*Problem guide for Cosmology and Astroparticle Physics FK7050*
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# Bergström & Goobar, "Cosmology and Particle Astrophysics"

## Chapter 1: The Observable Universe

All problems 1.2-4 are fairly interesting, basic and thus relevant.

## Chapter 2: Special Relativity

Problems 2.1-5 are useful for getting acquainted with the vector algebra of relativity; try to do a few. Problem 2.10 good for getting used to a common set of units. The rest is on kinematics, with special recommendation for 2.11 and 2.12.

Summary: Problems 2.2, 4, 11 and 12 recommended.

## Chapter 3: General Relativity

Problems 3.1, 3 and 5 recommended.

## Chapter 4: Cosmological Models

Problems 4.1, 3, 4, 6-8 and 11-13 are all good and relevant. Problem 4.10 is also nice, but I suspect it can be quite lengthy, doing it by hand.

Summary: Problems 4.1, 3, 4, 7, 11, 13 recommended.

## Chapter 5: Gravitational Lensing

Problems 5.1-3 and 5 recommended (although 5.5 has nothing to do with gravitational lensing).

## Chapter 6: Particles and Fields

Problem 6.3 recommended.

**Chapter 7: Phase Transitions**

Not included.

**Chapter 8: Thermodynamics in the Early Universe**

Problems 8.3, 4, 6 and 7 recommended.

**Chapter 9: Thermal Relics from the Big Bang**

Problems 9.2-4 recommended.

**Chapter 10: The Accelerating Universe**

Problems 10.2-3 recommended.

**Chapter 11: The Cosmic Microwave Background Radiation and Growth of Structure**

Problems 11.1, 3, 4 and 6 recommended.

**Chapter 12: Cosmic Rays**

Not included.

**Chapter 13: Cosmic Gamma-Rays**

Not included.

**Chapter 14: The Role of Neutrinos**

Not included.

**Chapter 15: Gravitational Waves**

Problem 15.1 good but may be lengthy. Problem 15.3 recommended.

**Appendix A: Some More General Relativity**

Problems nice for the student that wants to obtain a deeper knowledge of general relativity, but not required in this course.

### Appendix B: Relativistic Dynamics

No problems.

### Appendix C: The Dirac Equation

Not included.

### Appendix D: Cross-Section Calculations

Not included.

### Appendix E: Quantum Fluctuations of the Inflaton

No problems.

### Literature

"Cosmology and Particle Astrophysics",
Bergström, L. & Goobar, A., 2:nd edition,
Springer-Verlag Berlin Heidelberg (2004)