G202 Take-Home Lab Exercise 1
Applications of Scientific Techniques

Part 1. Scientific Method

1-1. Here's a problem to think about. Rocks make up the foundation of the planet that we are living on. As solid rocks are exposed to the atmosphere and hydrosphere at the Earth's surface, they chemically alter, break apart and generally "weather". The product of rock weathering is soft, loose ("unconsolidated") sediment, that for now, we will refer to as "soil". So in a simple way, rocks near the Earth's surface are generally covered by a mantle of "soil" (weathered, soft, loose sediment).

Wherever you are sitting right now, you are likely in a building that is built upon soil and rock. Your job as a G202 student is to use the scientific method (as discussed in class and the notes) to determine how thick the mantle of soil is outside the door right now. Write a step-by-step summary of how you would apply the scientific method to determine soil thickness. Include in your discussion observations, hypotheses, data collection techniques, and hypothesis testing methods.

Step 1 - Basic Observations
     Examine plants, vegetation. What do they say about "soil"? Is there any?

     Examine local ditches, excavations, road cuts. What do they tell you about soil thickness?

Step 2 - Hypothesis

     Compile initial observations and make a guess as to soil thickness.

Step 3 - Hypothesis Testing

     Drill a hole to determine soil thickness

     Excavate a test pit

Step 4 - Verify results, repeat procedure

Part 2. Mathematics Review

Use your class notes and conversion tables to work the following problems.

2-1. Write the following numbers in scientific notation, to two decimal places:

2593810123 2.59×10^9

98377 9.84×10^4

1   1.00×10^0

456   4.56×10^2

381039948379 3.81×10^4

2-2. Metric Conversion. Show all your work and unit cancellation.

10.73 km = ? m $(10.73 \, km)\left(\frac{1000 \, m}{1 \, km}\right) = 10730 \, m$

27.3 m = ? mm $(27.3 \, m)\left(\frac{1000 \, mm}{m}\right) = 27300 \, mm$

1 x 10⁸ mm = ? m $(1 \times 10^8 \, mm)\left(\frac{1 \, m}{1 \times 10^3 \, mm}\right) = 1 \times 10^5 \, m$

25 kg = ? mg $(25 \, kg)\left(\frac{1000 \, g}{1 \, kg}\right)\left(\frac{1000 \, mg}{g}\right) = 25000000 \, mg = 2.5 \times 10^7 \, mg$

2-3. English to Metric Conversion. Show all your work and unit cancellation.

How many feet are there in a mile? $5280 \, ft$

How many centimeters are there in a meter? $100 \, cm$

How many feet are there in a meter $3.281 \, ft$

24 km = ? mi $(24 \, km)\left(\frac{1000 \, m}{1 \, km}\right)\left(\frac{3.281 \, ft}{1 \, m}\right)\left(\frac{1 \, mi}{5280 \, ft}\right) = 14.91 \, mi$

3 m = ? inches $3 \, m \left(\frac{3.281 \, ft}{1 \, m}\right)\left(\frac{12 \, in}{1 \, ft}\right) = 118 \, in$

20°C = ? °F $(20°C)\left(\frac{9}{5}\right) + 32 = 68 °F$

453 cm = ? inches   XXXXXXXXXXXXXXXXXXXXXXXXXXX $\left(453 \, cm\right)\left(\frac{}{1 \, cm}\right) = 1150 \, in$ XXXXXXXXXXXXXXXXXXXXXXXXXXX

453 cm *[1 in / 2.54 cm] = 178.3 cm

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Part 3. Algebra Review

3-1. Given that the formula for velocity is:

V = d/t   where d is distance, and t is time

algebraically re-arrange the equation to solve for time (show all your steps)

$$V = \frac{d}{t} \; ; \quad t\,V = d \; ; \quad t = \frac{d}{V} \; ; \quad sec = \frac{m}{m/sec} = sec \; \checkmark$$

3-2. Evaluate the following exponential values (* = times, / = divided by):

$2^8 =$ ___256___ $2 + 2 \times 2 + 2 \times 2 \times 2 \; + \; 2 \times 2$
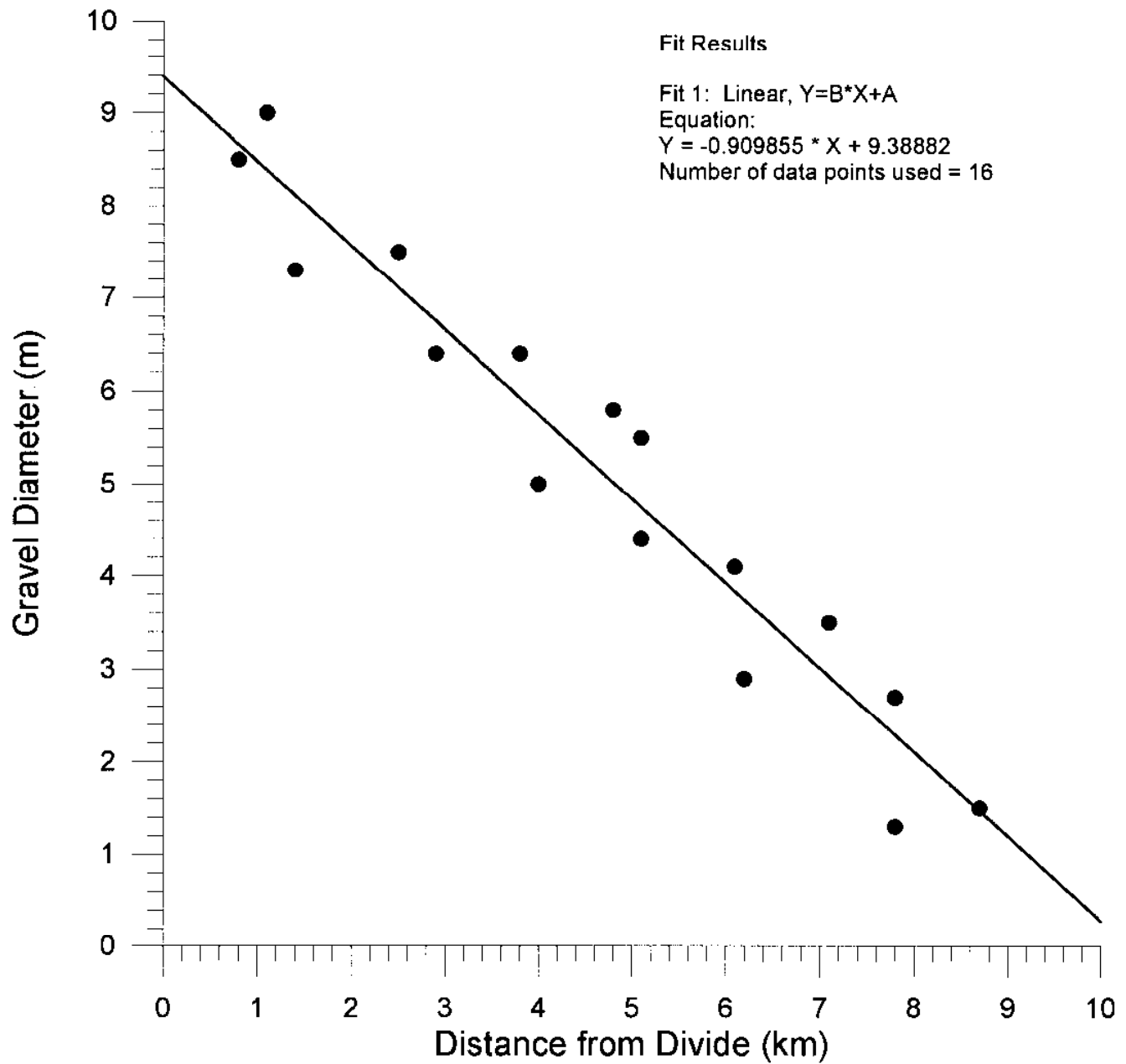
$2^8 * 2^{10} =$ ___2^{18}___

$(y)*(y) =$ ___y^2___

$(x^4)/(x) =$ ___x^3___

Part 4. Graphing Review.

4.1   Use the blank graph on the following page, to plot the following data (Remember to scale the axes, label the axes, give the graph a title). Plot Gravel on the Y-axis and Distance on the X-axis.

Gravel Diameter (m)	Distance from Drainage Divide (km)
8.5	0.8
1.3	7.8
3.5	7.1
5.0	4.0
6.4	2.9
5.8	4.8
1.5	8.7
2.7	7.8
2.9	6.2
4.4	5.1
4.1	6.1
5.5	5.1
6.4	3.8
7.3	1.4
9.0	1.1
7.5	2.5

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Graph of Data in Question 4-1 (G202 Lab 1)

Fit Results

Fit 1: Linear, Y=B*X+A
Equation:
Y = -0.909855 * X + 9.38882
Number of data points used = 16

4-2. From your graph above, complete the following:

   A. As best you can, approximate a best-fit line to the data (draw it on the graph)

   B. Determine the slope of the line _____ -0.91 _____

   C. Determine the Y-intercept of the line _____ 9.39 _____

   D. What is the equation of the best-fit line? _____ $Y = (-0.91)X + 9.39$ _____

$$D_g = (-0.91)D_d + 9.39$$

Part 5. Scientific Visualization

5-1. In the space below, draw and label a cross-sectional sketch of a mountainous landscape with flat-lying layers of rock below the Earth's surface. On your sketch, illustrate a style of vegetation of your choosing. Be very neat, and try to do a good job with everything labelled!

SHALE

SANDSTONE

LIMESTONE