Basic Problem Solving Strategy

1. Determine the problem to be solved. I.e., read the question and think about what is going on.
   - Try to visualize what is happening. The mental picture you form will guide your solution but do not hold to it religiously—this is a preliminary visualization and you must be prepared to revise it or to abandon it later as your analysis deepens.
   - Is this too big to deal with in one step? If so, think about how to break it up into smaller pieces.
   - Don't be too concerned if a full strategy isn't immediately obvious. Just start breaking off pieces and solving them. Sooner or later you'll notice that you are homing in on a solution.

2. Draw a picture.

- Don’t obsess on this—a rough sketch goes a very long way.

3. Determine the Physics at work.

- For much of this course, we will deal with forces, but you should be prepared for other scenarios.

4. If the problem involves forces, draw a free body diagram.
   - This can go on your sketch or beside it.
   - Be very critical of yourself in this step—this is where false Physics can creep in!
   - Caution: Make sure the forces you include are forces and not velocities, accelerations, momenta, or other non-force quantities.
   - Caution: Make sure the forces you include are acting on the object under consideration and not on something else, e.g., not reaction forces.
   - Be sure you get everything but don't double-count.
   - Here is where you pick a coordinate system—choose the one that will make your life easiest, this is usually one in which one axis is parallel to an expected acceleration direction.

5. Decompose vectors.

- Sometimes this step is not relevant. E.g., in some circular motion situations. But you should still have a picture of the directions of the motions and forces.

6. Determine what sort of tools you will need.

- Deal with orthogonal dimensions independently, you'll recombine them later.
- Here is where the crucial thinking happens. Decide what kind of motion or behavior you are dealing with.

7. Go to the toolchest.

- You have built up a set of mathematical tools, now is the time to dip into it—here is where you dig out the equations that you will use.
- Base your choice of tool on what quantities you know, but don't reject a tool just because you don't know some feature—often, these either divide out, are found elsewhere in the problem, or appear in a ratio which has value. If there's some quantity you don't know, pause and see if solving a sub-problem might give it to you.
- Don't be afraid to assign a "name" (an unused symbol) to a quantity for which you don't yet know a value.
- Be critical of your choices—don't choose blindly based on what symbols are present. Often, the same symbol is used for many different concepts leading to hilarious results (for the guy doing the grading).
- Each direction provides a separate equation. Finding a solution may involve combining orthogonal directions here.

8. Set up the equations.

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- Use subscripts and superscripts to keep things clear.
- Do dimensional analyses regularly

9. Do the math.

- Make sure that you are solving for the right thing.
- **DO NOT USE NUMBERS YET!!!!!!!!!!!!!!!!**

10. Think about your answer.

- Consider the behavior of your result; does it make sense?
- How does your result behave in extreme limits (you can use simple numbers for this part)? Often, you have an intuition about limiting behavior even if you don't know specifics.
- If things don't make sense here, doublecheck your math. But realize that it may be your intuition that is at fault, in which case some really deep thinking is appropriate—this is when you can really learn something profound!

11. Now you can plug in numbers, if you really want to

- Depending on the problem, orthogonal components can be considered separately or together at this stage if they weren't combined previously.
- Graphs are good!