1. How can we quickly tell if a galaxy is forming stars?

If the galaxy (or parts of it) appear blue. Blue, luminous stars are massive stars which only live for a very short time relative to the galaxy lifetimes. For them to exist, therefore, these stars must have formed very recently.

2. Imagine you are an ant walking around on a balloon. You have no idea of up or down; just forward, backwards, left and right (you are a two dimensional creature). Suppose someone blows air into the balloon. What do you see happen to the other ants on the balloon? What do they see? Is there a center to the expansion and if so, as an ant, can you see it?

You will see all the other ants move away from you. The most distant ants move faster away (don’t believe me - get a balloon, paint some dots on it, and blow it up!) Other ants will see the same thing. Every ant is moving away from every other ant and therefore no one ant could not say they were the unique center of expansion.

Intelligent ants might figure out that their space (the balloon surface) is expanding but they could not see the center that we, as 3-dimensional beings, trivially find.


No. The way the planets move around the Sun (the “rotation curve”) is well known and can be explained to high precision by almost all the mass being at the center of the Solar System in the Sun. There are small effects due to Jupiter and other planets but there are no gross differences due to masses that we don’t see. Therefore, by definition, there is no dark matter in the Solar System.
4. Why aren’t massive star supernovae good standard candles for distance measurements?

Massive stars come in a range of masses and therefore explode with a range of luminosities. Since we don’t know precisely how luminous a massive star supernovae is, therefore, it is not a good standard candle.

5. Quasars are generally found at high redshift. This means
   a) they are generally very distant
   b) they were more common in the early Universe
   c) galaxy collisions might be important in their evolution
   d) nearby galaxies, including the Milky Way, might once have been quasars
   e) they are powered by supermassive black holes

   REASONING: High redshift means a high velocity which means (by Hubble’s Law) a large distance. Such a large distance, in fact, that we are seeing them as they were when the Universe was young, smaller, and therefore when galaxy collisions were more frequent. Because they were so common in the early Universe but not now, we think it is quite possible that many galaxies were once quasars in their youth. These four points are all logical deductions from the initial statement. Quasars are most likely powered by supermassive black holes but that does not immediately follow from this statement.