Problem Solving Presentation

The following are two examples of incorrect and corrected presentation of problem solving. In the correct example, the bold are my comments indicating what should be included.

Example 1

1.) Given that the density of hexane is 0.659 g/ml, calculate the volume of a 34.65 milligram sample of hexane.

$$\frac{0.03456}{0.659} = 0.05$$

Nothing but a couple of numbers! No Units, no equation, poor attention to significant figures. Unacceptable. But, with a few minor additions, it becomes presentation quality.

1.) Given that the density of hexane is 0.659 g/ml, calculate the volume of a 34.65 milligram sample of hexane.

State the problem.

We know that $D = \frac{m}{V}$

Give constants and equations necessary to the solving of the problem. Include units.

Solving for Volume..

Annotation...

$D \cdot V = m$ or $V = \frac{m}{D}$

Set up the physical application of the problem.

Converting the mass into grams

Annotation...

$$34.65 \cdot mg \cdot \left(\frac{1 \cdot gram}{1000mg}\right) = 0.03456 \cdot gm$$

Show substitutions into applicable expressions. Solve equations explicitly with complete units, significant digits and annotations

Solving $V = \frac{m}{D} = \frac{0.03456 \cdot gm}{0.659 \cdot \frac{gm}{ml}}$

$$V = .0524 \cdot ml$$

Highlight answer by box, or underline or some other delineation. Include correct significant figures.

Example 2

$C_o := 0.0550 \cdot M$

$Ka := 1.80 \cdot 10^{-5} \cdot M$

HAc = H^+ + Ac^-

C_o-x x x

$Ka = \frac{(x)\cdot(x)}{C_o - x}$

$Ka = \frac{x^2}{C_o}$

$x := \sqrt{\left(1.80 \cdot 10^{-5} \cdot M\right)\cdot(.055 \cdot M)}$

$x = 9.95 \times 10^{-4} M$

$\frac{x^2}{C_o - x} = 1.833 \times 10^{-5} M$

$-\log\left(1.833 \cdot 10^{-5}\right) = 4.737$

It is almost hard to tell what is being done here! This is just a page full of junk. A problem is presented as you would present a paragraph, only using a *combination* of mathematics and words! These are not mutually exclusive. Tell the reader what you are doing in math and in annotation.

Further, this example is done poorly. It would be hard to tell where the error was when looking to see that the answer is wrong. Consider the alternative version on the next page....

1.) Calculate the pH of a 0.0550 M solution of Acetic Acid

State the problem.

Initial Concentration $C_o := 0.0550 \cdot M$

Equilibrium Constant $Ka := 1.80 \cdot 10^{-5} \cdot M$

Give constants necessary to the solving of the problem. Include units.

Now, I set up the equilibrium expression for HAc. If x is the degree of dissociation, then at equilibrium, we have

Annotation...

$$HAc \;=\; H^+ \;+\; Ac^-$$

$$C_o\text{-}x \qquad x \qquad x$$

Set up the physical application of the problem.

Substituting values into the equilibrium expression yields...

Annotation...

$$Ka = \frac{(H)\cdot(Ac)}{HAc} = \frac{(x)\cdot(x)}{C_o - x}$$

I will first assume that x << C_o because Ka is relatively small.

Show substitutions into applicable expressions.

$$Ka = \frac{x^2}{C_o}$$ solving for x gives... $$x = \sqrt{Ka \cdot C_o}$$

$$x := \sqrt{\left(1.80 \cdot 10^{-5} \cdot M\right) \cdot (.055 \cdot M)} \qquad x = 9.95 \times 10^{-4} M$$

Solve equations explicitly with complete units, significant digits and annotations

$$\frac{x^2}{C_o - x} = 1.833 \times 10^{-5} M$$ checking assumption..

check assumptions or shortcuts.

The calculated Ka is off, so the assumption is poor. I'll solve for x using the quadratic formula. Rearranging equation into the proper form gives

$$Ka \cdot \left(C_o - x\right) = x^2 \quad \text{or} \quad x^2 + Ka \cdot x - Ka \cdot C_o = 0$$

The quadratic solutions are

$$x = \frac{-b + \sqrt{b^2 - 4 \cdot a \cdot c}}{2 \cdot a} \quad \text{or} \quad x = \frac{-b - \sqrt{b^2 - 4 \cdot a \cdot c}}{2 \cdot a}$$

Substituting for proper values gives

$$x := \frac{-Ka + \sqrt{Ka^2 - (4) \cdot (1) \cdot \left(-Ka \cdot C_o\right)}}{2 \cdot (1)} \qquad x = 9.86 \times 10^{-4} M$$

Since Ka and C_o are defined, this is a suitable expression to evaluate

Now, calculating pH. By assignments given above, H^+ = x, thus

$$pH = -\log(x) \qquad pH := -\log\left(5.107 \cdot 10^{-4}\right) \qquad pH = 3.292$$

Highlight answer by box, or underline or some other delineation.