# General Astronomy - Spring 2011
Home work #5 - Solutions

1. How does the pressure differ between a normal and a degenerate gas?

Pressure in a degenerate gas is produced by quantum mechanical motions of the particles. Pressure in a normal gas is due to thermal motions. This implies that the pressure in a degenerate gas is roughly independent of temperature, while pressure in a normal gas depends linearly on temperature.

2. Draw a curve on an HR diagram showing the evolution of a solar mass star through the phases protostar, main sequence, red giant, horizontal branch, asymptotic giant branch, planetary nebula, and white dwarf. Be sure to label and enumerate the axes of the HR diagram.
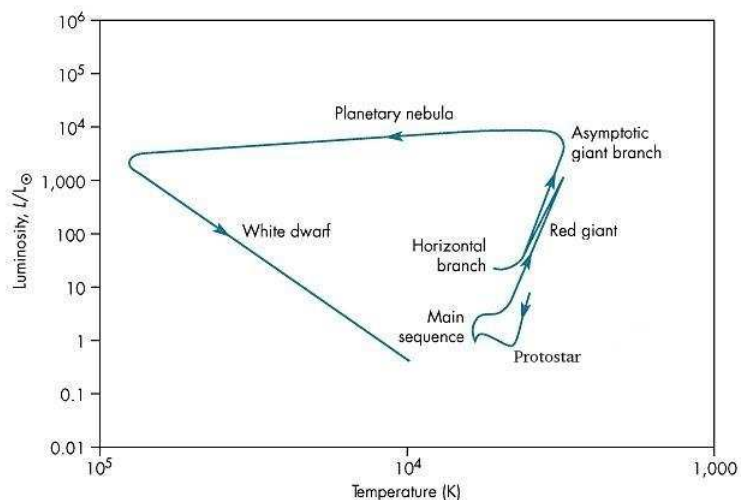
3. How long does a one solar mass star spend in each of the following stages: protostar, main sequence, red giant, horizontal branch.

Protostar – 20–50 million years
Main sequence – 10 billion years
Red giant – ~200 million years, total time on giant branch ~1 billion years
Horizontal branch – ~100 million years

4. A cluster of stars contains B stars, but no O stars on the main sequence. How old is the cluster?

The typical mass of a B star is around 10-18 $M_\odot$. The lifetime of a star is proportional to the mass to the -2.5 power. So, the lifetime of a 10 solar mass star would be $10^{-2.5} = 0.003$ times as long as the lifetime of the Sun (about 30 million years) and the lifetime of a 18 solar mass star would be $18^{-2.5} = 0.0007$ times as long as the lifetime of the Sun (about 7 million years). So to order of magnitude, the cluster is about 10 million years old. Alternatively, one can read 10 million years off the appropriate slide in the lecture notes.

5. What elements can be produced in one solar mass stars? What elements are produced in supernovae of massive stars?

One solar mass stars produce mainly He, C, and O. Massive stars produce He, C, O, Ne, Mg, Si, S, Ca, and Fe during their normal lifetimes. Supernova of massive stars produce almost all the other elements.