

Math 2270, Spring 2023 - Practice exam template

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- **Please show all of your work** as partial credit will be given where appropriate, **and** there may be no credit given for problems where there is no work shown unless otherwise specified.
- When you submit the exam, please double-check you have written the correct problem numbers assigned to each problem in the right order. Otherwise, your work may not be graded.

1. Write the problem number assigned to the first problem of the written portion.

Question number: L13

(a)

$$\begin{bmatrix} 1 & 2 & 3 & 1 \\ 2 & 4 & 5 & 3 \end{bmatrix}$$

(b)

$$\begin{bmatrix} 1 & 2 & 3 & 1 \\ 2 & 4 & 5 & 3 \end{bmatrix} R_2 = R_2 - 2R_1 \Rightarrow \begin{bmatrix} 1 & 2 & 3 & 1 \\ 0 & 0 & -1 & 1 \end{bmatrix} R_2 = -R_2 \Rightarrow \begin{bmatrix} 1 & 2 & 3 & 1 \\ 0 & 0 & 1 & -1 \end{bmatrix} R_1 = R_1 - 3R_2 \Rightarrow \begin{bmatrix} 1 & 2 & 0 & 4 \\ 0 & 0 & 1 & -1 \end{bmatrix}$$
$$\begin{bmatrix} 1 & 2 & 0 & 4 \\ 0 & 0 & 1 & -1 \end{bmatrix}$$

(c)

From above: $x_1 + 2x_2 = 4$
 $x_3 = -1$

free variable: x_2 $\therefore x_1 = 4 - 2x_2$
 $x_2 = x_2$
 $x_3 = -1$

$$\boxed{\vec{x} = x_2 \begin{bmatrix} -2 \\ 1 \\ 0 \end{bmatrix} + \begin{bmatrix} 4 \\ 0 \\ -1 \end{bmatrix}}$$

2. Write the problem number assigned to the second problem of the written portion.

Question number: E 6 1

(a)

$$\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} R_2 = R_2 + 3R_1 \rightarrow \begin{bmatrix} 1 & 0 & 0 \\ 3 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} R_3 = R_3 + 2R_2 \rightarrow \begin{bmatrix} 1 & 0 & 0 \\ 3 & 1 & 0 \\ 6 & 2 & 1 \end{bmatrix} R_1 = R_1 + R_2 + R_3 \rightarrow \boxed{\begin{bmatrix} 10 & 3 & 1 \\ 3 & 1 & 0 \\ 6 & 2 & 1 \end{bmatrix}}$$

(b)

$$A = \begin{bmatrix} -6 & 2 \\ 5 & 7 \end{bmatrix}$$

$$B = \begin{bmatrix} 1 & 4 \\ -9 & 17 \end{bmatrix}$$

$$AB = \begin{bmatrix} -6 & 2 \\ 5 & 7 \end{bmatrix} \begin{bmatrix} 1 & 4 \\ -9 & 17 \end{bmatrix} = \begin{bmatrix} -24 & 10 \\ -58 & 139 \end{bmatrix}$$

$$\begin{array}{r} 4 \quad 3 \quad 54 \\ 17 \quad 17 \quad 54 \\ \times 7 \quad \times 5 \quad + 85 \\ \hline 119 \quad 85 \quad 139 \end{array}$$

$$BA = \begin{bmatrix} 1 & 4 \\ -9 & 17 \end{bmatrix} \begin{bmatrix} -6 & 2 \\ 5 & 7 \end{bmatrix} = \begin{bmatrix} 14 & 30 \\ 139 & 101 \end{bmatrix}$$

$$\begin{bmatrix} -24 & 10 \\ -58 & 139 \end{bmatrix} \neq \begin{bmatrix} 14 & 30 \\ 139 & 101 \end{bmatrix} \therefore AB \neq BA$$

3. Write the problem number assigned to the third problem of the written portion.

Question number: A02

(a)

$$A: x_1 + x_2 = 200$$

$$B: x_1 + x_3 = 1000$$

$$C: x_2 + 800 = x_3 \therefore x_2 - x_3 = -800$$

$$\begin{bmatrix} 1 & 1 & 0 & 200 \\ 1 & 0 & 1 & 1000 \\ 0 & 1 & -1 & -800 \end{bmatrix}$$

(b)

$$\begin{bmatrix} 1 & 1 & 0 & 200 \\ 1 & 0 & 1 & 1000 \\ 0 & 1 & -1 & -800 \end{bmatrix} \xrightarrow{R_2 = R_2 - R_1} \begin{bmatrix} 1 & 1 & 0 & 200 \\ 0 & -1 & 1 & 800 \\ 0 & 1 & -1 & -800 \end{bmatrix} \xrightarrow{R_3 = R_3 + R_2} \begin{bmatrix} 1 & 1 & 0 & 200 \\ 0 & -1 & 1 & 800 \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

$$\xrightarrow{R_2 = -R_2} \begin{bmatrix} 1 & 1 & 0 & 200 \\ 0 & 1 & -1 & -800 \\ 0 & 0 & 0 & 0 \end{bmatrix} \xrightarrow{R_1 = R_1 - R_2} \begin{bmatrix} 1 & 0 & 1 & 1000 \\ 0 & 1 & -1 & -800 \\ 0 & 0 & 0 & 0 \end{bmatrix} \therefore \begin{aligned} x_1 + x_3 &= 1000 \\ x_2 - x_3 &= -800 \end{aligned}$$

x_3 is free

$$x_1 = -x_3 + 1000$$

$$x_2 = x_3 - 800$$

$$\vec{x} = x_3 \begin{bmatrix} -1 \\ 1 \\ 1 \end{bmatrix} + \begin{bmatrix} 1000 \\ -800 \\ 0 \end{bmatrix}$$