# F.2.2 Sample Exam Answers and Videos Questions 1-2

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# F.2.2 Sample Exam Answers and Videos Questions 1-2

## Question 1

0 points possible (ungraded)

1. Compute

(a) (3 points) $\begin{pmatrix} 1 & -2 \\ -1 & 1 \end{pmatrix} \begin{pmatrix} 1 & -1 \\ -2 & 2 \end{pmatrix} =$

(b) (3 points) $\begin{pmatrix} 0 & 1 \\ -1 & 2 \end{pmatrix} \begin{pmatrix} 1 & -2 \\ 0 & 2 \end{pmatrix} =$

(c) (2 points) $\begin{pmatrix} 1 & -2 & 0 & 1 \\ -1 & 1 & -1 & 2 \end{pmatrix} \begin{pmatrix} 1 & -1 \\ -2 & 2 \\ 1 & -2 \\ 0 & 2 \end{pmatrix} =$

(d) (2 points) How are the results in (a), (b), and (c) related?

1. Compute

(a) (3 points) $\begin{pmatrix} 1 & -2 \\ -1 & 1 \end{pmatrix} \begin{pmatrix} 1 & -1 \\ -2 & 2 \end{pmatrix} = \begin{pmatrix} 5 & -5 \\ -3 & 3 \end{pmatrix}$

(b) (3 points) $\begin{pmatrix} 0 & 1 \\ -1 & 2 \end{pmatrix} \begin{pmatrix} 1 & -2 \\ 0 & 2 \end{pmatrix} = \begin{pmatrix} 0 & 2 \\ -1 & 6 \end{pmatrix}$

(c) (2 points) $\begin{pmatrix} 1 & -2 & 0 & 1 \\ -1 & 1 & -1 & 2 \end{pmatrix} \begin{pmatrix} 1 & -1 \\ -2 & 2 \\ 1 & -2 \\ 0 & 2 \end{pmatrix} = \begin{pmatrix} 5 & -3 \\ -4 & 9 \end{pmatrix}$

(d) (2 points) How are the results in (a), (b), and (c) related? If one blocks the equations in (c), one sees that one merely needs to add the results of (a) and (b).

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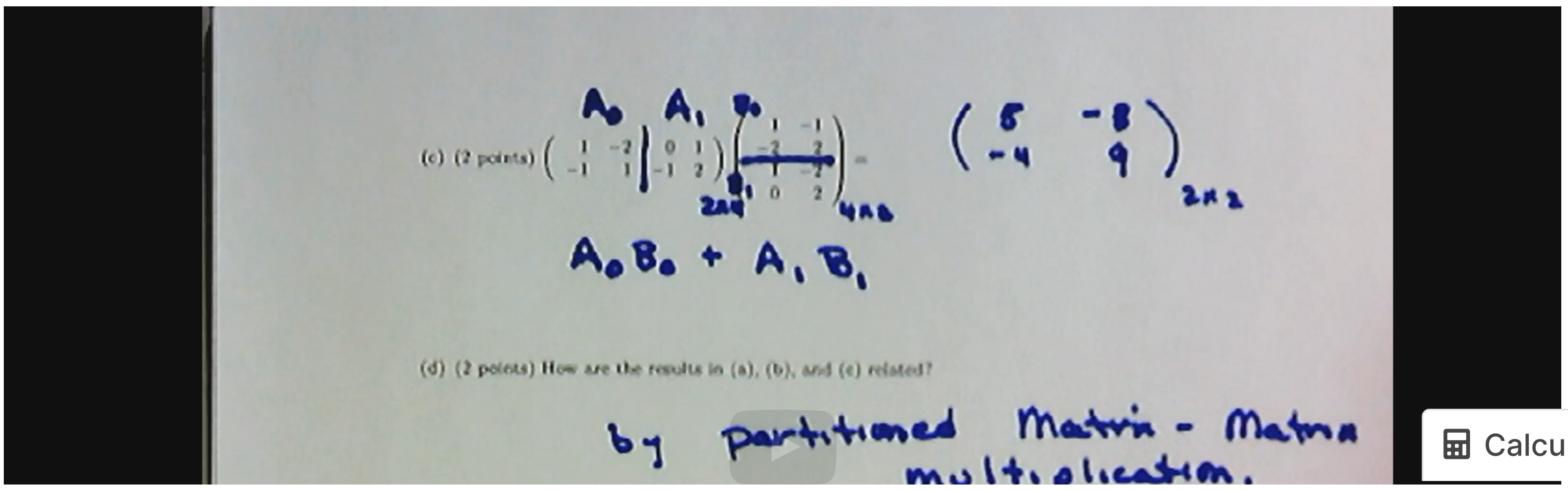
Answers are displayed within the problem

### Question 1

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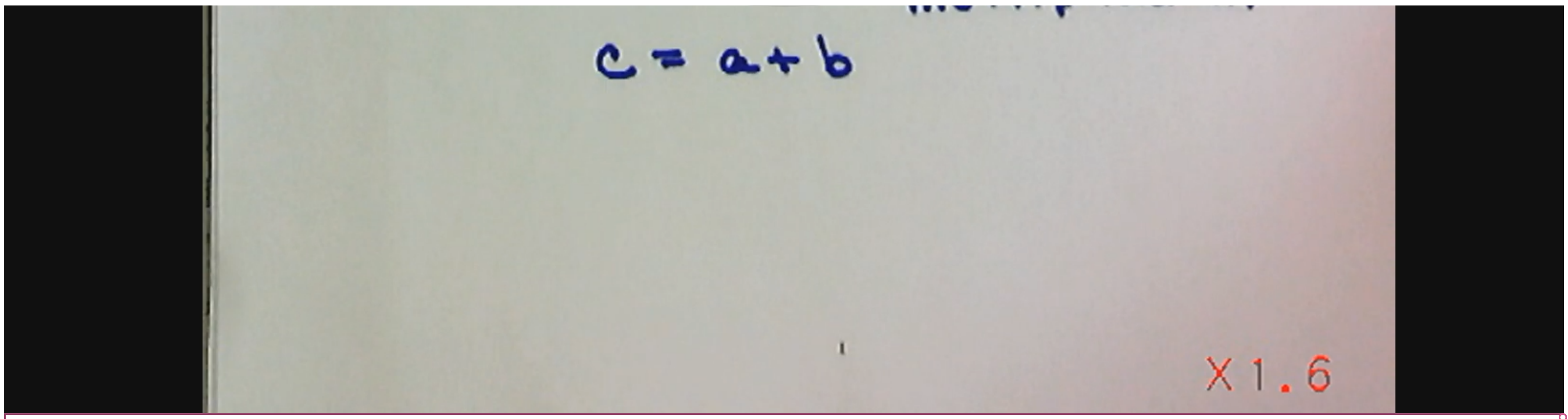


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## Question 2

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2. Consider

$$A = \begin{pmatrix} 1 & 0 & -1 \\ 3 & -1 & 0 \\ 0 & -1 & 1 \end{pmatrix}, \quad \text{and} \quad B = \begin{pmatrix} -2 & 2 \\ -1 & 1 \\ 3 & -3 \end{pmatrix}.$$

(a) (7 points)
Solve for $X$ the equation $AX = B$. (If you have trouble figuring out how to approach this, you can "buy" a hint for 3 points.)

(b) (3 points) In words, describe a way of solving this problem that is different from the approach you used in part a).

(c) (3 bonus points) In words, describe yet another way of solving this problem that is different from the approach in part a) and b).

2. Consider

$$A = \begin{pmatrix} 1 & 0 & -1 \\ 3 & -1 & 0 \\ 0 & -1 & 1 \end{pmatrix}, \quad \text{and} \quad B = \begin{pmatrix} -2 & 2 \\ -1 & 1 \\ 3 & -3 \end{pmatrix}.$$

(a) (7 points)
Solve for $X$ the equation $AX = B$. (If you have trouble figuring out how to approach this, you can "buy" a hint for 3 points.)
Partition $X$ and $B$ by columns yields

$$A \left( \begin{array}{c|c} x_0 & x_1 \end{array} \right) = \left( \begin{array}{c|c} b_0 & b_1 \end{array} \right)$$

so that $Ax_0 = b_0$ can be solved to find $x_0$ and $Ax_1 = b_1$ can be solved to find $x_1$. But in this particular case, we can notice that $b_1 = -b_0$ so that $x_1 = -x_0$. So all we need to do is solve for $x_0$ and we get $x_1$ for "free".
Let's set up an appended system:

$$\left( \begin{array}{ccc|c} 1 & 0 & -1 & -2 \\ 3 & -1 & 0 & -1 \\ 0 & -1 & 1 & 3 \end{array} \right) \rightarrow \left( \begin{array}{ccc|c} 1 & 0 & -1 & -2 \\ 0 & -1 & 3 & 5 \\ 0 & -1 & 1 & 3 \end{array} \right) \rightarrow \left( \begin{array}{ccc|c} 1 & 0 & -1 & -2 \\ 0 & -1 & 3 & 5 \\ 0 & 0 & -2 & -2 \end{array} \right).$$

Thus,

- $-2\chi_2 = -2$, which means that $\chi_2 = 1$.
- $-\chi_1 + 3(1) = 5$, which means that $\chi_1 = -2$.
- $\chi_0 - (1) = -2$, which means that $\chi_0 = -1$.

So, the matrix $X$ equals

$$\begin{pmatrix} -1 & 1 \\ -2 & 2 \\ 1 & -1 \end{pmatrix}.$$

(b) (3 points) In words, describe a way of solving this problem that is different from the approach you used in part a).
One could invert $A$ and then compute $X = A^{-1}B$.

(c) (3 bonus points) In words, describe yet another way of solving this problem that is different from the approach in part a) and b).
One could compute the LU factorization of $A$ and use it to solve for each of the two columns of $X$.

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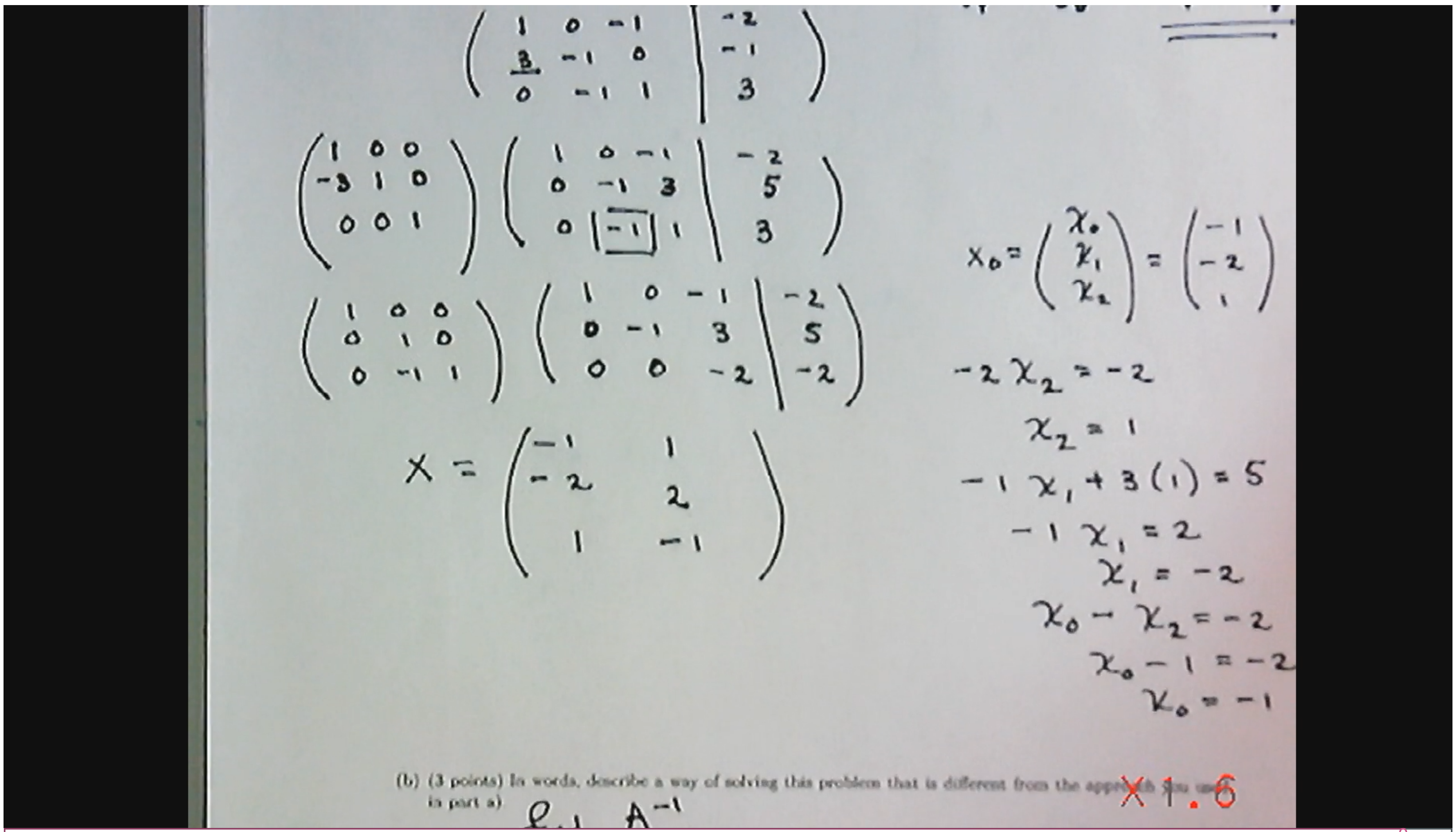
### Question 2

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