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.

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 ____________________

98377 ____________________

1 ____________________

456 ____________________

381039948379 ____________________

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

10.73 km = ? m ____

27.3 m = ? mm ____

1×10^{8} mm = ? m ____

25 kg = ? mg ____

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

How many feet are there in a mile?____

How many centimeters are there in a meter? ________________________________

How many feet are there in a meter ________________________________

24 km = ? mi ____

3 m = ? inches ____

20°C = ? °F ____

453 cm = ? inches ____

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)

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

$2^8 =$ ___________________

$2^8 * 2^{10} =$ ___________________

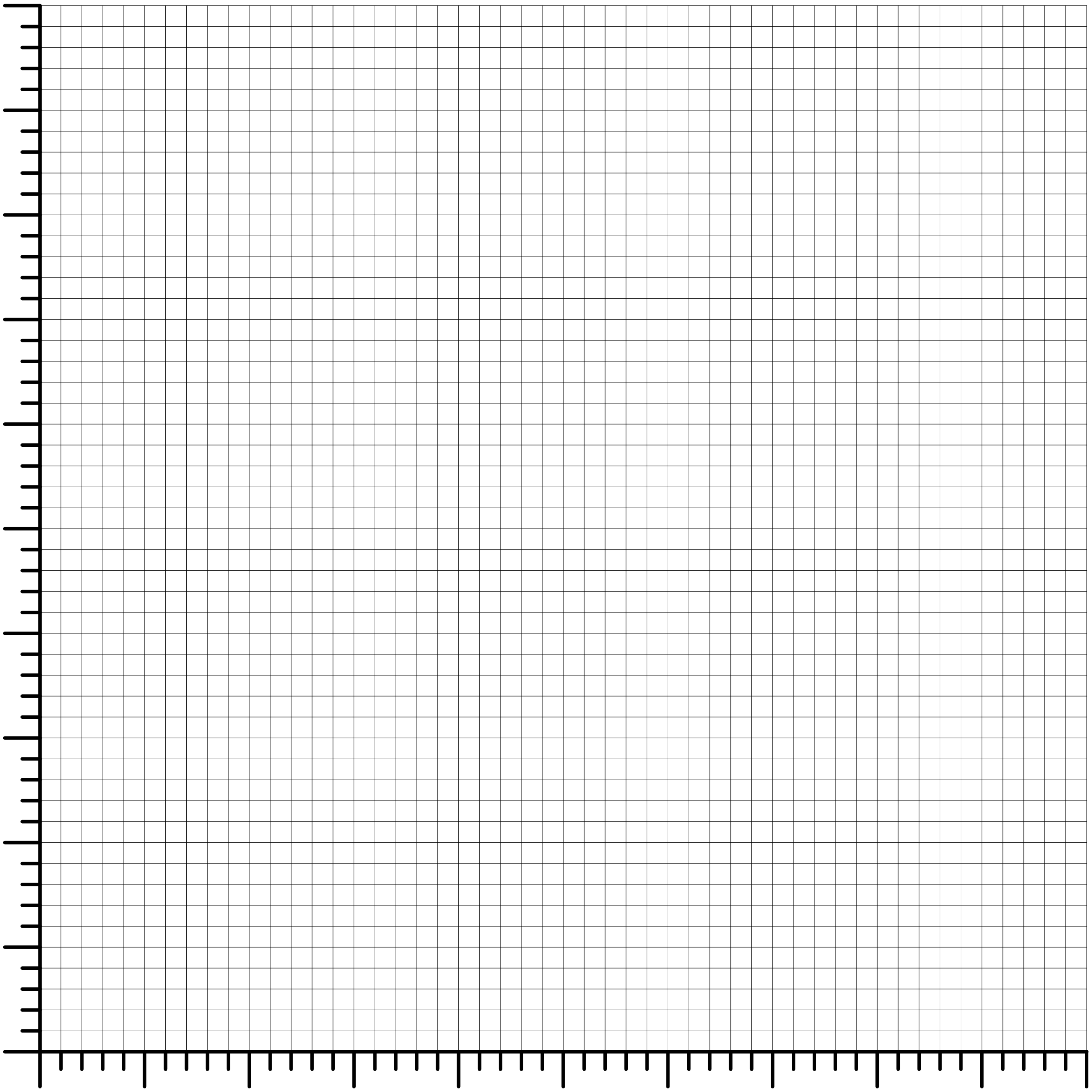
$(y)*(y) =$ ___________________

$(x^4)/(x) =$ ___________________

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



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 ______________________

C. Determine the Y-intercept of the line ______________________

D. What is the equation of the best-fit line? ______________________

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!

5-2. In the space below, draw a sketch map of the State of Oregon showing the location of WOU, your home town, and the major roads that lead from home to campus. You can choose to show the whole state, or a portion of the state, depending on your locality. Make sure you include a map title, north arrow, approximate scale, labels of roads and cultural features. If you draw a map of only a portion of the state, then show a smaller inset sketch of the whole state, and where the bigger map is approximately located. Be very neat, and try to do a good job with everything labelled!

APPENDIX 7
Table for length conversion

Unit	mm	cm	m	km	in	ft	yd	mi
1 millimeter	1	0.1	0.001	10^{-6}	0.0397	0.00328	0.00109	6.21×10^{-7}
1 centimeter	10	1	0.01	0.0001	0.3937	0.0328	0.0109	6.21×10^{-6}
1 meter	1000	100	1	0.001	39.37	3.281	1.094	6.21×10^{-4}
1 kilometer	10^6	10^5	1000	1	39,370	3281	1093.6	0.621
1 inch	25.4	2.54	0.0254	2.54×10^{-5}	1	0.0833	0.0278	1.58×10^{-5}
1 foot	304.8	30.48	0.3048	3.05×10^{-4}	12	1	0.333	1.89×10^{-4}
1 yard	914.4	91.44	0.9144	9.14×10^{-4}	36	3	1	5.68×10^{-4}
1 mile	1.61×10^6	1.01×10^5	1.61×10^3	1.6093	63,360	5280	1760	1

APPENDIX 8
Table for area conversion

Unit	cm^2	m^2	km^2	ha	in^2	ft^2	yd^2	mi^2	ac
1 sq. centimeter	1	0.0001	10^{-10}	10^{-8}	0.155	1.08×10^{-3}	1.2×10^{-4}	3.86×10^{-11}	2.47×10^{-8}
1 sq. meter	10^4	1	10^{-6}	10^{-4}	1550	10.76	1.196	3.86×10^{-7}	2.47×10^{-4}
1 sq. kilometer	10^{10}	10^6	1	100	1.55×10^9	1.076×10^7	1.196×10^6	0.3861	247.1
1 hectare	10^8	10^4	0.01	1	1.55×10^7	1.076×10^5	1.196×10^4	3.861×10^{-3}	2.471
1 sq. inch	6.452	6.45×10^{-4}	6.45×10^{10}	6.45×10^{-8}	1	6.94×10^{-3}	7.7×10^{-4}	2.49×10^{-10}	1.574×10^{-7}
1 sq. foot	929	0.0929	9.29×10^{-8}	9.29×10^{-6}	144	1	0.111	3.587×10^{-8}	2.3×10^{-5}
1 sq. yard	8361	0.8361	8.36×10^{-7}	8.36×10^{-5}	1296	9	1	3.23×10^{-7}	2.07×10^{-4}
1 sq. mile	2.59×10^{10}	2.59×10^6	2.59	259	4.01×10^9	2.79×10^7	3.098×10^6	1	640
1 acre	4.04×10^7	4047	4.047×10^{-3}	0.4047	6.27×10^6	43,560	4840	1.562×10^{-3}	1

APPENDIX 9
Table for volume conversion

Unit	mL	liters	m^3	in^3	ft^3	gal	ac-ft	million gal
1 milliliter	1	0.001	10^{-6}	0.06102	3.53×10^{-5}	2.64×10^4	8.1×10^{-10}	2.64×10^{-10}
1 liter	10^3	1	0.001	61.02	0.0353	0.264	8.1×10^{-7}	2.64×10^{-7}
1 cu. meter	10^6	1000	1	61,023	35.31	264.17	8.1×10^{-4}	2.64×10^{-4}
1 cu. inch	16.39	1.64×10^{-2}	1.64×10^{-5}	1	5.79×10^{-4}	4.33×10^{-3}	1.218×10^{-8}	4.329×10^{-9}
1 cu. foot	28,317	28.317	0.02832	1728	1	7.48	2.296×10^{-5}	7.48×10^6
1 U.S. gallon	3785.4	3.785	3.78×10^{-3}	231	0.134	1	3.069×10^{-6}	10^6
1 acre-foot	1.233×10^9	1.233×10^6	1233.5	75.27×10^6	43,560	3.26×10^5	1	0.3260
1 million gallons	3.785×10^9	3.785×10^6	3785	2.31×10^8	1.338×10^5	10^6	3.0684	1

APPENDIX 10
Table for time conversion

Unit	sec	min	hours	days	years
1 second	1	1.67×10^{-2}	2.77×10^{-4}	1.157×10^{-5}	3.17×10^{-8}
1 minute	60	1	1.67×10^{-2}	6.94×10^{-4}	1.90×10^{-6}
1 hour	360	60	1	4.17×10^{-2}	1.14×10^{-4}
1 day	8.64×10^4	1440	24	1	2.74×10^{-3}
1 year	3.15×10^7	5.256×10^5	8760	365	1

I. Angular Measurement

a. Angular Measurement (based on circle)

  i. Full Circle = 360 degrees

   1. 1 degree = 1/360 th of circle

    (1) Subdivisions of Degree
     (a) 1 degree = 60 minutes
     (b) 1 minute = 60 seconds
     (c) 1 degree = 60 min x 60 sec/min = 3600 sec

    (2) Famous Angular Measurements
     (a) Right Angle = 90 degrees
     (b) (Straight Angle) Line = 180 degrees
     (c) Circle = 360 degrees
     (d) Acute Angle < 90 degrees
     (e) Obtuse Angle: between 90-180 degrees
     (f) Complementary Angles – two angles add up to 90 degrees

2. Radians – unit of angular measurement based on the length of an arc circumscribed by a circle

  a. Circumference of Circle = $2\pi r$,
   where π = circumference of circle / radius of circle = 3.14, and r = radius of circle

  b. Circle = 360 degrees = 2π radians; 180 degrees = π radians

Degree Measure of an Angle

Let an angle be in standard position. It is said to have the measure one **degree**, written 1°, if the angle is obtained by rotating its terminal side $\frac{1}{360}$ of a complete revolution in the positive (counterclockwise) direction. Thus, an angle obtained from one complete counterclockwise revolution has a measure of 360°; an angle obtained from half a complete counterclockwise revolution has a measure of 180°; an angle obtained from one quarter of a complete counterclockwise revolution has a measure of 90°, and so on. An angle obtained from half a complete revolution in the clockwise (negative) direction has a measure of −180°. If the terminal side is not rotated so that the initial and terminal sides coincide, then the angle has measure zero degrees, written 0°. Some angles are depicted in Figure 2.

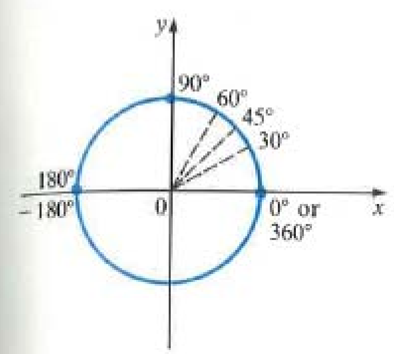


Figure 2

Some Special Angles

1. A **right angle** is an angle of 90°.
2. A **straight angle** is an angle of 180°.
3. θ is an **acute angle** if $0 < \theta < 90°$.
4. θ is an **obtuse angle** if $90° < \theta < 180°$.
5. Two acute angles, θ_1 and θ_2, are **complementary** if $\theta_1 + \theta_2 = 90°$. We say that θ_2 is the **complement** of θ_1, and vice versa.
6. Two positive angles, θ_1 and θ_2, are **supplementary** if $\theta_1 + \theta_2 = 180°$. We say that θ_2 is the **supplement** of θ_1, and vice versa.

These ideas are illustrated in Figure 5.

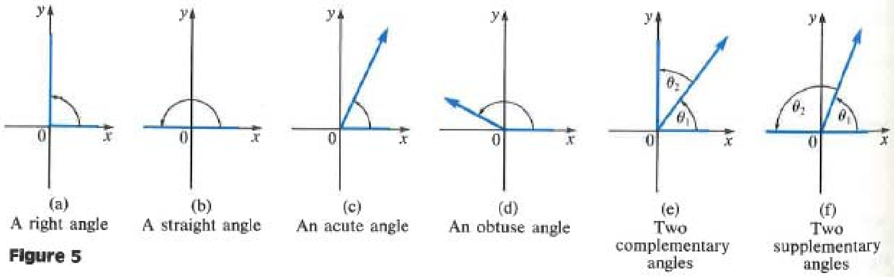


Figure 5