Using the GUESS Method to Solve Problems (Chemistry)

Problem solving courses like those in Math, Chemistry, Physics, Engineering and Statistics require a lot of practice and application of concepts in order for students to be successful. At the same time, some students struggle with these types of courses because they do not know where to start, or they do not have a method for completing the recommended practice problems. The GUESS method (Given, Unknown, Equations, Set-up, Solve) is an easy to remember acronym that breaks practice problems into five basic steps. Consider the following sample problem.

Sample Chemistry Question: What is the energy of a photon of a red light of wavelength 655nm?

Given:

In this question, you have been asked to find the energy of a red light, and you have been **given** the wavelength of this light. In addition to the wavelength, you should also be aware of any formulas involved in determining the energy of light that may have been covered in the lectures and/or assigned readings. Instructors also sometimes provide data sheets that show a list of formulas and constants commonly used in the course. Consulting these resources provides a starting point that involves listing all of the **given** information, which may include formulas that could be useful for solving this problem. In this example, the formula required is Planck's equation; therefore, the constants required are the speed of light (c) and Planck's constant (h).

Given:	Wavelength (λ) = 655nm = 6.55 x 10^{-7}m Constants Speed of light (c) = 2.998 x 108 m/s Planck's constant (h) = 6.626 x 10^{-34} J·s

Unknown:

The next step is to determine what is **unknown**. What information is required in order to move toward a solution to this particular problem? Planck's equation (E=hν) tells us that Energy (E) equals Planck's constant (h) multiplied by the frequency (ν). Energy is **unknown**; you have a formula for determining Energy (E), but before you can calculate Energy (E), you need to determine some other values. You know the formula for Planck's constant (6.626 x 10^{-34} J·s), but you will need to find the frequency in order to determine the energy of the red light. Therefore, in this case frequency is also **unknown**; you need to determine frequency (ν) before you can calculate Energy (E).

Unknown:	Energy =? Frequency =?

Equations:

As mentioned previously, the required formulas can often be found in lecture notes, textbooks, or sometimes on data sheets provided by the instructor. When solving problems, consult these resources and make a list of any formulas or equations that might be necessary. You know that you need to use Planck's **equation** (E=hν), but to use this equation you need to first determine the frequency (ν). The second **equation** required is one that determines the frequency of light using the speed of light (c) divided by the wavelength (λ), and fortunately you have both of those values: the speed of light is a constant and the wavelength has been provided in the initial question.

Equations:	$E = h\nu$ $\nu = \frac{c}{\lambda}$

Set-up:

Now that you have all of the required equations, set them up to solve for the Energy of a red light with a wavelength of 655nm by first using the formula for frequency, which is the speed of light (c) divided by the wavelength (λ). Because Energy is equal to Planck's constant (h) multiplied by frequency (c/λ), you should be able to calculate the energy of a photon with a wavelength of 655nm by multiplying the two.

Set-up:	$E = h\frac{c}{\lambda}$

Solve:

The last part of the process is a simple matter of carefully plugging the values into the equation and completing the equation with a calculator. However, note that the proper set-up and solution of this particular word problem is only achieved by listing the givens, the unknowns, and the equations required.

Solve:	$E = \frac{6.626\times10^{-34} J\cdot s \times 2.998\times10^{8} m/s}{6.55\times10^{-7} m}$ $E = 3.03 \times 10^{-19} J$