UCSB PHYSICS 133 Professor Martin
GALAXIES AND COSMOLOGY 2021 Spring Quarter

HOMEWORK #3 (Due 5:00pm April 16th)

NOTE: You should have finished reading Ryden ch. 4 last week; read chapter 5 this week.

Problem 1 (3 pts): **Einstein's Static Universe**
Ryden 4.2

Problem 2 (3 pts): **Age of the Universe**
Ryden, Problem 5.3.

Problem 3 (3 pts): **Einstein's Static Universe (continued)**
Ryden 5.6

Problem 4 (6 pts): **Proper Distance and Redshift**
In a flat universe with $H_0 = 70$ km s^{-1} Mpc^{-1}, you observe a glaxy at a redshift $z = 7$.
(a) What is the current proper distance to the galaxy, $d_p(t_0)$, if the universe contains only matter?
(b) What is the current proper distance to the galaxy, $d_p(t_0)$, in the Benchmark Model (a.k.a. ΛCDM)?
(c) What was the proper distance at the time the light was emitted, $d_p(t_e)$, if the universe contains only matter?
(d) What was the proper distance at the time the light was emitted, $d_p(t_e)$, in the Benchmark Model?
(e) Compare the horizon distance in the Benchmark model to the horizon distance of the flat matter-only model.
(f) Explain why the Benchmark Model and the flat matter-only model give different distances to the galaxy and different horizon distances.