"RECIPE" FOR SOLVING KINEMATICS PROBLEMS

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1. Read the problem completely. Don't start writing anything down until you've read all the way through the problem statement (including any drawing or sketch that may be present). It's very easy to start reading and say, "Oh, I know how to do this!" and end up solving the wrong problem, especially when you're in a hurry.

2. Make a list of the six variables that appear in the kinematics equations:
   $x_0 =$ (*same as* x_i *or* x_1) $x_t =$ (*same as* x_f *or* x_2) usually these two appear as Δx.
   $v_0 =$ (*same as* v_i *or* v_1) $v_t =$ (*same as* v_f *or* v_2)
   $a =$ $t =$ this may appear as Δt

3. Gather the information that is presented in the problem statement and fill in the list, **with units**. Beware that sometimes units will need to be converted to the SI system and/or to be made consistent. For example, you cannot work with a velocity in miles per hour and a time in seconds, unless you **do the units conversion first**. Doing these conversions at this point, before substituting into your equation, will make things much cleaner and simpler.

4. Put a question mark for the unknown variable that the problem is asking you to find. Put a dash in the list for any variable that is neither given nor requested (so you'll know you checked for it).

5. Be aware that some information is often "hidden" in the problem statement. That is, if a car starts from rest, like at a stop light, what is its initial velocity? Zero; so, fill in that value for v_0 in the list. The problem didn't come right out and say "The initial velocity is zero." but that information is there, anyway, and it needs to go into the list.

6. With the list filled in, look at the set of kinematics equations and find one that contains the given variables, **and the question-mark variable**. That variable may not appear by itself on the left side of the equation, but it must appear **somewhere** in the equation you choose! It may be easier to select the equation that does **not** contain the variable marked with a dash, that is, the variable that is not present in the problem.

7. If necessary, do the algebra needed to solve for the question-mark variable. In other words, perform the algebraic operations to isolate that variable on one side of the equation. **If terms are zero, drop them from the analysis at this point; leave a zero if one side of the equation evaluates to zero**.

8. Check that the units are correct in the equation that you will use. If the answer is supposed to be a velocity, then the units must be m/s. This can be checked before using any numbers. If the units aren't right, check your math again. (This is called a "dimensional analysis.")

9. Substitute the numerical values from the list; find the numerical result, using a calculator if necessary; print it neatly, with units. Circle or box the answer.

EXAMPLE

A car accelerates from 12 m/s to 24 m/s in 5.0 s. How far does it travel in those five seconds?

Δx = ? v_1 = 12 m/s v_2 = 24 m/s a = ---- t = 5.0 s

Looking at the four kinematic equations, we see that the one that does not include the acceleration is $\Delta x = 1/2\ (v_1 + v_2)\ t$. No algebra is needed, so we substitute the given values, to obtain 90 m. Note that we could have *derived* a value for the acceleration, using $a = \Delta v / \Delta t = (24 - 12) / 5$, and then we could use several of the kinematic equations to find Δx. However, it is best to **select an equation based only on the data given in the problem**. Why? Because if you make a mistake in calculating that derived quantity (like "a", here), then all the rest of the solution will be wrong.