

# ASTRONOMY 1102 – 1

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**Answers to HW5, Fall 1999**

## 1) *Spectral Classes*

A is the class with strongest H lines. Originally the order of the classes was alphabetical in order of decreasing strength of H lines. The modern spectral sequence OBAFGKM is ordered according to *decreasing* surface temperature. F stars are cooler than A stars and have weaker H lines because there are less collisions to excite the electron in H to higher levels. The H lines in the B class are weaker than in the A class, despite the higher temperature and collision rate, because much of the H is ionized and therefore cannot absorb (nor emit) since there is no electron left to be excited to a higher level.

2) a) When a star passes in front of the other we get an eclipse; so this is an eclipsing binary. It also shows one set of shifting lines; so it is also a single-lined spectroscopic binary. In summary we are dealing with an eclipsing, single-lined spectroscopic binary.

b) Minimum light during eclipse is when one of the stars is passing in front of the other. At that time it is moving transverse (at 90 degrees) to the line of sight. So the radial velocity is zero, there is no Doppler shift.

3) Using Fig. 15.11 on p. 501:

a) B0V: luminosity of over  $10^4 L_\odot$ , radius  $10R_\odot$ .

b) M I: surface temperature of about 3000 K, luminosity of about  $10^6 L_\odot$ .

c) WD radius:  $0.01R_\odot$ .

d) red dwarfs (M V): luminosity of  $10^{-4} L_\odot$ , radius  $0.01R_\odot$ .

4) a) The youngest is cluster 2: bluest main sequence (no turn off visible) and red dwarfs are still evolving toward the main sequence (pre MS stage). The oldest is cluster 3: has the reddest main sequence turnoff (around class G) and some HB (horizontal branch) stars.

b) Use the MS lifetimes quoted on Fig. 15.12,

Cluster 1: MS turn-off near B5V, age  $10^8$  yr (averaging  $3 \times 10^7$  yr and  $1.7 \times 10^8$  yr).

Cluster 2: all O stars appear to be there, so it is younger than 3 million years.

Cluster 3: MS turn-off near G2V, so 10 billion years old.

Cluster 4: MS turn-off near O6V, so about 5 million years old.

c) Cluster 3 is the oldest and has a HB (in addition to the more usual RGB and AGB) therefore it is likely to be a globular cluster. Compare with Fig. 15.21.