Books and notes (in any form) are <u>not</u> are allowed. You may use a calculator – but you must clearly show your set-up for the problem. Please also indicate when you use the matrix functions on the calculator. Show all other work for credit. ***Good luck!***   [Note: Each quiz score will be scaled to 15 points after grading.]

1. (2 pts) If the equation $C\mathbf{u} = \mathbf{v}$ has more than one solution for some $\mathbf{v}$ in $\mathbb{R}^n$, can the columns of the $n \times n$ matrix C span $\mathbb{R}^n$? (***Briefly***) Why or why not?

2. (2 pts) Can a square matrix with two identical columns be invertible? (***Briefly***) Why or why not?

3. (2 pts) If A is a 6×6 matrix and the equation $A\mathbf{x} = \mathbf{b}$ is consistent for every $\mathbf{b}$ in $\mathbb{R}^6$, is it possible that for some $\mathbf{b}$, the equation $A\mathbf{x} = \mathbf{b}$ has more than one solution? (***Briefly***) Why or why not?

4. (4 pts) Let W be the set of all vectors of the form $\begin{bmatrix} 2a - 3b \\ a + b + 2c \\ 0 \\ -3b + c \end{bmatrix}$, where $a, b,$ and c are arbitrary real numbers.

Find a set S that spans W or give an example to show that W is not a vector space.

5. (5 pts) Note: $M_{m \times n}$ is the set of all $m \times n$ matrices. $M_{m \times n}$ is also a vector space under addition of matrices and multiplication by a scalar.

Let F be a fixed 3×2 matrix, and let H be the set of all matrices A in $M_{2 \times 4}$ with the property that $FA = 0$ (the zero matrix in $M_{3 \times 4}$). Determine whether H is a subspace of $M_{2 \times 4}$. Show work to justify your answer.

Note: $H = \{A \text{ in } M_{2 \times 4} \mid FA = 0\}$