Numerical Quantities

Exact numbers verses experimental data	There are two kinds of values used in calculations. The first is known constants which are assumed to be highly accurate. The second is experimental data which is only as accurate as the instruments used to measure it. All calculations involve some experimental data, meaning that all calculated values are not exact numbers. ***As a result, numerical answers are reported in decimal form***. (No fractions)
Significant Figures	Relax, they are not testable, but you need this info in order to round correctly. This is a system set up to ensure that no answer is more accurate than the numbers used to calculate that answer. If your meter stick has centimeter markings (two places behind the decimal point), it would be impossible for values calculated from your measurements to be accurate to nine or ten places after the decimal point. Significant figures are a count of digits with some specialized rules for numbers containing zeros. Some examples are shown below. While significant figures are important in science, ***the AP Physics test is not overly concerned with them. The AP test, and thus all class tests, should contain answers between two and four significant figures***. Three significant figures is in the middle of this range, and works well. In the following examples the significant figures are underlined. Leading zeros never count — 0.00028 — 2 significant figures (2 digits matter) 0.000003894 — 4 significant figures Zeros between nonzero numbers always count — 507 — 3 significant figures 1008 — 4 significant figures Trailing zero's only count if there is a decimal point — 409000 — 3 significant figures 409.000 — 6 significant figures In the number 409000, the trailing zeros were needed to show that it was in the hundred thousands place. They had to be recorded but were not important to accuracy. 409000 looks like a number rounded to the nearest 1000. But, in 409.000 someone took the time to report three places after the decimal. If they were not important (significant) you could just write 409. What if the calculator display says 6926847561 and you must report three significant figures? You have two choices. You could write 6930000000 where you record the first two significant figures you see and then look at the fourth digit to see if the third digit rounds up or down. Then you could fill with trailing zeros which do not count as significant figures. Essentially, you are rounding to the nearest 10 million in this example. ***The second method is much easier and highly recommended. Use scientific notation***: 6.93x10^{9}. There are specific rules for how significant figures work in addition/subtraction and multiplication/division. ***AP Physics does not worry about these. Keep all your calculations running in your calculator and when you get the final answer, report it on paper with only three significant figures.***
Scientific Notation	Scientific notation is used when it takes less time to write than the ordinary number does. As an example: 200 is easier to write than 2.00x10^{2} (or 2.0E2) but 2.00x10^{8} (or 2.00E8)is easier to write than 200,000,000. In addition, scientific notation makes significant figures easier to record. If you must answer in three significant figures, then 2.00x10^{8} (or 2.00E8) is correct, since trailing zeros count only when numbers contain decimals.
Using the Calculator	Many students still struggle with "order of operations" mistakes on their $100+ calculators. No matter how expensive they are, you still need to know how to input data. Never use the carrot key (∧) to enter numbers like 7.98x10^{4} as it causes errors unless you put every expression in parenthesis. When you do you must enter the following key strokes (7.98x10∧4) a total of 11 keys. Instead, you should ***use the exponent key, usually marked as E or EE***. Using this key does not require parenthesis and is entered as 7.98E4, a total of 6 strokes. It is faster and avoids errors. Most order of operations mistakes occur when students have several numbers multiplied together in the denominator. ***It is essential that you enclose complicated denominators in parenthesis***.
Variables	The scientific quantities you will investigate have been assigned unique symbols. These symbols are written in italics. ***For example:*** t is used for time and d is used for distance. Every letter has a meaning. In addition subscripts are frequently used to tell similar variables apart. It takes a while to get used to all the letters and you should not be worried about them at this time. Just think of them as fancy versions of x and y taught by your friendly math teachers.
Units	Values in science include units. Units multiply and divide just like the variables x and y do in algebra classes.

Problem Set: The following problems are actual physics calculations taken from the class. Work out solutions to the problems below. Your answers should contain three significant figures and correct units.

Example: $E = (6.5\times10^{-21}kg)(3\times10^{8}m/s)^2$	$E = 5.85\times10^{-4}kg\cdot m^2/s^2$ (Note: make sure to include units)
a. $T_s = 2\pi\sqrt{\dfrac{4.5\times10^{-2}kg}{2.0\times10^{3}kg/s^2}}$	$T_s =$
b. $K = \frac{1}{2}(6.6\times10^{2}kg)(2.11\times10^{4}m/s)$	$K =$
c. $F = \left(9.0\times10^{9}\frac{N\cdot m^2}{C^2}\right)\frac{(3.2\times10^{-9}C)(9.6\times10^{-9}C)}{(0.32m)^2}$	$F =$
d. $e = \frac{(1.7\times10^{3}J)-(3.3\times10^{2}J)}{(1.7\times10^{3}J)}$	$e =$
e. $K_{\max} = (6.63\times10^{-34}J/s)(7.09\times10^{14}s) - 2.17\times10^{-19}J$	$K_{\max} =$
f. $(1.33)\sin 25.0^\circ = (1.50)\sin\theta$	$\theta =$
g. $\frac{1}{Rp} = \frac{1}{4.5\times10^{2}\Omega} + \frac{1}{9.4\times10^{2}\Omega}$	$R_p =$