Extension Worksheet – Option E, Worksheet 2, HL only

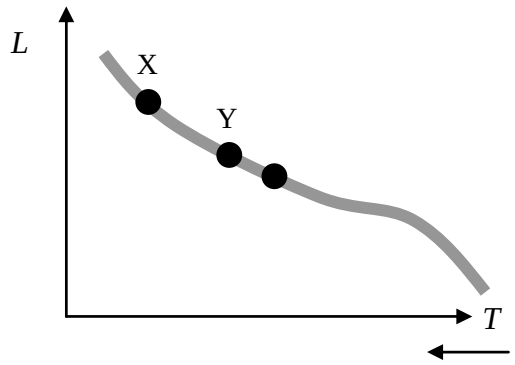
1 A large, cool cloud of gas may collapse under gravity to form a star. State where the energy comes from to heat up the star so that nuclear fusion may take place. [1]

2 In this question assume a mass–luminosity relation of $L \propto M^{3.5}$.

a Suggest why the quantity $\frac{L}{M}$ is an estimate the lifetime on the main sequence of a star of mass M and luminosity L. [2]

b Estimate the lifetime on the main sequence of a star of mass $12\,M_e$ in terms of the Sun's lifetime T_e. [2]

3 The HR diagram below shows two main sequence stars, X and Y, and our Sun.



a Explain how it may be deduced that star X is the most massive of the three stars. [2]

b Draw lines on the diagram to show the evolutionary paths of stars X and Y. [2]

4 Two main sequence stars have masses of $2\,M_e$ and $10\,M_e$. Compare the evolutionary paths of these two stars with reference to

a their final fate. [2]

b the intermediate stages in their evolution. [2]

c the nuclear reactions taking place in the stars. [3]

5 Outline how the following stars manage not to collapse under their own weight.

a A main sequence star. [1]

b A white dwarf. [1]

c A neutron star. [1]

6 Neutron stars are not shown on an H-R diagram. Suggest a reason for this. [1]

7 State and explain whether the inverse of the Hubble constant underestimates or overestimates the age of the universe. [2]

8 Explain why, in the very early universe, it was not possible to have stable structures such as nuclei and atoms. [2]