<u>Solving Systems of Equations in 3 Variables</u>

Solving a system of equations is 3 variables isn't much more complicated than a system of equations in two variables.

$$\begin{aligned} Eq_1 &\quad a+b+c=0 \\ Eq_2 &\quad 4a+2b+c=-1 \\ Eq_3 &\quad 9a+3b+c=0 \end{aligned}$$

Here you have a system of equations in 3 variables. Each equation has been labeled as being equation 1, equation2 and equation 3 to make it easier to follow.

$$\begin{aligned} Eq_1 &\quad a+b+c=0 \\ Eq_2 &\quad 4a+2b+c=-1 \end{aligned} \qquad \begin{aligned} Eq_1 &\quad a+b+c=0 \\ Eq_3 &\quad 9a+3b+c=0 \end{aligned}$$

One of these equations will be used twice. It doesn't matter which. In this case, equation 1 will be used twice.

$$\begin{array}{ll} -Eq_1 & -a-b-c=0 \\ +Eq_2 & 4a+2b+c=-1 \\ \hline Eq_4 & 3a+b=-1 \end{array} \qquad \begin{array}{ll} -Eq_1 & -a-b-c=0 \\ +Eq_3 & 9a+3b+c=0 \\ \hline Eq_5 & 8a+2b=0 \end{array}$$

Multiplying equation 1 by -1 and combining the equations yielded two new equations. You <u>must</u> get rid of the same variable each time.

$$\begin{aligned} Eq_4 &\quad 3a+b=-1 \\ Eq_5 &\quad 8a+2b=0 \end{aligned}$$

Now we have a system of equations in two variables.

$$\begin{array}{ll} -2Eq_4 & -6a-2b=2 \\ +\ Eq_5 & 8a+2b=0 \\ \hline & 2a=2 \\ & a=1 \end{array}$$

Multiply equation 4 by -2, and add the result to equation 5. This yields a numerical value for the variable a.

$$a=1$$

Substitute into equation 5

$$\begin{aligned} 8(1)+2b&=0 \\ 2b&=-8 \\ b&=-4 \end{aligned}$$

$$a=1 \quad b=-4$$

Substitute into equation 1

$$\begin{aligned} (1)+(-4)+c&=0 \\ -3+c&=0 \\ c&=3 \end{aligned}$$

Once the value of the first variable is found, substitute that number, in this case 1, into either equation 4 or 5 and solve for the remaining variable. Now that the value of two of the variables is known, go back to equation 1, substitute and find the value of the third variable.

$$a=1 \quad b=-4 \quad c=3$$

$$(1,-4,3)$$

The value of all three variables has now been found.

Write your solution in (x,y,z) format.