Explaining Your Calculations in Homeworks

In this course, we put emphasis on understanding astronomical concepts, not simply plugging numbers into formulas. For this reason, we require on homeworks that you not just show a calculation, but explain what you're doing. This requires using English as well as mathematics in your homeworks. We will take points off if you simply write equations and do calculations without any explanation. Let's take an example using some concepts you'll learn about in the first few weeks of class, namely, what is the speed of the space shuttle orbiting the Earth (mass 6×10^{24} kg)?

The following solution gets the right answer, but gets points off for lack of demonstration that you understand what you're doing:

$$v = \sqrt{\frac{GM}{r}} = \sqrt{\frac{2/3 \times 10^{-10}\,\mathrm{m^3\,s^{-2}\,kg^{-1}} \times 6 \times 10^{24}\,\mathrm{kg}}{7 \times 10^6\,\mathrm{m}}} = 8\,\mathrm{km/s}.$$

The answer is correct, it has the right number of significant figures, the units are all shown explicitly, but it would not get full credit. Not only is English nowhere to be seen in the above, there is no hint that you actually understand what you're doing, rather than finding a formula that you guess might be relevant, and plugging into it blindly. Here is the sort of response we're looking for:

The orbital speed v of an object moving in a circle of radius r around a body of mass M is given by:
$$v = \sqrt{\frac{GM}{r}},$$
where G is Newton's constant of gravitation. The space shuttle orbits 400 kilometers above the Earth's surface, and therefore is $r = 6400 + 400 \approx 7000$ km from the Earth's center. Plugging in the mass of the Earth and Newton's Constant gives:
$$v = \sqrt{\frac{GM}{r}} = \sqrt{\frac{2/3 \times 10^{-10}\,\mathrm{m^3\,s^{-2}\,kg^{-1}} \times 6 \times 10^{24}\,\mathrm{kg}}{7 \times 10^6\,\mathrm{m}}},$$
being careful to express all numbers in MKS units. The numbers we're using are given to a single significant figure, so the calculation under the square root isn't too difficult; approximating $7 = 6$ allows me to write this as:
$$v = \sqrt{2/3 \times 10^8}\,\mathrm{m/s} \approx 8 \times 10^3\,\mathrm{m/s},$$
or 8 kilometers per second.

This is the level of detail you'll see in the solution sets to the homeworks. You need not be *quite* so wordy, but you should make it as clear as the above example, that you've demonstrated you understand all the aspects of the problem.