Problem Solving Format – AP Physics

In AP Physics, you will be required to follow a fairly rigorous format for presenting problem solutions. The following items should be considered required elements in every problem solution you present for homework, quizzes, and exams.

1. Draw a diagram of the physical situation. This will help you visualize the problem. This drawing should give the general idea of the physical situation the problem represents. This is a sketch, and does not have to be beautiful artwork—nonetheless it is <u>required</u>.
2. Include a diagrammatic representation of the physical situation where applicable. This representation might be a motion map, a force diagram, or an energy bar graph/flow diagram. Not all units will have specialized diagrammatic representations, but where they exist you will be expected to use them. For instance, there should never be an instance where you solve a problem involving forces where you don't draw a force diagram. The same holds true for problems involving energy and energy bar graphs/flow diagrams.
3. Write down all given information from the problem. Where possible, you may use symbols for physical quantities. Many times you will want to subscript your symbols relative to your physical diagram. For instance, if you know two positions that are labeled A and B in your physical diagram, and the elapsed time between those positions, your given might be:

   Given: $\Delta\vec{x}_{AB} = 10.0 \text{ m} \qquad \Delta t_{AB} = 5.00 \text{ s}$

4. Write down what you are trying to find in the problem. For example, if you are trying to find the average velocity between positions A and B, your find might be:

   Find: $\bar{\vec{v}}_{AB}$

5. Write the equation you will use in its original form: Example⇒ $\bar{\vec{v}} = \dfrac{\Delta\vec{x}}{\Delta t}$
6. Algebraically rearrange the original equation into the form required for your problem solution. Show all essential algebraic steps. For example:

$$\bar{\vec{v}} = \frac{\Delta\vec{x}}{\Delta t}$$

$$\bar{\vec{v}} \cdot \Delta t = \frac{\Delta\vec{x}}{\Delta t} \cdot \Delta t$$

$$\bar{\vec{v}} \cdot \Delta t = \Delta\vec{x}$$

$$\Delta\vec{x} = \bar{\vec{v}} \cdot \Delta t$$

7. Substitute known values (including units) into algebraically rearranged equation.
8. Calculate the answer. Carry units throughout your calculation. Simplify the answer as much as possible. Show dimensionally how the units reduce to the final units you report.
9. Write down the final answer including units. Highlight your answer by drawing a box or circle around it.

The steps outlined above should be shown on any problem solution that is to be turned in as homework, labs, quizzes, or exams.

Your problems will be graded with the elements described above in mind. For instance, homework problems will sometimes be worth 5 points each. Within that 5 point total, the point values might be assigned as follows: Diagram(s), Given, Find-1 pt. Equation and steps 3-8 above-3 pts. Answer with units - 1 pt.

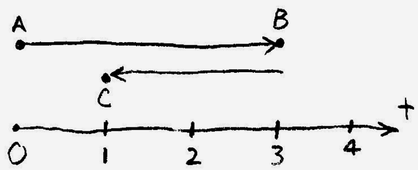
On the back of this page is an example of a well-prepared problem solution which would receive full credit.

Example Problem:

A physics teacher starts at the origin and travels at a constant speed to the right to a position 3.00 m to the right of the origin. He then instantaneously turns around and travels back at the same constant speed to a position which is 1.00 m to the right of the origin. The complete trip took a total of 5.00 s.

a. What is the average speed of the physics teacher for the trip described?
b. What is the average velocity of the physics teacher for the trip described?
c. Sketch a position vs. time graph corresponding to the motion of the physics teacher.
d. Draw a qualitative motion map corresponding to the motion of the physics teacher.
e. If the physics teacher were to travel at a constant speed equal to the average speed you calculated in part a, how long would it take him to travel a total distance of 15.0 m?

EXAMPLE PROBLEM SOLUTION:



GIVEN: $\vec{x}_A = 0$

$\vec{x}_B = +3.00\,m$

$\vec{x}_C = +1.00\,m$

$\Delta t_{AC} = 5.00\,s$

FIND: a. $\bar{v}_{AC}$

b. $\vec{\bar{v}}_{AC}$

a. $\bar{v} = \frac{d}{\Delta t}$

$d_{AC} = d_{AB} + d_{BC}$

$d_{AC} = 3.00\,m + 2.00\,m$

$d_{AC} = 5.00\,m$

$\bar{v}_{AC} = \frac{5.00\,m}{5.00\,s}$

a. $\bar{v}_{AC} = 1.00\,\frac{m}{s}$

THE AVERAGE SPEED OF THE PHYSICS TEACHER FOR THE 5.00 s TRIP IS 1.00 $\frac{m}{s}$

b. $\vec{\bar{v}} = \frac{\Delta\vec{x}}{\Delta t}$

$\Delta\vec{x}_{AC} = \vec{x}_C - \vec{x}_A$

$\Delta\vec{x}_{AC} = 1.00\,m - 0$

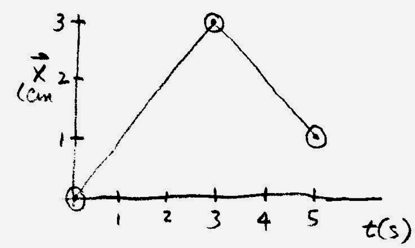
$\Delta\vec{x}_{AC} = +1.00\,m$

$\vec{\bar{v}}_{AC} = \frac{+1.00\,m}{5.00\,s}$

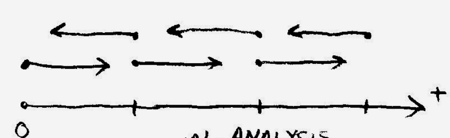
b. $\vec{\bar{v}}_{AC} = +0.200\,\frac{m}{s}$

THE AVERAGE VELOCITY OF THE PHYSICS TEACHER IS 0.200 $\frac{m}{s}$ TO THE RIGHT

c.



d.



e.

GIVEN: $\bar{v} = 1.00\,\frac{m}{s}$

$d = 15.0\,m$

FIND: Δt

$\bar{v} = \frac{d}{\Delta t}$

$\bar{v}\Delta t = \frac{d}{\Delta t}\Delta t$

$\bar{v}\Delta t = d$

$\frac{\bar{v}\Delta t}{\bar{v}} = \frac{d}{\bar{v}}$

$\Delta t = \frac{d}{\bar{v}}$

$\Delta t = \frac{15.0\,m}{1.00\,\frac{m}{s}}$

DIMENSIONAL ANALYSIS

$\frac{\frac{m}{1}}{\frac{m}{s}} \rightarrow \frac{m}{1}\cdot\frac{s}{m} \rightarrow s$

e. $\Delta t = 15.0\,s$

THE PHYSICS TEACHER WILL REQUIRE 15.0 s TO TRAVEL 15.0 m