Opening the Geologist's Tool Kit — Part I

Every profession has a specialized vocabulary. An accountant, for example, may speak of a "leveraged" deal on the stock market or declare that a "low-income family" qualifies for the government's "earned income credit." All three terms have specific, defined meanings. Similarly, an accountant uses specific tools to do her job. She may perform financial analysis with a balance sheet or computer spreadsheet. The point: to understand what any professional does, you must learn their *vocabulary* and understand their *tools*.

The same is true in science. That's why you will learn new vocabulary in this course and discover special tools for analyzing the world around us. It's easiest to learn the vocabulary and tools by doing small problems and experiments. Like learning to ride a bicycle, once you get the hang of it, you won't forget what you have mastered.

Part I of this lab manual contains Units 1 and 2, which summarize analytical methods. These methods are the basic tools of the trade in scientific work. You may have used some of them in high school, but revisiting them here will refresh your memory and improve your understanding. These units let you practice basic scientific skills before you jump into the specifics of geology.

Understanding the tools in this unit will lay a firm foundation for the rest of your geology course. *So please do all the work assigned in these units with great care, because you need to master these skills before continuing.* Ask for help if you have difficulty!

Paper-and-Pencil Tools — Unit 1

This unit presents paper-and-pencil tools used by geologists and other scientists. We offer examples and problems in unit conversion (like meters to feet), unit analysis of formulas, constructing graphs, and constructing histograms (bar graphs). We also offer problems in applying the Le Châtelier principle: a system at equilibrium responds to any change by working to minimize the change.

Tool 1.1 Unit Conversion

One of arithmetic's most useful tools is unit conversion–converting from inches to feet, liters to gallons, miles to kilometers, and so on. The key to unit conversion is that you can multiply any number by 1 without changing the value of the original number. For example,

$$5 \times 1 = 5$$
$$31 \times 1 = 31$$
$$py^3 \times 1 = py^3$$

Also, when you divide anything by itself, like $7 \div 7$, the result is 1. All such expressions are equal in value to the number 1. For example:

$$27 \div 27 = 1$$
$$\frac{168}{168} = 1$$
$$843/843 = 1$$

Further, you can multiply any number by a fraction like 1/1, abc/abc, or 62/62 without changing the value of the original number. This little trick allows us to change *units* to more useful forms without altering *value* in any way. As a first step toward converting units, we can write:

$$\frac{12 \text{ inches}}{1 \text{ foot}} = 1$$

This equality is true because the upper and lower numbers in the fraction have the same equivalent value

Q1.1) $\frac{10{,}000{,}000 \text{ gal}}{} \times \frac{3.785 \text{ L}}{1 \text{ gal}} = 37{,}850{,}000 \text{ L}$

Q1.2) $\frac{37{,}850{,}000 \text{ L}}{} \times \frac{0.91 \text{ kg}}{1 \text{ L}} \times \frac{1 \text{ metric ton}}{1000 \text{ kg}} = 34{,}443.5 \text{ metric tons}$

Q1.3) $\frac{1488 \text{ metric tons}}{} \times \frac{1000 \text{ kg}}{1 \text{ metric ton}} \times \frac{2.205 \text{ lbs}}{1 \text{ kg}} \times \frac{88 \text{ cents}}{1 \text{ lbs}} \times \frac{1 \text{ dollar}}{100 \text{ cents}} = 2{,}887{,}315.2$

Q1.4) $\frac{1 \text{ m}^3}{} \times \frac{35.31 \text{ ft}^3}{1 \text{ m}^3} = 35.31 \text{ ft}^3$

Q1.5) $\frac{388 \text{ grams}}{} \times \frac{1 \text{ troy ounce}}{31.1035 \text{ grams}} \times \frac{\$345}{1 \text{ troy ounce}} = \$4{,}303.70$

Closed system -

Unit 1 Paper-and-Pencil Tools

Last (Family) Name _____ First Name _____

Instructor's Name _____ Section _____ Date _____

Q1.1. 37,850,000 liters $10{,}000{,}000\ \text{gal} \times \frac{3.785\ \text{liters}}{1\ \text{gal}} = 37{,}850{,}000\ \text{liters}$

Q1.2. 34,443.5 metric tons

Q1.3. US$ 2,887,315.2

Q1.4. 35.31 cubic feet

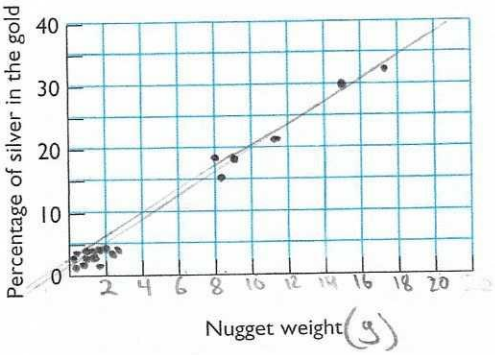
Q1.5. US$ 4,303.70

Q1.6. (circle one) (yes) no

Q1.7. porosity unit: P.U. or Porosity Unit

Q1.8.

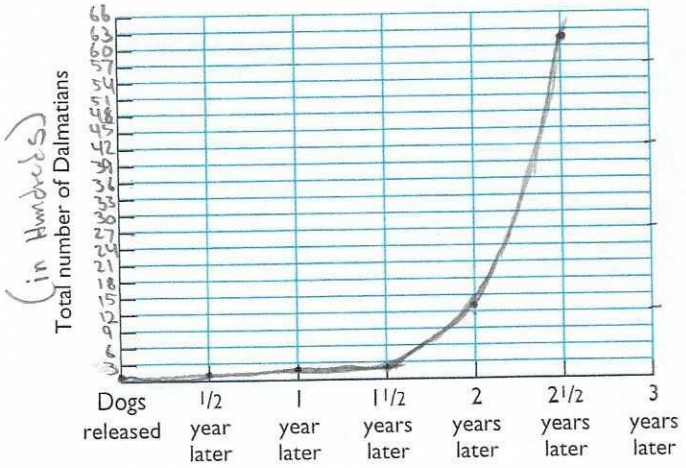
Figure 1.12 Percentage of silver in the gold nuggets.



Q1.9. (circle one) (yes) no

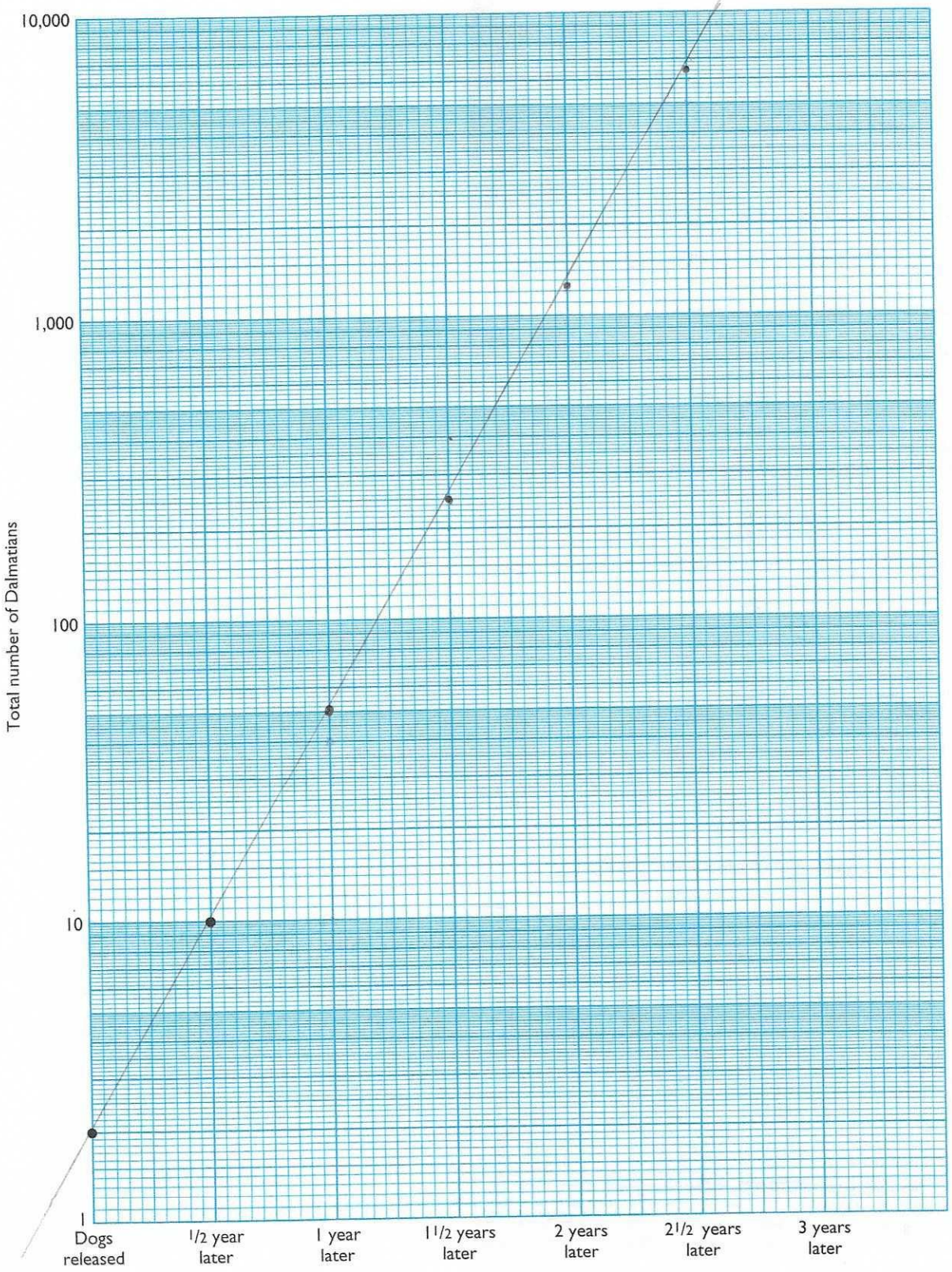
Q1.10.

Figure 1.13 Linear plot of exponential population.



Q1.11.

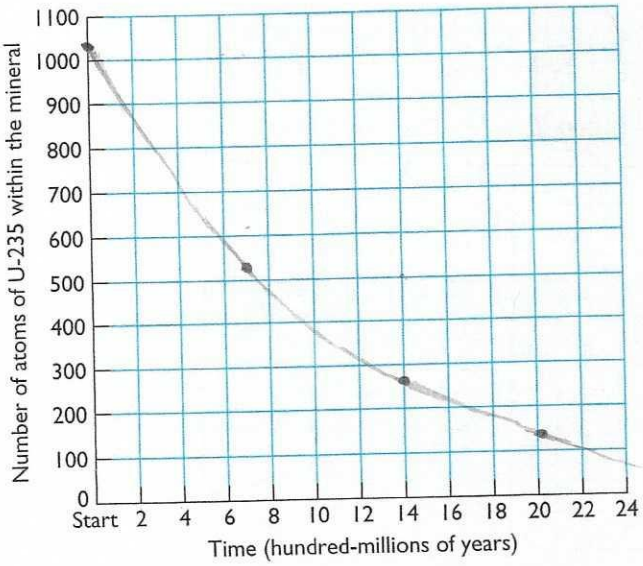
Figure 1.14 Semilogarithmic plot of exponential population growth of Dalmatian dogs.



Q1.12. The line shows a low population that doubles & then skyrockets as the # doubled gets larger & larger.

Q1.13.

Figure 1.15 Half-life of uranium-235 shown on linear graph.

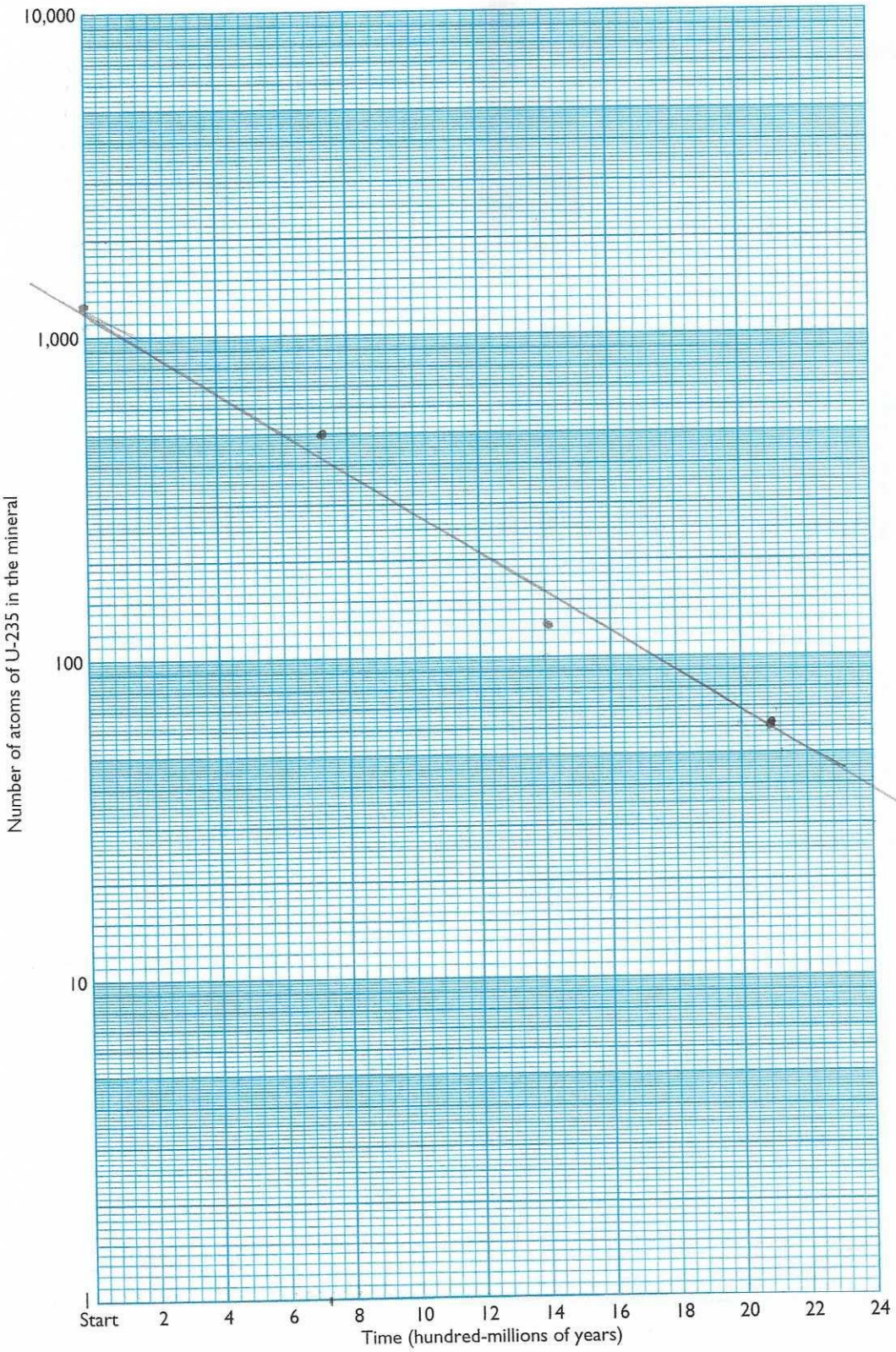


704my = half life

1024 atoms
513
256
128
64
32
16
8
4
2
1
.5
.25
.125

Q1.13. (*cont'd.*)

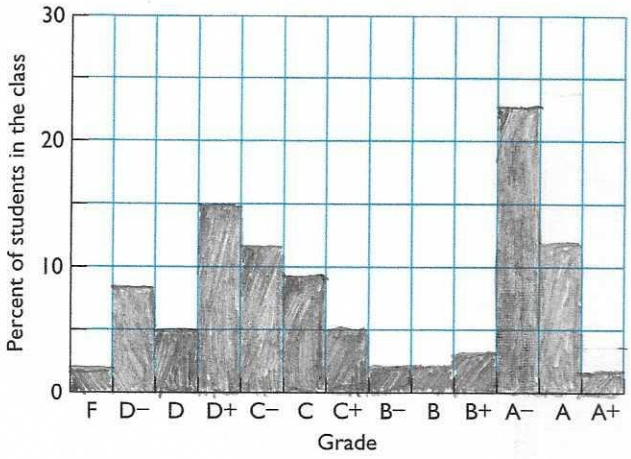
Figure 1.16 Half-life of uranium-235 shown on semilogarithmic graph.

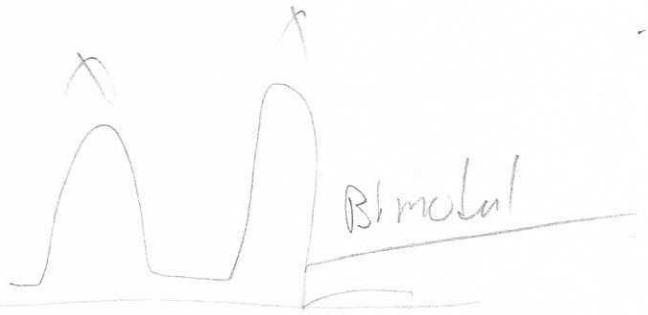


atoms	years
1024	start
512	704
256	1408
128	2112
64	2816
32	3520
16	4224

Q1.14.

Figure 1.17 Histogram of grade distribution for the class.

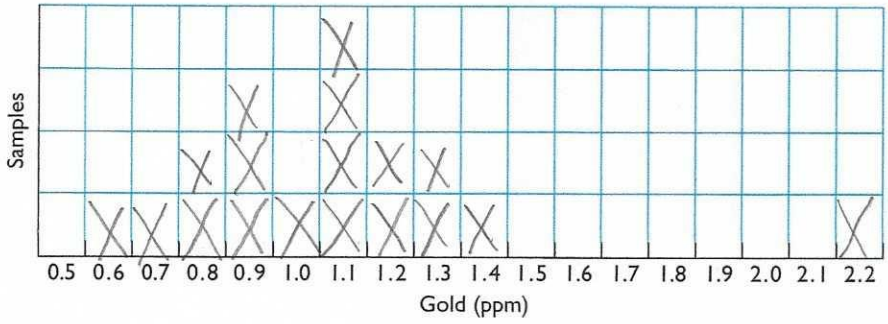




Q1.15. bimodal distribution

Q1.16.

Figure 1.18 Histogram showing distribution of gold concentration (ppm) in rock samples.



Q1.17. Sample 11, 2.2 ppm

Q1.18. It shows a system trying to reach equilibrium. As the water heats, the salt dissolves which uses heat/energy which in turn cools the water, slowing the whole prosess.

Q1.19. More of the graphite will shift to diamond as pressure increases. This is a relationship between pressure & volume. Increase pressure & vol will decrease & the same in reverse.