Concentrations and Dilution's

Exploration 1

A chemist makes a series of dilutions from a stock solution of 12 M HCl. For each dilution, the chemist begins with 100 ml of the 12 M stock solution. The diluted concentrations are 8, 6, 4, 3, 2, 1, 0.75, 0.5, and 0.25 M respectively. Table 1 below outlines the chemist's dilutions.

Table one

Stock solution concentration (M)	Volume of stock solution (ml)	Final diluted concentration (M)	Water added to stock solution (ml)	Final dilution volume (ml)
12	100	8	50	150
12	100	6	100	200
12	100	4	200	300
12	100	3	300	400
12	100	2	500	600
12	100	1	1100	1200
12	100	0.75	1500	1600
12	100	0.5	2300	2400
12	100	0.25	4700	4800

1. Construct a scatter graph plotting final diluted concentration vs. final diluted volume for the data in table 1.

2. Sketch the graph.

DIRECTIONS FOR TI-82/83

[Y=] Clear all equations
[STAT] EDIT
L1=Final diluted concentration (M)
L2=Final dilution volume (ml)
[2nd] [Y=]
Plots Off
[ENTER]
[2nd] [Y=]
Plot1
ON
⌙⋰ Xlist=L2 Ylist=L1 Mark: +
[ZOOM]
ZoomStat

3. Describe the relationship between final diluted concentration and final diluted volume. *(Hint: are they varying/proportional direct/inverse)*

4. Recall from our study of gas laws which formula below describes a direct relationship? Which describes an inverse? *(k = constant)*

$$\frac{y}{x} = k \qquad y * x = k$$

5. Use the data in table 1 to determine which mathematical relationship above results in a constant for final diluted concentration and final diluted volume . *(hint: use the list editor on your calculator)*

6. Amend the equation in **#5** above to represent a word equation expressing the variables *final diluted concentration* and *final diluted volume.*

7. Using the equation from **#6** above, compute the mathematical value of **k**.

8. Use the equation from **#6** above and the data in table 1 to compute **k** values for the stock concentration and stock volume of solution.

9. How do the **k** values for the stock and dilute solutions compare?

10. Write a mathematical word equation showing the concentration and volume relationship for a diluted solution being prepared from a concentrated solution. *(concentrated = dilute)*

Does the mathematical relationship established above only hold true for concentrations expressed in molarity? To answer this question lets examine data table 2 below for the dilution of a 10 % (m / v) solution.

table two

Stock Solution Concentration (10%)	Volume of Stock Solution (ml)	Final Diluted Concentration (%)	Water Added (ml)	Final Dilution volume (ml)
10	50	3.00	116.67	166.67
10	50	4.00	75.00	125.00
10	50	6.00	33.33	83.33
10	50	0.50	950.00	1000.00
10	50	2.00	200.00	250.00
10	50	1.00	450.00	500.00
10	50	0.75	616.67	666.67
10	50	8.00	12.50	62.50
10	50	9.00	5.56	55.56
10	50	3.25	103.85	153.85

11. Construct a scatter graph plotting final diluted concentration vs. final diluted volume for the data in table 2.

12. Sketch the graph.

DIRECTIONS FOR TI-82/83

L3=Final diluted concentration (%)
L4=Final dilution volume (ml)
[2nd] [Y=]
Plots Off
[ENTER]
[2nd] [Y=]
Plot2
ON
Xlist=L4 Ylist=L3 Mark: +
[ZOOM]
ZoomStat

13. Describe the relationship between final diluted concentration and final diluted volume. *(hint: are they varying/proportional direct/inverse)*

14. Determine the value of **k** for the dilute data in table 2.

If the relationship between volume and concentration is truly an inverse, then a plot of concentration vs. 1 / volume should give a straight line.

15. Calculate 1 / volume for the data in table 2. Construct a scatter graph plotting final diluted concentration vs. 1 / final diluted volume for the data in table 2.

DIRECTIONS FOR TI-82/83

L5=1 / L4
[2nd] [Y=]
Plots Off
[ENTER]
[2nd] [Y=]
Plot3
ON
Xlist=L5 Ylist=L3 Mark: +
[ZOOM]
ZoomStat

16. Calculate a linear regression for the data and record the equation information.

17. Add the equation line to the graph and sketch the graph.

[STAT] CALC LinReg(ax+b) L5,L3
ENTER
[Y=] Y1
[VARS] Statistics EQ RegEQ
[GRAPH]

18. Is the relationship between concentration vs. 1 / volume a linear function? Explain.

19. Examine the value for the slope of the line. Explain the importance of its value.

20. Does the dilution equation established in the molarity dilution seem to be the same for the percent (m / v) dilution outlined in table 2 above? If so, write a generic mathematical word equation describing a dilution using the following terms: C_1, C_2, V_1, V_2.

Clear the calculator lists.

DIRECTIONS FOR TI-82/83

STAT
EDIT
4:Clrlist
L1,L2,L3,L4,L5,L6

Findings

1. Describe how you would prepare 50 ml of a 250 ppm KCl solution using a 750ppm stock KCl solution.

2. You have the following stock solutions available: 2.0 M NaCl, 4.0 M KNO_3, and 0.50 M $MgSO_4$. Describe how you would prepare the following solutions.

a. 500. ml of 0.50M NaCl
b. 2.0 L of 0.20M $MgSO_4$
c. 50 ml of 0.20M KNO_3