Algebra II
Blizzard Bag #2 -- Crack the Code

Solve the following problem. Show all work. Label all answers. Submit a written summary of your process and answer(s) following the POW rubric and guidelines given to you. Remember to include HOW you solved the problem in your write-up.

POW:
A Letter-Number Code
This POW concerns codes for arithmetic problems rather than for word messages. To use such a code, you start with an arithmetic problem such as:

$$\begin{array}{r} 35 \\ + 35 \\ \hline 70 \end{array}$$

To create a coded version of the problem, you replace each number with a letter, always using the same letter for a particular number. For example, you might replace 3 with A, 5 with D, 7 with O, and 0 with H. If you do this, the addition problem becomes:

$$\begin{array}{r} AD \\ + \ AD \\ \hline OH \end{array}$$

(In using such a code, you need to be careful to distinguish between the number "0" and the letter "O.")

Figuring Out the Code
It's easy to make up such a code, and it's just as easy to figure out what the coded problem represents if you know the replacement system.

What's more interesting is trying to figure out the code merely by looking at the coded problem. That is, you are shown only the problem written with letters, and you have to figure out what the original arithmetic problem was.

The Rules
Problems like there usually follow certain rules:
- ➢ If a letter is used more than once in the same problem, it stands for the same number each time it is used.
- ➢ Different letters in the same problem always stand for different single-digit numbers.
- ➢ A letter standing for 0 never starts a number with more than one digit. For example, the final arithmetic problem can't have a number like "05" (but it can use "507" or "80" or even simply "0").

For some letter problems, it is very easy to reconstruct the original arithmetic problem; for others, it is not too hard; and for still others, it is quite difficult. Sometimes there is no possible answer, and sometimes there are many possible answers.

See whether you can crack the codes for these problems based on the rules just listed. If you think there is only one right answer, prove it. If you think there are several possibilities, give them all and prove that there are no others. You will need to keep careful track of how you arrive at your answers.

1. A B B
       -   A
        D D

2. S S
   + E E
      S S T

3. A B
   + B C
      A D E

4.   Note: This one is definitely harder than the previous ones, but definitely still doable ☺
        S E N D
     + M O R E
       M O N E Y

Write-up
1. Process and Solution: Do a separate write-up for each of the questions #1-4 for the process and solution steps. The "Understanding the Problem" scale can be done for the whole POW at the very beginning. In each of the separate write-ups, you must prove that your solutions are the only ones possible. You may find that explaining the process you went through to decipher the code will be part (or perhaps all) of your proof.