

Astronomy 422 Cosmology

Homework Assignment #0 – Due 11:00 am February 9th

5 (participation) points for just doing this, right or wrong

Please explain your answers in complete sentences where called for. Although collaboration is normally encouraged, **this is an exception**. I really need to know where you personally are in your problem solving skills and skillset (yes, those are two different things). I've estimated the time it should take after each problem. If you find yourself spending a lot of time on a problem, please note that in your answer (“I spent way too much time on this problem”) and **don't feel that you have to finish it. You'll get all 5 points for taking decent stabs at all of these.**

In fact, it would be VERY USEFUL to me and to you to tell me roughly how much time you spend on each problem. Approximately. You'll thank me later. **Try not to leave anything blank!!! Give yourself an hour to an hour and a half at most.**

1. Imagine you have this differential equation where the dot refers to a derivative with respect to time: $\dot{a}^2 = a^2 + 1/a$ (a) Solve for the extreme cases $a \gg 1$, $a \ll 1$ and be sure to put in integration constants where needed. (b) Attempt to solve it exactly, and be sure to show that your answer tends toward the extremes you derived in part (a). (15 min)
2. Knowing that galaxies come in different brightnesses, what is the potential counting bias with a flux-limited all-sky galaxy survey? Explain. (5 min)
3. What do we know about conservation laws for particles that obey Bose-Einstein statistics vs. Fermi-Dirac statistics? (5 min)
4. Science supposedly rests on the idea that a result can be duplicated. If Dr. I.M.N. Sane conducts an experiment in his lab, Dr. U. R. Wong can attempt to do the same experiment and see if she gets the same results. But what can we do with only one universe? Discuss how Bayes Theorem can help us out here. (10 min)
5. Show that the first three Legendre polynomials are orthonormal in the usual way by taking their “dot product.” This will involve doing six integrals. If you don't understand this question at all, say so. Give yourself a couple minutes to look up the actual polynomials before starting: no-one expects (well, I don't expect) you to have memorized any but the first one or two $P_l(x)$'s! Not much verbiage needed for this one! (10 min)
6. Do the three angles of spherical triangles (say on the Earth's surface) add up to less or more than 180° ? Give an example which proves your point using latitude and longitude lines. (5 min)
7. One last one, except it's really two: Use your favorite computer plotting program to plot $y = x^3 / (e^x - 1)$ $x \in [0, 10]$ What value of x gives the maximum of y ? You can find it the old fashioned way by taking the derivative and fussing with a transcendental equation, or write a quick code that will find it for you. (10 min)
8. Write this statement: “I have read the syllabus and understand it” and sign it if it's true! The syllabus is online at both the class website and the ELMS website.