# The HR Diagram and Stellar Evolution

Name_______________

## Purpose:

- To provide you with necessary skills to understand how the HR diagram illustrates the major ideas of stellar evolution

Estimated Completion Time: 45 minutes

Resources needed:

- Calculator (preferably scientific)
- Textbook
- Web access is highly desirable
- Stellarium

/10

Questions

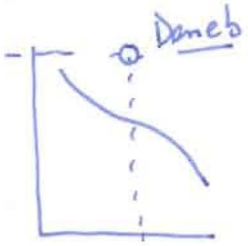
1. Explain what astronomers mean by the terms:
   a. zero–age main sequence
   b. main sequence lifetime

2. Review online lecture 9.4 and estimate the main-sequence lifetimes for the following stars (in billions of years):

use $\left(\frac{1}{M^{2.5}}\right) t_{sun}$

$= \left(\frac{1}{M^{2.5}}\right) 10\ Ga$

| Star | Mass (Mo) | Main Sequence Lifetime (Ga) |
|---|---|---|
| Vega | 2.11 | 1.55 |
| Alnitak | 28 | 0.0024 (2.4 Ma) |
| Deneb | 20 | 0.0056 (5.6 Ma) |
| Altair | 1.79 | 2.33 |




/4

3. How old is Deneb? Do a web search for the absolute magnitude and temperature of Deneb and place it on the HR diagram supplied. Next, use the applet hrEvolve to investigate the age of Deneb. (Note – hrEvolve is evolving itself! There are a few minor bugs so be patient when you access the evolutionary tracks for stars!)

/3

$M = -8.4$

$T = 8500K$

Run the applet until it "evolves" Deneb to current point on HR diagram ∴ age = 8.48 Ma

4. Will Deneb become a supernova? If so what type, when and estimate how bright it will become in the night time sky. To do this you will need to use the distance modulus relation (either the formula or graph) and the absolute magnitude that Deneb would have as a supernova. Stellarium can tell you the distance!

/3

yes - it's very massive and will become a Type II supernova with $M = -17$

since $r = 800pc$ ; $m - M = 5\log\left(\frac{r}{10}\right)$

$\therefore m = M + 5\log\left(\frac{r}{10}\right) = -17 + 5\log\left(\frac{800}{10}\right) = -7.5$ ; bright!