

ASTR 340 - Origin of the Universe  
HOMEWORK #4 (Tue Mar 31, 2015)  
due date: Tue April 7 in class  
100 total points FMC is the text book

READING: Chapter 8,9 ,10

1 Black holes [30pts]

- a. FMC Q9.1 [20pts]
- b. FMC Q9.3 [10 pts]

2 Measuring Cosmic expansion [30pts]

- (a) What are comoving coordinates ? [10pts]
- (b) What is a “standard candle” and how are sources of this kind used to measure cosmic distances? [10pts]
- (b) Explain the role Cepheid variable stars played in establishing the fact that the Universe is expanding.[10pts]

3. Describe **two** aspects of the binary pulsar PSR1913+16 that require General Relativity to explain. [15pts]

4. Cosmic Expansion [25 pts]

It was recently reported that astronomers had discovered a galaxy with a redshift of  $z=8.55$ .

- a. Suppose that this galaxy has an optical emission line with an emitted wavelength of 500nm. At what wavelength would we (on Earth) observe this emission line, and to which part of the spectrum does this wavelength correspond? [10pts]
- b. FMC Q10.10 [15pts]