Welcome to AP Environmental Science

Greetings AP Environmental Science students for the 2021-2022 school year

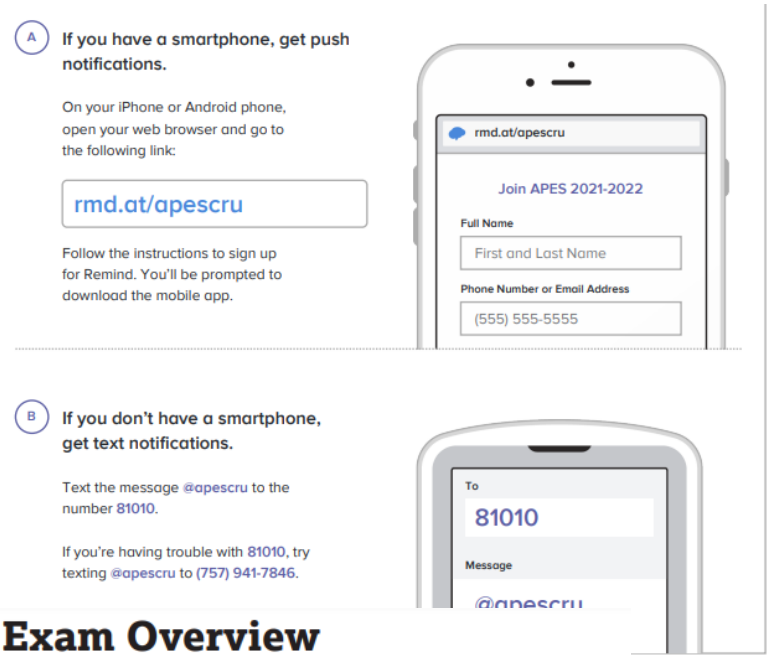
I hope this email finds you well and enjoying your summer break. I am so excited and grateful that you have chosen AP Environmental Science. I have put together directions on Google Classroom (class code yy62h44). You may print your summer assignment and work through the problems on paper, make a copy of the Google Doc and edit, or use the PDF version for a Kami edit. All work is due on the first day of your class. (Monday or Tuesday depending on Green or Gold Day schedules) You can expect a review test on this material within the first two weeks of school. If you join the course late in the summer, please be sure to contact me and we will make a plan for your success. This is mostly a skills review.

Below you will find a description of our oyster field study we will begin in August, Remind sign up directions, as well as course and exam information. Then, the summer assignment directions and questions follow.

As you work through the material and work through the assignment, please feel free to reach out to me any time this summer for help or clarification. We can email or set up a Google Meet. I'm looking forward to an exciting year!

God bless you, Jennifer McMullen

Some Classroom Housekeeping Information for AP Environmental Science



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Remind App_apescru: We will perform a field study this year in partnership with OysterReefKeepers and the Langley family. We have raised oyster spat (juvenile oysters) and recorded monthly environmental and biological data for over a decade. We will set up the oyster nursery on a field trip day in late September. The whole class will then also go on a boat trip or First Landing hiking trip to plant the oysters in their permanent reer in late April. All APES students must go on both field trips as well as join a small group for an after school monthly data collection at the nursery once a semester. Please join the Remind text or email reminder using the joining information in the image here. Reminders will be sent out over the course of the via Remind.

Exam Overview

The AP Environmental Science Exam assesses student understanding of the science practices and learning objectives outlined in the course framework. The exam is 2 hours and 40 minutes long and includes 80 multiple-choice questions and 3 free-response questions. A four-function, scientific, or graphing calculator is allowed on both sections of the exam. The details of the exam, including exam weighting and timing, can be found below:

Section	Question Type	Number of Questions	Exam Weighting	Timing
I	Multiple-choice questions	80	60%	90 minutes
II	Free-response questions	3	40%	70 minutes
	Question 1: Design an investigation (10 points)			
	Question 2: Analyze an environmental problem and propose a solution (10 points)			
	Question 3: Analyze an environmental problem and propose a solution doing calculations (10 points)			

The exams assess content from the four big ideas of the course.
Big Idea 1: Energy Transfer
Big Idea 2: Interactions between Earth systems
Big Idea 3: Interactions between different species and the environment
Big Idea 4: Sustainability

AP Environmental Science Exam College Board AP Schedule 2022

To the left is a diagram of the Spring 2022 AP Environmental Science Exam you will take. Please read the overview and the big ideas to help you understand the format of the course and get an idea of what lies ahead this school year.

This course is designed to be comparable to an introductory college environmental science course. Students will apply scientific principles, concepts, and methodologies required to understand the interrelationships of the natural world. Students will also identify and analyze environmental problems, both natural and human made, and evaluate the risks associated with these problems while examining alternative solutions for resolving and/or preventing them.

AP Environmental Science Summer Assignment

Objective 1: Identify components of strong experimental design

Background Information on Experimental Design

Please follow the links and read the articles on Fair Tests in Science Experiments. Then use the articles to help you answer the questions on the various field study scenarios.

What's a "fair test": Fair tests: A do-it-yourself guide
Developing a "fair test"
- Fair tests in the field of medicine: Aiding Alzheimer patients
- Fair tests in the fossil record: Avoiding extinction
- Fair tests in physics: Examining eclipses

Below is an experiment that was designed to investigate the effect of sulfur dioxide on soybean reproduction. Answer the following questions on the effective components of this experimental design.

Agricultural scientists were concerned about the effect of air pollution, sulfur dioxide in particular, on soybean production in fields adjacent to coal-power plants. Based on initial investigations, they proposed that sulfur dioxide in high concentrations would reduce reproduction in soybeans. They designed an experiment to test this hypothesis. In this experiment, 48 soybean plants, just beginning to produce flowers, were divided into two groups, treatment and no treatment. The 24 treated plants were divided into four groups of 6. One group of 6 treated plants was placed in a fumigation chamber and exposed to 0.6ppm (parts per million) of sulfur dioxide for 4 hours to simulate sulfur dioxide emissions from a power plant. The experiment was repeated on the remaining three treated groups. The no-treatment plants were divided similarly into four groups of 6. Each group in turn was placed in a second fumigation chamber and exposed to filtered air for 4 hours. Following the experiment, all plants were returned to the greenhouse. When the beans matured, the number of bean pods, the number of seeds per pod, and the weight of the pods were determined for each plant.

1. An independent variable is changed or manipulated by the scientist. **Identify** the independent variable?

2. A dependent variable is measured or observed. **Identify** the dependent variable(s)? 3. A

controlled or constant variable is the same in all groups. **Identify** as many controls as you can.

4. **Explain** why replication and sample size are important considerations when designing an experiment. **Describe** how these scientists incorporate replication and sample size in their investigation.

5. **Identify** the treatment that was given to the control group?

6. **Identify** the level of treatment given to the experimental group? (*This is a concentration and/or time.)*

7. **Describe** result(s) that would support the scientists' hypothesis.

8. **Describe** result(s) that would force the scientists to reject the hypothesis?

Objective 2: Create an experiment to investigate a scientific question

The active ingredients in many pesticides are chemical compounds that kill organisms such as insects, molds, and weeds. Opponents of pesticides claim that pesticides degrade water and soil quality. Design a laboratory experiment to determine whether or not a new pesticide (product X) is toxic to minnows, a type of small fish.

9. **Create** a hypothesis for this scenario. (Do not use if…then statements. Include a prediction of results and propose a scientific explanation for these results. Multiple sentences are often needed.)

10. **Describe** the method you would use to test your hypothesis.

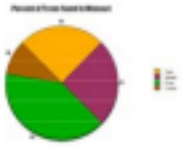
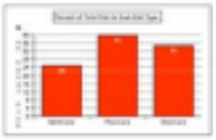
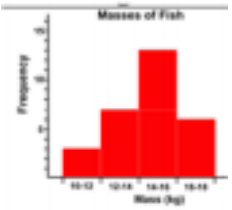
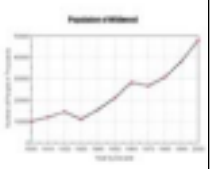
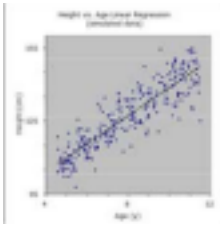
11. **Identify** the control.

12. **Identify** the dependent variable(s).

13. **Describe** experimental results that would lead you to reject your hypothesis. (Be specific)

Objective 3a: Create Effective Visuals; Choosing an appropriate graph

There are several types of graphs that scientists often use to display data. They include:

Pie Graphs	Bar Graphs	Histograms	Line Graphs	Scatter Plots
				
- Dependent variable is NOT continuous. -Usually presents data as a "part of a whole" or as percentages.	-Dependent variable is NOT continuous. -There is no order to the categories on the X-axis. -Bars typically don't touch. -Y-axis is usually a percentage or frequency (count)	-A specific type of bar graph. -Dependent variable must have a natural order that can be grouped into defined "chunks".	-Dependent variable IS continuous. -Points are plotted using x and y components. -The points are connected because the observations are NOT independent.	-Dependent variable IS continuous. -Points are plotted using x and y components. -The points are NOT connected because the observations are independent. -Uses a best-fit line or curve to show relationship.

Identify the best type of graph to represent each type of data set.

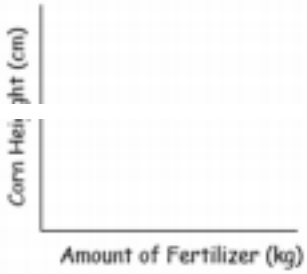
#	Description	Pie	Bar	Histo	Line	Scatter
Ex	A graph showing the number of 5th graders who prefer Coke or Pepsi		X			
14	a newborn baby's weight changes over time					
15	percentage of the class earning As, Bs, and Cs.					
16	distribution of trees of different size groups (e.g. 0-10 cm, 10-20 cm, etc.…) in a forest					
17	relationship between height and arm length in a group					
18	percentage of an allowance spent on different categories (e.g. food, movies, etc.)					
19	amount of rainfall, by month over a 12-month period					
20	number of ice cream cones purchased as a function of the day's temperature					

Objective 3b: Create Effective Visuals; Labeling Axes

When labeling your axes, keep 3 things in mind:

- The independent (manipulated) variable is written along the horizontal axis (X axis)
- Dependent (responding) variable is written along the vertical axis (Y axis)
- Units on any variables should be included in parentheses ( ) following the axis title

SAMPLE: A farmer wants to know if there is a relationship between the amount of fertilizer (in kilograms) she uses and how tall her corn grows (in centimeters).



For each experiment described below, write the independent and dependent variable on the appropriate axis. Be sure to include units when appropriate.

21. Geologists wanted to know if there was a relationship between the density (in g/cm^3) of a rock and how many meters down it was collected from.	**22.** A scientist studied the relationship between the amount of rain (in cm) and the numbers of zebra babies born each spring.
23. Sea otters were counted over several years to see if their numbers were decreasing over time.	**24.** Does the amount of nitrogen in the soil (measured in kilograms) affect corn production (measured in kilograms).

Objective 3c: Create Effective Visuals, Scaling Axes

There are a few important steps involved in correctly scaling an axis:

STEP 1: Find the range for the variable Range = Largest Value - Smallest Value

STEP 2: Divide the range by the number of intervals you want

(not too many or too few). We don't want all of the data smooshed in only part of the graph; spread it out. After dividing, we may need to round *up* to get a number that is easy to count by. (It is easier to count by 2s instead of 1.9s)

STEP 3: Use the rounded number to mark off intervals along the axis. The interval must be the same amount each time (count up by the same number).

25-28. Determine the range.

EX.

Mass (g)
5
11
14
19
26
30
40

Largest #: 40

Smallest #: 5

Range: 40-5 = 35

A)

Students
100
99
88
70
72
64
55

Largest #: _____

Smallest #: _____

Range: _____

B)

Distance (cm)
3
5
6
7
9
10
12

Largest #: _____

Smallest #: _____

Range: _____

C)

Time (s)
0.22
0.51
0.78
1.01
1.23
1.60
1.74

Largest #: _____

Smallest #: _____

Range: _____

29-32: Determine the interval values. Your graph has 10 intervals (places to put numbers).

A)

Range = 35

# of intervals = 10

$\frac{\text{Range}}{\text{Intervals}} = \frac{35}{10} = 3.5$

Round to Count = 4

A)

Range = _____

# of intervals = _____

B)

Range = _____

# of intervals = _____

C)

Range = _____

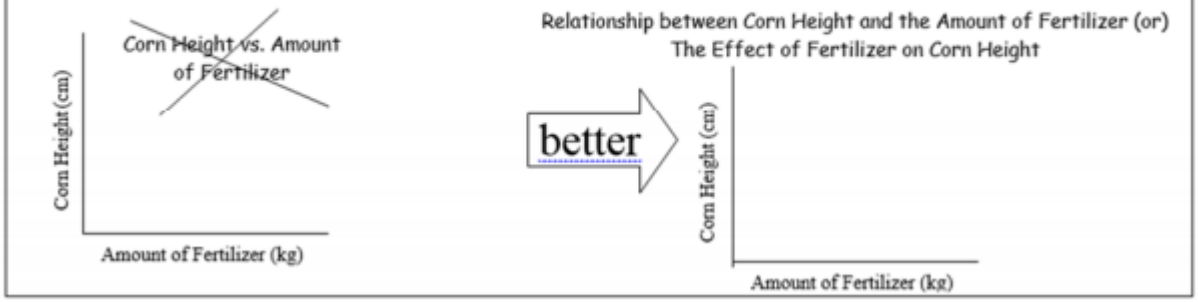
# of intervals = _____

Objective 3d: Create Effective Visuals, Forming Proper Titles

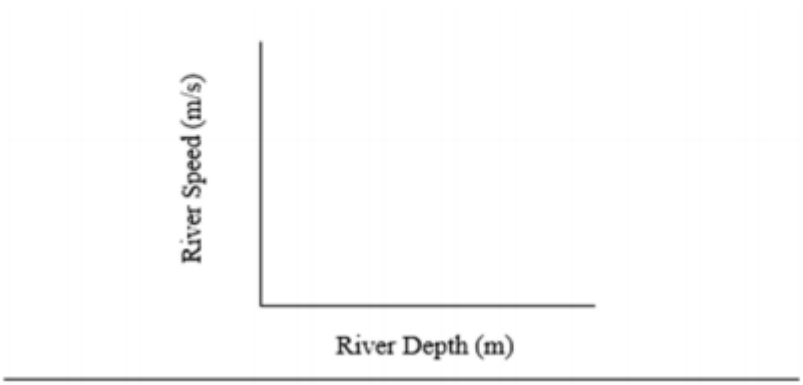
When writing a title for you graph, please remember

- The title must communicate the dependent and independent variables
- The title cannot be presented in the form "Y versus X"
- Some graphs need more explanation than others. Make sure your reader would be able to understand what your data represents.

SAMPLE: A farmer wants to know if there is a relationship between the amount of fertilizer (in kilograms) she uses and how tall her corn grows (in centimeters).



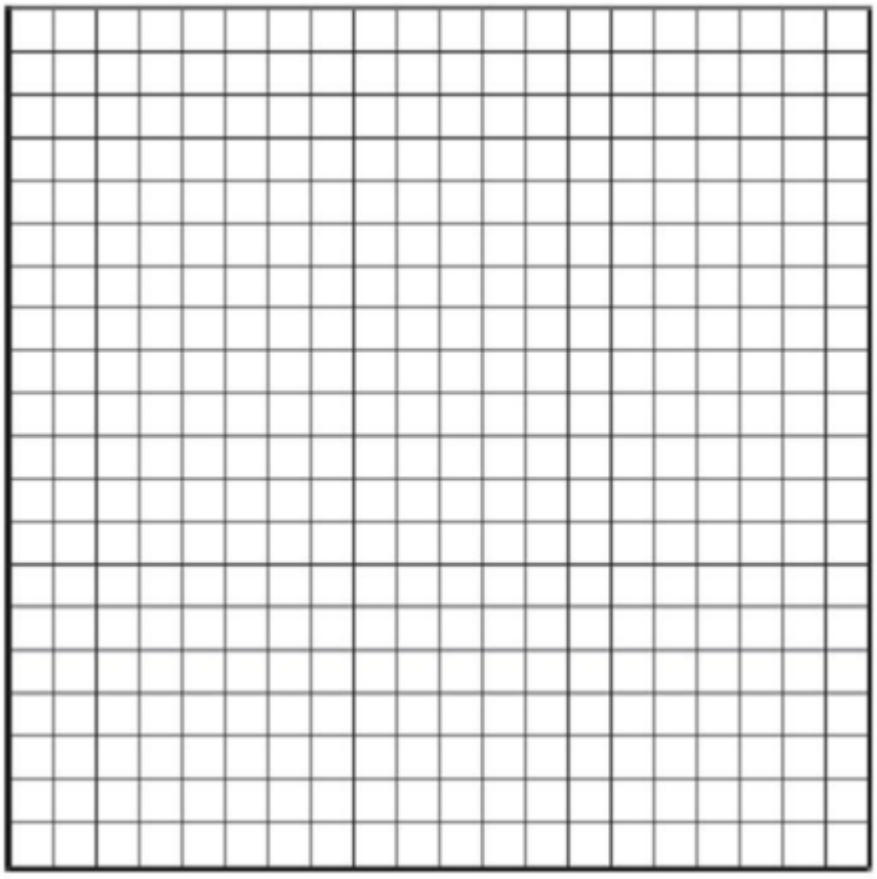
33. Create a title for the following graph.



34. Put it all together - Graph the following data set and include appropriate scale, title, and axis labels.

Plants lose water from their aboveground surfaces in the process of transpiration. Most of this water is lost from stomata, microscopic openings in the leaves. Excess water loss can have a negative effect on the growth, development, and reproduction of a plant. Severe water loss can be fatal. Environmental factors have a major impact on the rate of plant

Temperature (°C)	20	23	27	28
Transpiration Rate ($mmol/m^2.sec$)	1.5	3	5	4.5



Objective 4: Understand the basics about some important pieces of Environmental Legislation.

Use the internet to fill in the missing information pertaining to important legislation.

Legislation Name	**Is this a US or World Treaty, Law or Act?**	**Date Enacted (Year)**	**Description of the Legislation (Give the purpose, important founding organizations or people, any major points that you find)**
Kyoto Protocol			
Montreal Protocol			
CITES			
SMRCA			
RCRA			

Lacey Act			

Clean Water Act			
Safe Drinking Water Act			
Clean Air Act			
Endangered Species Act			
CERCLA			

Objective 5: Math Review

Throughout the year, you will be expected to do some math, especially when we begin to study renewable and nonrenewable energy sources. Below you will find some math review to make sure you are prepared.

Things to Remember:

1. SHOW ALL OF YOUR WORK, even if you think it is really simple. This is REQUIRED on the APES exam, so it will be required on all of your assignments, labs, quizzes and tests.
2. INCLUDE UNITS in each step. Your answers ALWAYS need units!
3. Check your work! Go back through each step to make sure you didn't make any mistakes in your calculations.
4. Make sure your answer makes sense. If the question asks, "How many pizza slices did you eat in 20 minutes?" your answer will probably not be "13 billon." If you get an answer that seems unlikely, it probably is!

Directions:

Reach each section below for review. Look over the examples and use them to help you work through the practice problems. SHOW ALL WORK and be sure to include units. Check your work when you are finished.

A. Metric Units

A. Metric Units

Kilo-, cent-, and milli- are the most frequently used prefixes in the metric system. Since the multiples and divisions of the base units are all factors of 10, you just need to move the decimal con convert from one to another. con convert from one to another.

To convert to a larger unit, move the decimal point to the left the appropriate number of spaces or divide. ←

To convert to a smaller unit, move the decimal point to the right the appropriate number of spaces or multiply. →

10^{12}	10^{11}	10^{10}	10^{9}	10^{8}	10^{7}	10^{6}	10^{5}	10^{4}	10^{3}	10^{2}	10^{1}		10^{-1}	10^{-2}	10^{-3}	10^{-4}	10^{-5}	10^{-6}	10^{-7}	10^{-8}	10^{-9}
Giga	X	X	Tera	X	X	Mega	X	X	Kilo	Hecto	Deka	BASE UNIT	Deci	Centi	Milli	X	X	Micro	X	X	Nano

Example: 55 centimeters = ? kilometers

- Step 1: Figure out how many places to move the decimal. Centimeters to Kilometers is 5 places to the left (Couth the one you are going to, but not the one you are on.)
- Step 2: Move the decimal five places to the left since you are going from smaller to larger. 55

centimeters = .00055 kilometers

Example: 19.5 kilograms = ? milligrams

- Step 1: Figure out how many places to move the decimal. Kilograms to milligrams is 6 places to the left (Couth the one you are going to, but not the one you are on.)
- Step 2: Move the decimal six places to the right since you are going from larger to smaller. In this case, you will need to add zeros. 19.5 kilograms = 19,500,000 milligrams

Metric Unit Practice

1.) 1300 kilograms = ? milligrams

2.) 12000 micrometers = ? meters

3.) 780 hectometers = ? centimeters

4.) 14 grams = ? kilograms

5.) 180 megaliters = ? deciliters

6.) 120000000000000 nanometers = ? gigameters

B. Scientific Notation

Introduction

Scientific notation is a shorthand way to express large or tiny numbers. Since you will need to do calculations through the year WITHOUT A CALCULATOR, we will consider anything over 1000 to be a large number. Writing these numbers in scientific notation will help you do your calculations much quicker and easier and will help prevent mistakes in conversions from one unit to another. Like the metric system, scientific notation is based on factors of 10. A large number written in scientific notation looks like this:

$$\mathbf{1.23 \times 10^{11}}$$

The number before the x (1.23) is called the coefficient. The coefficient must be greater than 1 and less than 10. The number after the x is the base number and it is always 10. The number in the superscript (11) is the exponent.

Writing Numbers in Scientific Notation

To write a large number in scientific notation, put a decimal after the first digit. Count the number of digits after the decimal you just wrote in. This will be the exponent. Drop any zeros so that the coefficient contains as few digits as possible.

Example: 123,000,000,000

- Step 1: Place a decimal after the first digit. 1.23000000000
- Step 2: Count the number of digits after the decimal… There are 11
- Step 3: Drop the zeros and write in the exponent. 1.23×10^{11}

Writing tiny numbers is similar to scientific notation is similar to writing large numbers. The only difference is the decimal is moved to the left and the exponent is negative. A tiny number written in scientific notation looks like this:

$$\mathbf{4.26 \times 10^{-8}}$$

To write at tiny number in scientific notation, move the decimal after the first digit that is not a zero.

Count the number of digits before the decimal you just wrote in. this will be exponent as a negative. Drop any zeros before or after the decimal.
Example: .0000000426

- Step 1: 00000004.26
- Step 2: Count the number of digits before the decimal… There are 8
- Step 3: Drop the zeros and write in the exponent as a negative. 4.26×10^{-8}

Adding and Subtracting Numbers in Scientific Notation

To add or subtract two numbers with exponents, the exponents must be the same. You can do this by moving the decimal one way or another to get the exponents the same. Once the exponents are the same, add or subtract the coefficients just as you would any regular problem. The exponent will stay the same. Make sure your answer has only one digit before the decimal – you may need to change the exponent of the answer.

Example: $1.35 \times 10^6 + 3.72 \times 10^5 = ?$

- Step 1: Make sure both exponents are the same. It is usually easier to go with the larger exponent so you don't have to change the exponent in your answer, so let's make both exponents 6 for this problem.

$$3.72 \times 10^5 \rightarrow .372 \times 10^6$$

- Step 2: Add the coefficients just as you would regular decimals.

$$\begin{array}{r} 1.35 \\ +\ .372 \\ \hline 1.722 \end{array}$$

- Step 3: Write your answer including the exponent, which is the same as what you started with.

$$1.722 \times 10^6$$

Multiplying and Dividing Numbers in Scientific Notation

To multiply exponents, multiply the coefficients just as you would regular decimals. Then add the exponents to each other. The exponents DO NOT have to be the same.

Example: $1.35 \times 10^6 \times 3.72 \times 10^5 = ?$

- Step 1: Multiply the coefficients

- Step 2: Add the exponents

$$5 + 6 = 11$$

- Step 3: Write your final answer

$$5.022 \times 10^{11}$$

To divide exponents, divide the coefficients just as you would regular decimals. Then subtract the exponents. In some cases, you may end up with a negative exponent.

Example: $5.635 \times 10^3 / 2.45 \times 10^6 = ?$

- Step 1: Divide the coefficients

$$5.635 / 3.45 = 2.3$$

- Step 2: Subtract the exponents

$3 - 6 = -3$

- Step 3: Write your final answer

2.3×10^{-3}

Scientific Notation Practice

Write the following numbers in scientific notation

1.) 145,000,000,000

2.) .002

3.) 13 million

4.) 435 billion

5.) .000348

Complete the following calculations – and SHOW YOUR WORK in steps, as shown in the example below. While I know you can type this into your calculator to get an answer in one step, it will be beneficial to know how this works in the long run.

Example: $6.7 \times 10^{12} \times 17.9 \times 10^{-3}$

1.) Multiply	2.) Add your	3.) Put it all together and move the decimal for your final answer:
Coefficients: 6.7 x 17.9 = 119.93	Exponents: 12 + -3 = 9	119.93×10^{9} □ **1.1993×10^{11}**

1.) $3 \times 10^{3} + 4 \times 10^{3}$

2.) $4.67 \times 10^{4} + 323 \times 10^{3}$

3.) $9.85 \times 10^{4} - 6.35 \times 10^{4}$

4.) $1.278 \times 10^{-13} - 1.021 \times 10^{-10}$

5.) $1.32 \times 10^{8} \times 2.34 \times 10^{4}$

6.) $3.78 \times 10^{3} \times 2.9 \times 10^{2}$

7.) $3.45 \times 10^{9} / 2.6 \times 10^{3}$

8.) $1.98 \times 10^{-4} / 1.72 \times 10^{-6}$

C. Dimensional Analysis

Introduction

Dimensional Analysis is a way to convert a quantity given in one unit to an equal quantity of another unit by lining up all the known values and multiplying.

In a dimensional analysis problem, start with your given value and unit, and then work toward your desired unit by writing equal values side by side. Remember, you want to cancel out each of the intermediate units. To cancel a unit on the top part of the problem, you have to get the unit on the bottom. Likewise, to cancel a unit that appears on the bottom part of the problem, you have to write it on the top.

Once you have the problem written out, multiply across the top and bottom and then divide the top by the bottom.

Example 1: 3 years = ? seconds

- Step 1: Start with the value and unit you are given. There may or may not be a number on the bottom.

3 years

- Step 2: Start writing in all the values you know, making sure you can cancel top and bottom. Since you have years on top right now, you need to put years on the bottom in the next segment. Keep going, cancelling units as you go, until you end up with the unit you want (in this case seconds) on the top.

$$3\ \cancel{\text{years}} \times \frac{365\ \cancel{\text{days}}}{1\ \cancel{\text{year}}} \times \frac{24\ \cancel{\text{hours}}}{1\ \cancel{\text{day}}} \times \frac{60\ \cancel{\text{minutes}}}{1\ \cancel{\text{hour}}} \times \frac{60\ \text{seconds}}{1\ \cancel{\text{minute}}} =$$

- Step 3: Multiply by all the values on the top and divide by all the values on the bottom. REMEMBER TO include your units!

$$3\ \text{years} \times \frac{365\ \text{days} \times 24\ \text{hours} \times 60\ \text{minutes} \times 60\ \text{seconds}}{1\ \text{year} \times 1\ \text{day} \times 1\ \text{hour} \times 1\ \text{minute}} = \frac{94{,}608{,}000}{1} = \boxed{\begin{array}{c}94{,}608{,}000\ \text{seconds} \\ \text{OR} \\ 9.4608 \times 10^7\ \text{seconds}\end{array}}$$

- Step 4: Review your answer to see if it makes sense. 9.4608×10^7 is a REALLY BIG number. Does it make sense for there to be that many seconds in 3 years… YES! If you had gotten a tiny number, then you would need to go back and check for mistakes.

In a lot of APES problems, you will be given a unit on the top and bottom and need to convert both. Don't panic! Just convert the top one first and then the bottom!

Example 2: 50 miles per hour = ? feet per second

- Step 1: Start with the value and unit(s) you are given.

$$\frac{50 \text{ miles}}{1 \text{ hour}}$$

- Step 2: Start writing in all the values you know, making sure you can cancel top and bottom. Since you have miles on top right now, you need to put miles on the bottom in the next segment. Multiply by all the values on the top, and divide by all the values on the bottom. REMEMBER TO include your units!

$$\frac{50 \text{ miles}}{1 \text{ hour}} \times \frac{5280 \text{ feet}}{1 \text{ mile}} = \frac{264{,}000 \text{ feet}}{1 \text{ hour}}$$

- Step 3: You now know that you are travelling 264,000 feet per hour, but the question asks how many feet are traveled per second. Since you have hours on bottom right now, you need to put hours on the top in the next segment. Keep going, cancelling units as you go, until you end up with the unit you want (in this case seconds) on the top. Multiply by all the values on the top, and divide by all the values on the bottom. REMEMBER TO include your units!

$$\frac{264{,}000 \text{ feet}}{} \times \frac{1 \text{ hour}}{} \times \frac{1 \text{ minute}}{1 \text{ hour}} = \frac{264{,}000}{60 \text{ minutes}} = \frac{73.333 \text{ feet}}{60 \text{ seconds}} = \frac{73.333 \text{ feet}}{1 \text{ Second}}$$

  - NOTE: You can combine steps 2 and 3, instead of doing the separately, like this

$$\frac{50 \text{ miles}}{1 \text{ hour}} \times \frac{5280 \text{ feet}}{1 \text{ mile}} \times \frac{1 \text{ hour}}{60 \text{ minutes}} \times \frac{1 \text{ minute}}{60 \text{ seconds}} = \frac{73.333 \text{ feet}}{1 \text{ Second}}$$

- Step 4: Review your answer to see if it makes sense.

Dimensional Analysis Practice

Conversions:

- 1 square mile = 640 acres
- 1 hectare (Ha) = 2.47 acres
- 1 kw-hr = 3,413 BTUs
- 1 barrel of oil = 159 Liters
- 1 metric ton = 1000 kg

1.) 134 miles = ? inches

2.) 1.35 kilometers per second = ? miles per hour

3.) 8.9×10^5 tons = ? ounces

4.) A city that uses 10 billion BTUs of energy each month is using how many kilowatt-hours of energy?

5.) A 340 million square mile forest is how many hectares?

6.) Fifty-eight thousand kilograms of solid waste is equivalent to how many metric tons?