Metric System
Math Review -Dimensional Analysis

In 1960 the International Bureau of Weights and Measures (Sevres, France) adopted the "International System of Units", also known as "SI" units.

7 base units are used. All other SI units are derived from combinations of these base units:

SI Base Units

Length	meter	m
Mass	kilogram	kg
Time	second	s
Electric Current	ampere	A
Temperature	Kelvin	K
Amount of Substance	mole	mol
Luminous Intensity	candela	cd

General Punctuation Rules:

a) use space instead of comma to separate numbers into groups of three
ex: 63 000 000 m 0.000 000 003 m

b) use decimals instead of fractions to express partial units

c) space between the numeric value and unit symbol

d) do not use periods after symbols

e) all abbreviations are singular

f) follow capitalization rules as given in problems

Metric Prefixes are combined with a unit to indicate that the unit has been multiplied by a certain power of 10. Prefixes are to be used to keep numerical values in tables, results, and specifications between 0.1 and 1000.

example: 144 000 N = 144 kN

Six basic prefixes are used commonly. They will be used to demonstrate the basic principles. Less common prefixes are given in the metric appendix.

The first example: kilo (abbreviated with lowercase 'k'
This prefix represents 3 decimal places, usually associated with 1000.
examples: 1 km = 1000 meters (1000 m) 2.3 kJ = 2 300 Joules (2 300 J)

Another example: centi (abbreviated with lowercase 'c'
This prefix represents 2 decimal places, usually associated with 0.01
examples: 100 cm = 1 meter (1 m) 2.3 E 2 cm = 2.3 meters (2.3 m)

Another commonly used metric prefix is milli ('m')
examples: 1000 mL = 1 liter (1 L) 2.3 E 3 mL = 2.3 liters (2.3 L)

Less common but used occasionally are the following:
mega (M) 1 000 000 (1 E 6)
micro (μ) 0.000 001 (1 E - 6)
nano (n) 0.000 000 001 (1 E - 9)

The remaining prefixes and their multiplication factors can be seen in the metric appendix.

Dimensional Analysis Examples

Dimensional analysis is also called the factor-label method of problem solving. It is a way of setting up a problem in a constant fashion that breaks the problem down into simple steps. Each step is a ratio that must equal 1, thus canceling out some preceding unit.

example problem: 4.4 km = ? m

solution: $4.4\ \text{km} \times \frac{1000\ \text{m}}{1\ \text{km}} = 4\,400\ \text{m}$

(note that the 'km' cancel and you multiply 4.4 times 1000 to get your answer)

problem: 4.4 km = ? cm

solution: $4.4\ \text{km} \times \frac{1000\ \text{m}}{1\ \text{km}} \times \frac{100\ \text{cm}}{1\ \text{m}} = 4.4\ \text{E}\ 5\ \text{cm}$

solution using scientific notation: $4.4\ \text{km} \times \frac{1\ \text{E}\ 3\ \text{m}}{1\ \text{km}} \times \frac{1\ \text{E}\ 2\ \text{cm}}{1\text{m}} = 4.4\ \text{E}\ 5\ \text{cm}$

problem without metric prefixes: 4.4 weeks = ? seconds

solution: $4.4\ \text{wk} \times \frac{7\ \text{day}}{1\ \text{wk}} \times \frac{24\ \text{hour}}{1\ \text{day}} \times \frac{60\ \text{minute}}{1\ \text{hour}} \times \frac{60\ \text{seconds}}{1\ \text{minute}} = 2.7\ \text{E}\ 7\ \text{s}$

some points of interest:

- 1 E 3 m = 1 km
- place the 1 with the large unit (then all other numbers in conversion are greater than 1)
- use base units whenever possible
- must know number of decimal places in each prefix
- 1 cm^3 = 1 mL for all substances
- 1 cm^3 = 1 mL = 1 g for pure water only

Metric Problems: the following problems solutions are part of the homework. Try them before you look at the solutions (no peeking).

- 4 g to cg
- 12 L to mL
- 12. 5 mL to μL
- 0.068 kL to L
- 8.5 E - 5 mg to cg
- 1.85 E - 6 Mm to nm

Solutions:

- $4\ \text{g} \times \frac{1\ \text{E}\ 2\ \text{cg}}{1\ \text{g}} = 4\ \text{E}\ 2\ \text{cg}$

- $12\ L \times \frac{1\ E\ 3\ mL}{1\ L} = 1.2\ E\ 4\ mL$

- $12.5\ mL \times \frac{1\ L}{1\ E\ 3\ mL} \times \frac{1\ E\ 9\ \mu L}{1\ L} = 1.25\ E\ 7\ \mu L$

- $0.068\ kL \times \frac{1\ E\ 3\ L}{1\ L} = 68\ L$

- $8.5\ E - 5\ mg \times \frac{1\ g}{1\ E\ 3\ mg} \times \frac{1\ E\ 2\ cg}{1\ g} = 8.5\ E - 6\ cg$

- $1.86\ E - 6\ Mm \times \frac{1\ m}{1\ E\ 6\ Mm} \times \frac{1\ E\ 9\ nm}{1\ m} = 1.86\ E - 3\ nm$

Metric Appendix

Name	Symbol	Multiplication Factor
exa	E	1 E 18
petra	P	1 E 15
tera	T	1 E 12
giga	G	1E 9
mega	M	1 E 6
kilo	k	1E 3
hecto	h	1 E 2
deka	da	1 E 1
deci	d	1 E - 1
centi	c	1 E - 2
milli	m	1 E - 3
micro	µ	1 E - 6
nano	n	1 E - 9
pico	p	1 E - 12
femto	f	1 E - 15
atto	a	1 E - 18

Common Conversions

1 mile = 5280 ft 1 mile = 1760 yd 1 m = 100 cm 1 in = 2.54 cm 1 slug = 14.6 kg
1 km = 1000 m 1 hour = 3600 s 1 km = 0.6214 mile 1 L = 1.06 qt1 km = 0.6214 mile 1 m = 3.28 ft 1 lb = 454 g 1 year = 365.24 day

Significant Figures

* There is a difference between pure numbers (as used in math classes) and measured quantities (such as 35.6 mL of acid).

* Measurement tools often limit our ability to measure quantities.

* We must be aware of the accuracy limits of each piece of lab equipment that we use and record our data to the proper number of significant figures.

* You are always allowed one estimated figure in measurements.

* When measured quantities are given to you, it is assumed that the proper number of significant figures were recorded. (all measurements in scientific notation must be recorded to the proper number of significant figures).

* When using conversions, `1' is considered to be correct to several significant figures.

Rules for Counting Significant Figures

Rule: All non-zero digits are significant.
12.83 cm [4] 16935 g [5]

Rule: Zeros between other significant figures are significant.
12 038 cm [5] 169.04 g [5] 70 304 g [ ] 395.01 kg [ ]

Rule: Zeros to the right of a decimal point and to the right of a number are significant.
12.380 cm [5] 169.00 m [5] 3.010 mL [4] 1.30 kg [ ] 1691.100 cm [ ]

Rule: A zero standing alone to the left of a decimal point is not significant.
0.421 g [3] 0.5 m [ ]

Rule: Zeros to the right of the decimal and to the left of a number are not significant.
0.000 421 mg [3] 0.001 80 cm [3] 0.010 kg [ ] 0.01010 m [ ]

Rule: Zeros to the right of the last number but left of the decimal point may or may not be significant. This information is known only to the person that made the measurement. Use scientific notation when in doubt. The use of a bar over the last significant zero is acceptable as well as using the decimal point to indicate that all digits to its left are significant.
4000. g [4] 3400 kg [2] 69 700. mL [ ] 4.50 E 2 g [ ]

Rounding Rules

When rounding examine the digit to the right of the digit that is to be last (this number is called the trigger):
a) if the trigger is less than 5, drop it and all the digits to the right of it
b) if the trigger is more than 5, increase by 1 the number to be rounded
C) if the trigger is 5, round the number so that it will be even

63.5347 m [4] = 62.53 m 726.835 m [5] = 726.84 m
3.787 21 m [3] = 3.79 m 24.8514 m [3] = 24.8 m

Scientific Notation

Integral Powers of 10

10^0 = 1 E 0 = 1 (1 x 10^0 is acceptable)
10^1 = 1 E 1 = 10
10^2 = 1 E 2 = 100
10^6 = 1 E 6 = 1 000 000

10^{-1} = 1 E -1 = 0.1
10^{-2} = 1 E -2 = 0.01
10^{-6} = 1 E -6 = 0.000 001

Proper Notation:
Place the leftmost significant figure to the left of the decimal and display the rest of the figures (significant only) to the right of the decimal following rounding rules. There can only be 1 integer to the left of the decimal.

example: 93 000 000 m = 9.3 E 7 m

0.000 028 in = 2.8 E -5 in

Decimal points and a bar over the last significant zero will be demonstrated in class.

Multiplying measured quantities using scientific notation:
Rule: multiply the numbers and add exponents:
example: (9.0 E 3 m) (7.0 E 2 m) = 63 E 5 m^2 = 6.3 E 6 m^2

Dividing in scientific notation:
Rule: Divide the numbers and subtract the exponents:
example: (4.5 E - 6 m^2) / (1.5 E -2 m) = 3.0 E -4 m

Multiplication and Division using Significant Figures

Rule: In multiplication and division, the result may have *no more* significant figures than the factor with the fewest number of significant figures.

example: 2.52 m x 1.000 424 3 m = 2.521 069 236 m^2 but must be recorded as 2.52 m^2 (3 sig figs)

example: 7540 m x 1.3 m = 0902.000 m^2 but must be recorded as 9800 m^2 (only 2 sig figs)

Rule: When adding and subtracting numbers that come from measurements, arrange the numbers in columnar form. The final answer can contain only as many decimal places as found in the measurement with the fewest number of decimal places.

example: 134.050 m + 1.23 m =

134.050 m
<u>+ 1.23 m</u>
135.28 m (2 decimal places)

Directions: Perform all the operations using your calculator and record the answer with the proper number of significant figures. See Mr. Jones for answers.

1. $\dfrac{(3.4617 \text{ E } 2)\ (5.61 \text{ E } -4)}{(9.87 \text{ E } 5)\ (3.1)\ (1.171 \text{ E } 4)}$

2. $\dfrac{(3.52164 \text{ E } 2)\ (3.1741 \text{ E } 5)}{(8.22 \text{ E } 7)\ (4.65217 \text{ E } -3)\ (9.711 \text{ E } 4)}$

3. $\dfrac{(1.8741 \text{ E } 11)}{(5.6 \text{ E } 4)\ (2.173 \text{ E } 8)}$

4. $\dfrac{(1.745 \text{ E } -2)\ (9.51 \text{ E } -7)}{(16.21)\ (9.346 \text{ E } -10)}$

5. $\dfrac{(3.4721 \text{ E } 5)}{(5.6145 \text{ E } 7)\ (9.5 \text{ E } 1)}$

Word Problems using Significant Figures

Directions: Solve the following word problems and record the answer using the proper number of sig figs. Use 3.1416 for π. See Mr. Jones for answers.

1. The volume of a cylinder is: $V = \pi r^2 L$
   What is the volume of a cylinder that has a radius of 0.0631 m and a length of 2.0 m?

2. The 100 sheets of a textbook measure 0.02375 m. What is the thickness of only 1 of those sheets?

3. formula: $t = d/V$
   How long does it take light traveling at 2.99793 E 8 m/s to travel across a room that is 6.2 m long?

4. formula: $a_c = 4\pi r/T^2$
   Find the centripetal acceleration (a_c) when the radius is 1.261 m and the period (T) is 0.64 s.

5. formula: $d = 1/2\ a t^2$
   What is the distance traveled by a body from rest when the gravitational acceleration (a) is 9.80665 m/s^2 and the fall time (t) is 13.29 s?

6. I massed 150 tacks. The total mass was 10.35 g. What is the mass of a single tack?

Word Problems Using Significant Figures

Rule: When calculating the number of significant figures allowed in an answer, the following categories are NOT considered:

Numbers representing a numerical count:

example: 25 students, each carrying 2.693 54 kg of sugar

→ 25 x 2.693 54 kg = 67.338 5 kg

Numbers representing mathematical formulas:

example: volume of a sphere = $4/3 \pi r^3$ for sphere with radius 2.11111 cm

→ $4/3 \pi 2.11111^3 = 39.4114 \text{ cm}^3$ (using 3.141 6 for π)

Numbers in a conversion:

→ 1 km = 1000 m the 1 is considered to have several significant figures

Sample problems: (not found in other practice problem sheets)

1. What is the perimeter of a rectangle with a length of 2.1 m and a width of 0.65 m?

   $P = 2l + 2w$

2. The period of an oscillating spring is $T = 2\sqrt{\pi}(m/k)$. If the spring constant (k) is 0.9531 N/m and the mass (m) is 1.2 kg, what is the period?

3. How long does it take light traveling at 2.99793 E 8 m/s to travel across a room that is 6.2 m long?

4. The 100 sheets of a textbook measure 0.02375 m. What is the thickness of only 1 of those sheets?

5. The period of revolution for Uranus is 30 685.93 days. How many hours is that?

6. If the thickness of 1 sheet of paper is 0.023 7 cm, what is the thickness of 6 of those sheets?

7. The perimeter of a polygon is the sum of its sides. What is the perimeter of a polygon with sides of 25.623 m, 5.97 m, 3.21 m, 0.2 m, and 4.621 m?

Answers available from Mr. Jones

Dimensional Analysis

Dimensional analysis is also known as the factor-label method of problem solving.
It involves the use of conversions to systematically change units.

The following examples may help:

1.0 ft = _____ cm

$$1.0 \text{ ft} \times \frac{12 \text{ in}}{1 \text{ ft}} \times \frac{2.54 \text{ cm}}{1 \text{ in}} = 30.48 \text{ cm} = 30. \text{ cm}$$

63 s = ____ ns (nanoseconds)

$$63 \text{ s} \times \frac{1 \text{ E } 9 \text{ ns}}{1 \text{ s}} = 63 \text{ E } 9 \text{ ns} = 6.3 \text{ E } 10 \text{ ns}$$

1.00 year = _______ s

$$1.00 \text{ yr} \times \frac{365.24 \text{ day}}{1 \text{ yr}} \times \frac{24 \text{ hr}}{1 \text{ day}} \times \frac{3600 \text{ s}}{1 \text{ hr}} = 3.2 \text{ E } 7 \text{ s}$$

Expansion - Contraction Coefficients

Almost without exception, solids expand upon heating and contract on cooling. The table given below shows the change in length (expansion or contraction) when a unit length (1 m or 1 ft, etc) of a material is warmed or cooled one Celsius degree. This fractional change in length for a temperature rise of 1° is called the COEFFICIENT OF LINEAR EXPANSION. For example, 1.00 m of steel increases 2.00 E-5 m when it is warmed 1° C. Consider a bridge 1.00 E 3 m long. For every increase in temperature of 1° C every meter of the bridge increases by 2.00 E-5 m. This results in a total of 2.00 E-2 m increase in length. When the temperature increases by 10.0 degrees the increase in length will be 10 times as much. And between winter and summer, a change of temperature of as much as 40.0° may take place, increasing the length of this bridge by 0.800 m (1.00 E 3 m x 40.0° C x 2.00 E-5 /° C). If the engineer did not allow for expansion, the force exerted by this expansion (or contraction in winter) would result in buckling of steel girders.

In metal rods or wires, the expansion or contraction that engineers are concerned about is essentially in one dimension -- length (if you were dealing with a block of metal, you could observe expansion or contraction in three dimensions). In a liquid, however, the expansion or contraction in three dimensions in always important. Therefore the figures in the table for the expansion of liquids express the COEFFICIENT OF CUBICAL EXPANSION - the change in volume for a unit volume (liter, gallon, etc.) of a liquid changing one Celsius degree in temperature.

You cannot easily observe the effects of temperature change on gases unless the gas is sealed in a container. The gases of the atmosphere are free to move when expanding or contracting. However, experimentation has shown that unlike solids and liquids, all gases expand and contract to the same extent with a change in temperature. That is, all gases have the same coefficient of expansion or contraction.

The behavior of substances as the temperature changes gives us another means of identifying them. Solids melt and liquids boil; if they are pure substances, they melt or boil at definite temperatures. But whether or not these changes occur, matter in all states expands or contracts with a change in temperature, and the extent of this change can be measured. Melting points, boiling points, and the amount of expansion or contraction are three properties useful in distinguishing among substances. but some substances neither melt nor boil. Still other properties are needed to distinguish between them.

Problems:
1. Using the tables (below), determine what change in length or volume results
a. an aluminum rod 1.00 m long is warmed 1.00° C:
b. a glass rod 5.00 m long is warmed 2.00° C:
c. 10.0 m of platinum wire are cooled 5.00° C:
d. 2.00 L of grain alcohol are cooled 10° C:
e. 1.00 L of benzene is warmed 5.00° C:
2. Using the tables, to what temperature must a steel rod 1.00 m long at 20.0° C be heated to increase in length by 1.00 E - 4 m?
3. An unmarked volume of a liquid was warmed from 20.0° C to 30.0° C. This resulted in an increase of 0.107 L. The coefficient of cubical expansion of the liquid was 5.10 E-4/° C. What was the original volume of the liquid?

Table of Coefficients of Linear Expansion - **SOLIDS**			Table of Coefficients of Cubical Expansion - **LIQUIDS**	
aluminum	2.3 E - 5/° C		ethanol	1.12 E - 3/° C
platinum	9.0 E - 6/° C		benzene	1.24 E - 3/° C
glass	9.0 E - 6/° C		mercury	1.8 E - 4/° C
steel	2.0 E – 5/°C		water	2.1 E – 5/°C

Calculator Lab

Can you use each of these functions using your calculator?

1) clear entry vs all clear
2) change sign
3) ()
4) scientific notation
5) inverse (inv on some, 2nd function on others)
6) square roots and squares
7) Y to X power
8) memory (store, recall, clear memory)
9) Pi
10) sin, cos, tan

Sample problems (answers given to proper # of sig figs)

1) (6.29 E 5) (4.39 E - 7) = 2.76 E - 1 (0.276)

2) (7.80 E - 4) / (9.55 E 12) = 8.17 E - 17

3) $\frac{(3.243 \text{ E } 5)}{(1.812 \text{ E } 4)(2.530 \text{ E} - 1)} = 70.74$

4) $3 + (4 \times 3) \times 2 = 27$

5) $3 + (4 \times 3) \times 2^3 = 99$

6) $3 + (4 \times 3) \times 2^{3.1} = 106$

7) $(6.07 \text{ E} - 2)^2 = 3.68 \text{ E} - 3$ (0.003 68)

8) $(5.45 \text{ E } 2)^3 = 1.62 \text{ E } 8$

9) $(6.38 \text{ E} - 4)^7 = 4.30 \text{ E} - 23$

10) $(6.291 \text{ E } 3)^{1/3} = 18.46$

11) $(2.173 \text{ E } 4)^{1/9} = 3.033$

12) $[1/3 \times 6/15 + 4/13]^3 = 0.086$

13) $\frac{[4 \times 3^2 + (6/5)]^{1/3}}{(12 \times 4) + (2/6)^2} = 6.94 \text{ E} - 2$ (0.0694)

14) $\sin 9.614^\circ = 0.1670$

15) $\tan 15.71^\circ = 0.2813$

16) $\sin^{-1} 0.1745 = 10.05^\circ$

17) inv sin 0.9898 = 78.75°

18) $\frac{8.33 (4 - 5.2) / ((8.33 - 7.46) \times 0.32)}{4.3 (3.15 - 2.75) - (1.71 \times 2.01)} = 4.57$

Accuracy, Precision, Average Deviation, Error

Mathematics deals with pure numbers, and pure numbers are precise, or exact. In science, getting precise numbers is difficult unless, for example, you divide a number by 2, which is exact, or multiply by a whole number. However, most data is not exact. It might be possible to get a precise value for the number of people in a room, bit if there are 50 people moving about it might be difficult. You might count them 3 or 4 times and get a different value each time. Your value might not be very accurate or precise. In science, there is often a wide range of acceptable values, and few numbers are exact.

Accuracy is a measure of how close a number is to the actual value (how far from the actual value a particular measurement falls). In many experiments, accuracy cannot be determined; only an estimate of the accuracy can be found, because the actual value is not known. **Precision**, on the other hand, refers to how close repeated measurements are to each other (a measure of the variation present in a set of readings).

see drawing on board here

Although standard deviation is a more accurate method of finding the error margin we will use the **average deviation** method because it is relatively easy to calculate.

To Find Average Deviation (precision of measurement)

1. Find the average value of your measurements.
2. Find the difference between your first value and the average value. This is called the deviation.
3. Take the absolute value of this deviation.
4. Repeat steps 2 and 3 for your other values.
5. Find the average of the deviations. This is the average deviation.

The average deviation is an estimate of how far off the actual values are from the average value, assuming that your measuring device is accurate. You can use this as the **estimated error**. Sometimes it is given as a number (numerical form) or as a percentage.

To Find Percent Error

1. Divide the average deviation by the average value.
2. Multiply this value by 100.
3. Add the % symbol.

Sample Problem:
A man wants to see if his car gets the number of miles per gallon (mpg) claimed by the dealer. he took data for five fill ups and found that he got 27, 33, 28, and 32 mpg. The car manufacturer stated that he should get 32 mpg. Find if the stated mpg agrees with the advertised value.

Solution: The average value is found to be 31 mpg. (27 + 33 + 35 + 28 + 32) / 5 = 31 mpg. Precision is found to be plus or minus 3, because (4 + 2 + 4 + 3 + 1) / 5 = 2.8, which is rounded to 3, as this is just an estimate of how far off the answer is. This give a value of 31, plus or minus 3 mpg – or between 28 and 34 miles per gallon. It shows the car is doing OK.

Average Deviation Problems

1. On five different tankfuls of gas a pickup got 12, 15, 16, 12, and 15 mpg. Find the average mpg of this truck.

2. Find a value that gives an estimate of the error in gas mileage of the truck in problem 1.

3. Find the percent error for mileage given the numerical error that you found in problem 2.

4. Suppose that instead of using a truck, the person in the problem had used a car that got 39, 45, 47, and 41 mpg on four tanks of gasoline. Find the average value for the mpg, and estimate how much range in value is expected.

5. Find the estimated percent error in problem 4.

6. You walk down a football field and find that in 100 yards, you have taken 150 steps. You then measure a distance by walking 240 steps. How far have you gone?

Once the estimated error has been found for a measurement two rules can be used in the calculation of an error estimate when doing mathematical operations:

1. When adding or subtracting, add the numerical error.
2. When multiplying or dividing, add the percent error.

Counting Significant Figures

1) 967 ______

2) 967 000 ______

3) 96.7 ______

4) 9.67 ______

5) 0.009 67 ______

6) 9.670 0 ______

7) 9.067 ______

8) 30.4 ______

9) 2 700 ______

10) 5.10 ______

11) 0.023 ______

12) 7.020 0 ______

13) 0.040 10 ______

14) 54.000 ______

15) 34.802 ______

16) 0.000 065 ______

17) 4.530 ______

18) 222 ______

19) 70 164 ______

20) 3.00 ______

21) 2.700 ______

22) 304 ______

23) 51.0 ______

24) 9 ______

25) 90 ______

26) 900.0 ______

27) 0.009 ______

28) 0.90 ______

29) 0.090 ______

30) 909 ______

31) 0.008 81 ______

32) 0.490 0 ______

33) 0.022 4 ______

34) 0.006 007 ______

35) 0.000 05 ______

36) 0.500 ______

37) 0.050 ______

38) 5000 ______

39) 0.005 670 ______

40) 0.111 0 ______

41) 0.007 600 9 ______

42) 670 000 ______

43) 670 004 ______

44) 45.908 ______

45) 0.008 72 ______

46) 54 000 ______

47) 0.000 008 ______

48) 0.800 008 ______

49) 453.987 0 ______

50) 500 000 000 ______

51) 24 091 800 ______

52) 780 ______

53) 708 ______

54) 780.0 ______

55) 780.000 ______

56) 780.00 ______

57) 78 000 ______

58) 500 ______

59) 0.005 ______

60) 16 ______

Expressing the Very Large and the Very Small

Instructions: Express each of the following numbers using scientific notation or change from scientific notation to standard notation.

1) 325 ____________

2) 70 ____________

3) 96 400 ____________

4) 5.921 E 3 ____________

5) 6 587 324 000 ____________

6) 42.372 ____________

7) 2.538 E - 3 ____________

8) 3 621.471 ____________

9) 362.516 ____________

10) 4 E 3 ____________

11) 240.000 ____________

12) 3 752.6 ____________

13) 23 000 000 ____________

14) 741 900 ____________

15) 1.7 E - 5 ____________

16) 3 ____________

17) 456.83 ____________

18) 5.000 E - 1 ____________

19) 215 ____________

20) 7 000 631 ____________

21) 0.361 __________

22) 0.0428 __________

23) 0.005 73 __________

24) 0.000 543 8 __________

25) 0.000 056 73 __________

26) 0.507 __________

27) 0.004 83 __________

28) 0.000 000 000 9 __________

29) 1.000421 E 2 __________

30) 0.000 005 4 __________

31) 0.000 039 256 __________

32) 0.06723 __________

33) 0.751 400 00 __________

34) 0.000 000 010 __________

35) 0.000 023 __________

36) 1.2900 e – 4 __________

37) 0.003 700 4 __________

38) 0.000 000 38 __________

39) 0.010 10 __________

40) 0.000 000 001 __________

Math Practice Quiz 1

1. Correct the following by using the proper punctuation:

a. 630, 000, 000 m

b. 43 1/3 foot

c. 6875ml

d. 88.4 secs

e. 1200 Kg

f. 545 in./sec.

2. Complete the following:

a. 1 km = _____________ m

b. 1 m = ______________ km

c. 10 mg = ____________ g

d. 10 g = _____________ mg

e. 1 m = ______________ µm

f. 10^3 km = ____________ mm

g. 10^3 mm = __________ km

3. In the brackets indicate the number of significant figures in the given measurement:

a. 165.5 m [ ]

b. 0.154 A [ ]

c. 60.05 s [ ]

d. 6000 K [ ]

e. 0.410 mol [ ]

f. 101.1010 kg [ ]

g. 10010 m [ ]

h. 400.0 K [ ]

4. Round each of the following measurements to the number of significant figures indicated in the brackets:

a. 354.460 m [4] ________________

b. 63.0049 mm [3] ________________

c. 1000.0 nm [4] ________________

d. 89 301 km [2] ________________

e. 45.400 m [4] ________________

5. Perform the indicated operation and record the answer to the proper number of significant figures:

a. 6.00 m x 3.1 m = ____________________

b. 8800. m x 240 m = __________________

c. 3.5 m^2 / 1.50 m = ___________________

d. 6.300 m + 2.9 m = __________________

e. 6.3031 m - 0.03 m = _________________

f. 1800 cm^2 / 9 cm = ___________________

6. List the proper standard base unit in the SI metric system:

a. time: ___________________

b. temperature: _____________

c. length: __________________

d. mass: __________________

e. amount of substance: _________

7. Express the following as a whole number (or decimal number if less than 1):

a. 6.88 E 3 m = ________________________

b. 6.88 E – 3 m = _______________________

c. 4.689 32 E – 2 m = ___________________

8. Express the following in proper scientific notation:

a. 0.036 892 m = _____________________

b. 0.000 342 m = ______________________

c. 9 460 000 000 000 m = ___________________

9. Perform the indicated operation and record the final answer to the proper number of significant figures:

a. (1.6 E – 24 g) (4.60 E 30 mol/g) = _____________________

b. (6.5 E 2 m) (2 E 6 m) = ______________________________

c. (2.80 E – 5 m) (6.2 E – 5 m) = _________________________

d. (9.46 E 10 g) / (5.0 E – 4 cm^3) = ____________________

e. (3.4 E – 4 cm^2) / (2.00 E 4 cm) = _____________________

Practice Problems: Counting sig figs (answers given):

1. 98 cm	[2]	6. 54 000 kg	[2]
2. 432 g	[3]	7. 0.00532 s	[3]
3. 15.9 L	[3]	8. 30.50 g	[4]
4. 89 650 s	[4]	9. 450.5890 m	[7]
5. 0.582 s	[3]	10. 22.009 s	[5]

Scientific Notation (Exponential Notation)

1. 1 000 000 000 (1 E 9)
2. 0.000 000 1 (1 E-7)
3. 85 000 000 (8.5 E 7)
4. 4 300 000 000 000 000 (4.3 E15)
5. 0.000 154 (1.54E-4)
6. 9.5 E 4 (95 000)
7. 3.2 E-9 (0.000 000 003 2)
8. 7.31558 E 4 (731 555.8)
9. 3.903 E 9 (3 903 000 000)
10. 1.1 E-1 (0.11)

Signficant figures with math

1. 4.5 cm + 9.9 cm (14.4 cm)
2. 30.5 g + 13.68 g (44.1 g)
3. 2.8 mL + 1.35 mL + 3.452 mL (7.5 mL)
4. 3 cm x 4 cm (10 cm^2)
5. 6.5 mm x 1.22 mm (7.9 mm^2)
6. 0 cm x 15 cm (400 cm^2)
7. 150. m x 283 m (42 400 m^2)
8. 0.035 m^2 / 0.155 m (0.22 m)
9. 28.0000 mm^2 / 7.500 mm (3.733 mm)
10. 0.00408 cm^2 / 30 cm (0.000 1 cm or 1 E – 4 cm)

Use of Scientific Formulas

The magnifying power of a telescope can be determined using the formula below. In the formula, F, represents the focal length of the larger lens and f, the focal length of the smaller lens. What is the magnifying power of a telescope in which the larger lens has a focal length of 62.5 cm and the smaller lens, a focal length of 50.mm? M = F/f Answer = 12.5X

Using the formula given above, find the magnifying power of the large telescope at the Yerkes Observatory if the large lens in that telescope has a focal length 18.9 m and the small lens has a focal length of 75.0 mm.
Answer = 252X

Metric Conversions:

4 g to cg (400 cg)
3 m to km (0.003 km)
12 L to mL (12 000 mL)
6 m to nm (6 E 9 nm)
9 cm to m (0.09 m)
15 mL to L (0.015 L)
2.3 km to m (2 300 m)
10 µm to m (1 E -5 m)
12.5 mL to µL (1.25 E 4 µL)
55.8 mm to nm (5.58 E 7 nm)
0.6 cg to mg (6 mg)
0.068 kL to L (68 L)
8.5 e -5 mg to cg (8.5 E -6 cg)
0.089 km to mm (89 000 mm)
1.85 E -6 µm to nm (1.85 E -3 nm)

Metric-English Conversions:

3.0 yd to m (2.7 m)
8.0 ft to m (2.4 m)
2.5 kg to lb (5.5 lb)
250 cm to in (98 in)
11 lb to kg (5.0 kg)
4.2 in to cm (11 cm)
22 g to oz (0.78 oz)
7 mile to km (10 km 11.3 km really)
8 lb to cg (4 E 5 cg 362 880 cg really)
24 m to yd (27 yd)
162 km to mile (101 mile)
5.5 E -3 yd to mm (5.1 mm)
325 mm to ft (1.07 ft)
42.68 mm to ft (0.1400 ft)
28.500 mg to lb (0.0628 lb)
0.0495 L to qt (0.0524 qt)
0.125 gal to mL (473 mL)
2.305 m to in (90.75 in)
28.95 qt to L (27.39 L)
0.789 yd to m (0.721 m)