A list of questions to consider for the PIV experiment:

1. The centerline velocity is predicted to vary as $x^{0.2}$. Does it experimentally (a log-log graph is really useful here)? Does it match in some regions and not others? What is the average deviation? Is the slope of the growth rate the predicted 1/5? To within error? Note that Uc is *not* the theoretical centerline velocity, just its dimensional scaling! Also, x is *not* the height of the image put into the program pivplot.m, but rather the location of the particles in the image.

2. The width of the profile is predicted to vary as $x^{0.4}$. Does it experimentally? The same issues discussed in question 1 apply here too.

3. The centerline velocity and width are also expected to have power law dependence on the power applied to the wire. Are these observed? Quantitatively? Do weird things happen at high powers? Low powers? After long times?

4. Is the shape of the profile what was expected? How does it differ? Is it different in different regions? Why?

5. The horizontal velocity magnitude (delta v between the left and right sides is a good metric) is supposed to have power law dependence on x and Q/L. Do these match up in slope and magnitude?

6. Continuity states that there is a quantitative relationship between dv/dy and du/dx. Does this match up with your experiments? Do you get weirdness in the horizontal velocity profile (e.g., does dv/dy change in sign)? Why? Is it different in some regions than others?

7. Can you collapse all of your scaled dimensionless vertical velocity profiles onto a single plot for different heights above the wire? Do some collapse, but not others? If so, which ones and why? Do the plots for different power levels collapse as well?

8. The boundary layer approximation breaks down very close to the wire. You can actually measure the velocity right down at and below the wire. How does the experimental centerline velocity vary in this region with x? Quantitatively compare this with theory (undefined for $x<0$, of course). The magnitude of the horizontal velocity (e.g., question 5) is even more interesting in this region. It is predicted to diverge at $x=0$ and be undefined for $x<0$. Obviously, the experimental values won't do this, but what is the comparison in this region? How does the location of the transition compare with the boundary layer approximation? Quantitatively? You will probably need to "force" the center to be consistent in doing measurements below the wire, as the computer won't be able to get the center right (and you can see the wire where the laser sheet cuts it anyway).

9. Stratification is an interesting way to explain some of your results. Periodically measure the magnitude of the gradient (or set an upper bound) and compare it to Tc/Lx (times the appropriate dimensionless order one numbers as suggested by the theory). Is this ratio large? Small? When weirdness is observed, and when it isn't? Can you intentionally stratify the fluid, and does this produce the expected results?

10. The centerline velocity is predicted to be only a very weak function of composition due to the competing effects of viscosity and (primarily) heat capacity. Is this borne out? Do the width predictions line up?

11. The shape of the profile has a very subtle dependence on composition (it gets pointier as Pr goes up – why?). Is this observed?

12. The flow is assumed to be 2-D. Can you see any variation along the length of the wire? Near the ends? At different heights above the wire? Is the 2-D approximation better in some regions than others, quantitatively? Can you think of any scalings of where this might break down, and does it match with experimental observations?

13. Sometimes the flow is observed to be unstable, waving back and forth. Are there any experimental conditions which seem to be associated with this effect? Is there any period or magnitude associated with this phenomenon? Note that the centerline location of the vertical velocity profile (calculated by pivplot.m if the pictures are good enough – it's the variable y0 and both saved in the vel.m files and printed on one of the graphs) is a good metric.

14. What does the combined quiver plot look like for different heights above the wire? Note that you need to adjust the center (that variable y0 again) to get the points to line up in real space if there was any sideways drift. Where are the walls in the images? How does the finite tank width affect observations?

15. Things will definitely diverge as you get very close to the upper free surface. Is this deviation felt further down, or is any deviation in this region due to the distance from the wire? How far up is the free surface, anyway? What happens if you change it (e.g., put in more or less fluid, but keep the height above the wire for observations constant)?

16. Reproducibility and error: the measurements at different powers, heights, and compositions usually have a point of intersection (e.g., experiments done on different days, but at exactly the same conditions). Are the measurements reproducible? What is the quantitative deviation? If you, say go from high powers to low, do you get the same behavior as if you go from low to high? If you dump the fluid out, shake it up, and put it back in, do you get the same velocities?

First, note that this is not an exhaustive list of questions – I'm sure you can come up with more! Second, there is no way you could ever answer all of these in three lab sessions, nor do I expect you to! I want you to explore the phenomenon and analyze the theory. You should definitely study the first four, and then pick and choose from among the others what will be most revealing about the phenomenon and theory.