6.
a) What is the concentration of KCl in a solution made by diluting 5.000 ml of a 0.500 M KCl solution to give a solution with a final volume of 1.000 L?

Known:	**Need:**
5 ml KCl solution$_{(conc.)}$	M KCl solution (dilute)
0.500 M	= # of moles KCl in the dilute solution
1.000L solution$_{(dilute)}$	# L of the solution(dilute)

Since we know the volume of the dilute solution in liters, what is needed in the number of moles of KCl in the dilute solution. We get this using the molarity of the concentrated solution, and the volume of that solution used.

1.) Find the # of moles of KCl used to make the dilute solution

$$5.000ml\ solution_{(conc.)}\left(\frac{1L}{1000ml}\right)=0.005000L\ solution_{(conc.)}$$

$$0.005000L\ solution_{(conc.)}\left(\frac{0.500moles KCl}{1L\ solution_{(conc.)}}\right)=0.00250moles KCl$$

2) Substitute this value into the definition of Molarity using the volume of the dilute solution.

$$\left(\frac{\#\ moles KCl}{\#\ L\ solution_{(dilute)}}\right)=\left(\frac{0.00250moles KCl}{1.000L\ solution_{(dilute)}}\right)=0.00250\,M\,KCl\,solution_{(dilute)}$$

b) What is the concentration of KCl in a solution made by diluting 5.000 ml of a 0.500 M KCl solution with 995 ml water?

Known:
5 ml KCl solution$_{(conc.)}$
0.500 M
995ml water
5ml + 995ml =
1000ml solution$_{(dilute)}$

Need:
M KCl solution (dilute)
= # of moles KCl in the dilute solution
L of the solution(dilute)

This problem is identical to the problem above except that instead of being given the total volume of the dilute solution you find it by adding together the volume of the concentrated solution that was used and the volume of water used.

1.) Find the # of moles of KCl used to make the dilute solution

$$5.000ml\ solution_{(conc.)}\left(\frac{1L}{1000ml}\right)=0.005000L\ solution_{(conc.)}$$

$$0.005000L\ solution_{(conc.)}\left(\frac{0.500moles KCl}{1L\ solution_{(conc.)}}\right)=0.00250moles KCl$$

2) Substitute this value into the definition of Molarity using the volume of the dilute solution.

$$\left(\frac{\#moles KCl}{\#L\ solution_{(dilute)}}\right)=\left(\frac{0.00250moles KCl}{1.000L\ solution_{(dilute)}}\right)=0.00250M\ KCl\ solution_{(dilute)}$$

Here are 2 more problems to try once you have looked over the solutions to 6a) and 6b).

c) A dilute solution is made from a 0.995 M HCl solution. This dilute solution was made using 0.01000 L of the concentrated solution and has a final volume of 0.15000L. What is the concentration of HCl in the dilute solution? (answer = 0.0663M HCl)

d) A solution was made by mixing 130 ml of 1.2M $CaCl_2$ and 1500ml of water. What is the concentration of CaCl2 in the dilute solution? (1L = 1000ml) (answer = 0.087M $CaCl_2$)