1. Below is a homogeneous system of linear equations, the coefficient matrix A and the reduced echelon form of matrix A, called B. Answer the questions below.

$$\begin{cases} v + 2w + x + 2y + z = 0 \\ -v - 2w + x + y + z = 0 \\ 2v + 4w + y = 0 \\ x + y + z = 0 \end{cases} \qquad A = \begin{pmatrix} 1 & 2 & 1 & 2 & 1 \\ -1 & -2 & 1 & 1 & 1 \\ 2 & 4 & 0 & 1 & 0 \\ 0 & 0 & 1 & 1 & 1 \end{pmatrix} \qquad B = \begin{pmatrix} 1 & 2 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 1 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{pmatrix}$$

   (a) What is the rank of A?

   (b) Find the set of solutions to the system and express the set in vector form.

   (c) Is the set of solutions a vector space? Why or why not?

   (d) What is the *dimension* of the solution set and why?

2. (Theorem 3.13) Let A be an $m \times n$ matrix with rank r. What sort of number can r be? If A is the coefficient matrix of a homogeneous system, how many equations and how many unknowns are there? What can you say about the solution set?

3. (Corollary 3.14) Let A be an $n \times n$ matrix. The followins statements are equivalent:
   (a) A has rank n
   (b) (what can you say about the rows?)
   (c) (what can you say about the columns?)
   (d) (what can you say about SoLE's with A as a coefficient matrix?)
   (e) (is A singular or nonsingular?)

Section 3.1.1

1. Let $V = \mathbb{R}^3$ and $W = \mathcal{P}_2$. Give an intuitive argument that these are not really different vector spaces.

2. **Definition**

3. (Lemma 1.11)