Practice Test 3E for Calculus II, Math 1502, October 19, 2012

## Name:

## Section:

## Name of TA:

This test is to be taken without calculators and notes of any sorts. The allowed time is 50 minutes. Provide exact answers; not decimal approximations! For example, if you mean $\sqrt{2}$ do not write $1.414 \ldots$. Show your work, otherwise credit cannot be given.
Write your name, your section number as well as the name of your TA on EVERY PAGE of this test. This is very important.


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I: (20 points) Calculate all the possible matrix products of the matrices

$$
A=\left[\begin{array}{ll}
1 & 3 \\
2 & 1 \\
1 & 2
\end{array}\right], B=\left[\begin{array}{ll}
1 & 2 \\
2 & 1
\end{array}\right], C=\left[\begin{array}{lll}
3 & 1 & 1 \\
1 & 2 & 1
\end{array}\right]
$$

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II: (20 points) Let $T: \mathcal{R}^{4} \rightarrow \mathcal{R}^{3}$ be a linear transformation such that $T(\vec{x})=\vec{b}$ has a solution for all vectors $\vec{b} \in \mathcal{R}^{3}$. Draw all the possible echelon forms for the matrix associated with $T$, i.e., the matrix $A$ with $T(\vec{x})=A \vec{x}$.

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III: (20 points) Let $f: \mathcal{R}^{2} \rightarrow \mathcal{R}^{2}$ be a linear transformation such that

$$
f\left(\left[\begin{array}{l}
1 \\
0
\end{array}\right]\right)=\left[\begin{array}{l}
1 \\
0
\end{array}\right]
$$

and with the property that $f \circ f=f$. Find all possible $2 \times 2$ matrices such that $f(\vec{x})=A \vec{x}$ for all $\vec{x} \in \mathcal{R}^{2}$.

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IV: (20 points) Two $n \times n$ matrices $A$ and $B$ are said to commute if $A B=$ $B A$. Find all $2 \times 2$ matrices $B$ that commute with the matrix

$$
\left[\begin{array}{ll}
0 & 1 \\
1 & 0
\end{array}\right] .
$$

V: (20 points) a) Suppose the vectors $\overrightarrow{v_{1}}, \overrightarrow{v_{2}}, \cdots, \overrightarrow{v_{p}}$ span all of $\mathcal{R}^{n}$ and let $T: \mathcal{R}^{n} \rightarrow \mathcal{R}^{n}$ be a linear transformation with the property that $T\left(\overrightarrow{v_{j}}\right)=$ $\overrightarrow{0}, j=1, \ldots, p$. Show that $T$ is the zero transformation.
b) Let $T:: \mathcal{R}^{n} \rightarrow \mathcal{R}^{m}$ be a linear transformation and let $\overrightarrow{v_{1}}, \overrightarrow{v_{2}}, \overrightarrow{v_{3}}$ be linearly dependent vectors in $\mathcal{R}^{n}$. Show that $T\left(\overrightarrow{v_{1}}\right), T\left(\overrightarrow{v_{2}}\right), T\left(\overrightarrow{v_{3}}\right)$ are also linearly dependent.

