PHAS1102 PHYSICS OF THE UNIVERSE
Problem class 2 - Stellar astrophysics - Week 10, 2011

The following may be assumed if required:

Solar luminosity	$L_\odot$	4.0×10^{26} W
Solar mass	$M_\odot$	2.0×10^{30} kg

1. A star has apparent visual magnitude $m_V = 1.0$, colour index $(B - V) = -0.2$, absolute visual magnitude $M_V = -3.4$, and $(B - V)_0 = -0.3$.

   Calculate the colour excess of the star. Assuming the standard relationship between colour excess and interstellar extinction in the V band, calculate how many magnitudes of starlight (A_V) have been extinguished by the interstellar medium between the star and the Earth. What has the extinction done to the colour of the star, and why?

   Use the distance modulus relation, including interstellar extinction, to find the distance of the star.

   By comparing the absolute magnitudes of the star and the Sun, how many times brighter than the Sun is the star in the V band? (The absolute V magnitude of the Sun is 4.8.)

2. Calculate the main sequence lifetime (in years) of a 10-$M_\odot$ star if it has a luminosity of 10^4 $L_\odot$ and 10% of its mass will be converted from hydrogen to helium in the core. What will be the end state of this star?

3. Briefly explain what is meant by *hydrostatic equilibrium*.

4. Outline (in a few sentences) the key processes that make a normal main sequence star become a red giant?

5. If the brightness of a star exploding into a supernova increases by 20 magnitudes, calculate the corresponding increase in luminosity.

6. Life on Earth centres on carbon. Where did the carbon come from and how did it get there?