

Answer all questions. Some questions may require you to consult other sources: if so, remember to reference the sources used in standard style (see the Department's web page on "Plagiarism and Collusion" for instructions on referencing). Always use your own words, unless there is justification for a brief direct quote—if there is, use quotation marks. This exercise counts 5% towards your total module mark.

1. Deuterium is an isotope of hydrogen. Briefly explain why its Lyman series spectral lines can nevertheless be distinguished from those of ordinary hydrogen. [2]
2. Rogerson and York measure deuterium in the spectrum of β Cen, a B1_{III} giant—but the title of the paper is "interstellar deuterium abundance". How do they know that the lines they are studying are interstellar deuterium, and not deuterium in the envelope of β Cen? Does β Cen matter at all, or could they have made this measurement using any background star? [3]
3. Briefly, and ***in your own words***, explain how Rogerson and York make their measurement. Define any specialist terms you use. [4]
4. Why do Rogerson and York need to discuss whether their measurement, which is $N(D_i)/N(H_i)$, is in fact a good measure of $N(D)/N(H)$, and what are their arguments in support of this? Briefly explain why Rogerson and York expect their measured value to be less than the value of the deuterium abundance found in the solar system. [3]
5. Rogerson and York derive a value of $1.5 \times 10^{-31} \text{ g cm}^{-3}$ for the present density of the universe. Compare this with modern values, and comment on any differences. [3]