• DO NOT begin working, or even open this packet, until instructed to do so.

• You should be in your assigned seat, unless instructed otherwise by Ed or one of the TAs.

• Enter all requested information on the top of this page, and put your name on the top of every page, in case the pages become separated.

• You may use a two-sided page of notes on this exam.

• You may **not** use your books, additional notes, or any calculator on this exam.

You are required to show your work on each problem on this exam. The following rules apply:

• **Organize your work**, in a reasonably neat and coherent way, in the space provided. Work scattered all over the page without a clear ordering will receive very little credit.

• **Mysterious or unsupported answers will not receive full credit**. Unless otherwise directed in the statement of the problem, a correct answer, unsupported by calculations, explanation, or algebraic work will receive little or no credit. An incorrect answer supported by substantially correct calculations and explanations might still receive partial credit.

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DO NOT turn this page until instructed to do so
1. Let $A = \begin{bmatrix} 1 & 0 & 3 & 0 \\ 0 & 2 & 0 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 1 & 1 & 0 \end{bmatrix}$ and let $a, b, c, d$ be some numbers.

   (a) (7 points) Find $A^{-1}$.

   (b) (3 points) Solve the equation $A\vec{x} = (a, b, c, d)$. You may answer in terms of $a, b, c$ and $d$. 
2. (10 points) Let $\mathbb{P}_2$ be the vector space of polynomials with degree at most 2, and let $\mathcal{B} = \{1 + x, 1 + x^2, x + x^2\}$. $\mathcal{B}$ is a basis for $\mathbb{P}_2$ (and you don’t need to prove this). Let $T : \mathbb{R}^3 \rightarrow \mathbb{R}^3$ satisfy $T \left( [a_0 + a_1 x + a_2 x^2]_\mathcal{B} \right) = (a_0, a_1, a_2)$. Find the matrix corresponding to $T$. 
3. (10 points) Let $A$ be a matrix which is row-equivalent to
\[
\begin{bmatrix}
1 & 2 & 0 & 3 \\
0 & 0 & 5 & 6 \\
0 & 0 & 0 & 0 \\
\end{bmatrix}
\]
and let $T : \mathbb{R}^3 \rightarrow \mathbb{R}^7$ be a linear transformation such that $T(\vec{x}) = \vec{0}$ if and only if $\vec{x} = A\vec{y}$ for some $\vec{y} \in \mathbb{R}^4$. Find the dimension of the range of $T$. 
4. (a) (5 points) Let $P$ be a parallelopiped in $\mathbb{R}^3$. Suppose that one of its vertices is $(0, 1, 0)$, and the three vertices adjacent to that one are $(0, 1, 2)$, $(1, 1, 1)$ and $(1, 0, -1)$. Find the volume of $P$.

(b) (5 points) Let $A$ and $B$ be invertible matrices with $\det A = 4$ and $\det B = 2$. Find $\det(A^2B^{-1})$. 