\ \mathbf{6} \\ \mathbf{6} \end{bmatrix}$

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

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

| | | | |
|---|---|---|---|
| 1 | 1 | 0 | 2 |
| 0 | 0 | 1 | 1 |
| 0 | 0 | 0 | 0 |

**a.** Record the RAM from part **a** here. →

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

( ***x = 2 – y, y = y(free), z = 1*** )

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

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### Question 4: Commuting Pairs of Matrices

**Question 4:** The number of commuting pairs is: **1**

## Question 5: Trace of a matrix product *AB*

**Question 5a:** The trace of A = magic(3) is: **15**

**Question 5b:** The number of pairs satisfying $\mathrm{Tr}(AB) = \mathrm{Tr}(BA)$ is: **All: 1,000**

**Question 5c:** The number of pairs satisfying $\mathrm{Tr}(AB) = Tr(A) \cdot Tr(B)$ is: **Varies, Usually around 210-ish**

## 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**

## 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: $R = \begin{bmatrix} 0.5 & 0.5 \\ 0.5 & -0.5 \end{bmatrix}$

## Question 8: Solving Linear Systems $A\vec{\mathbf{x}} = \vec{\mathbf{b}}$ using `linsolve(A, b)`

**Question 8a.** Record the solution here: $\vec{\mathbf{x}} = \begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix}$

**Question 8b.** Record the RAM here.

```
RREF of Augmented Matrix with rref():
     1     0     0     1
     0     1     0     2
     0     0     1     3
```

## 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**

$$C_3H_8 + O_2 \rightarrow H_2O + CO_2$$

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**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.