1a. Let $P = \begin{bmatrix} s & t \\ g & h \end{bmatrix}$. In terms of s, t, g and h, what is the inverse of P? And what condition needs to be satisfied for this matrix P^{-1} to exist?

1b. Let $Q = \begin{bmatrix} 8 & 6 \\ 7 & 5 \end{bmatrix}$. Use the answer to (1a) to find Q^{-1}; simplify all entries as much as possible.

2. Let $D = \begin{bmatrix} a & b & c \\ d & e & f \\ g & h & i \end{bmatrix}$ and let $E = \begin{bmatrix} q & r & s \\ t & u & v \\ m & n & z \end{bmatrix}$.

2A) What is the entry in the third row, second column of the product DE?

2B) What is the entry in the third row, second column of the product ED?

3. Suppose $T : \mathbb{R}^n \to \mathbb{R}^m$ is a linear transformation and the associated matrix is M.

Use the following statements in the multiple choice question below.

A) $T(\mathbf{x}) = \mathbf{w}$ has at least one solution $\mathbf{x}$ in $\mathbb{R}^n$ for every $\mathbf{w}$ in $\mathbb{R}^m$.

B) The matrix M has more rows than columns.

C) $T(\mathbf{z}) = T(\mathbf{w})$ implies $\mathbf{z} = \mathbf{w}$ for all $\mathbf{z}$ and $\mathbf{w}$ in $\mathbb{R}^n$.

D) The matrix M has at least one non-pivot column.

E) The matrix M has a row of 0's in its RREF.

F) For every $\mathbf{b} \in \mathbb{R}^m$ there is some $\mathbf{a} \in \mathbb{R}^n$ for which $T(\mathbf{a}) = \mathbf{b}$.

G) There are elements of the codomain of T which are not in the range of T.

H) $T(\mathbf{p}) = \mathbf{q}$ has at most one solution $\mathbf{p}$ in $\mathbb{R}^n$ for every $\mathbf{q}$ in $\mathbb{R}^m$.

P) If $\mathbf{a} = \mathbf{z}$, then $T(\mathbf{a}) = T(\mathbf{z})$, for all $\mathbf{a}$ and $\mathbf{z}$ in $\mathbb{R}^n$.

Q) $M\mathbf{x} = \mathbf{c}$ is consistent for every $\mathbf{c}$ in $\mathbb{R}^m$.

R) There are no free variables in the equation $M\mathbf{x} = \mathbf{c}$ for any $\mathbf{c}$ in $\mathbb{R}^m$.

S) The columns of M form a linearly independent set of vectors.

Answer these four **multiple-choice** questions:

3.1: Which of the above statements either is a definition of "T is one-to-one" or can be used to prove T is 1-1? List all qualifying statements by letter:

3.2: Which of the above statements either is a definition of "T is onto $\mathbb{R}^m$" or can be used to prove T is onto $\mathbb{R}^m$? List all qualifying statements by letter:

3.3: Which statements, if any, can be used to show T is *not* 1-1? List by letter:

3.4: Which, if any, can be used to show T is not onto $\mathbb{R}^m$?