Hertzsprung-Russell Diagram

The importance of this diagram to astronomers cannot be overstated! In order that you understand it you will make one yourself. Follow the directions below and turn in the resulting graph and responses to questions 3, 6, and 8 – 12 for a 30 point grade.

1. Begin by labeling each axis. The *x*-axis is spectral type. The *y*-axis is absolute magnitude.
2. Plot the nearest and brightest stars from the tables provided in class using absolute magnitude and spectral type. Some stars shown in the tables do not have enough information to plot in this manner – skip these for now. For binary stars, plot A and B separately wherever possible.
   Include a key or legend and use different colors or symbols to distinguish the nearest from the brightest. Include the Sun and label it by name. (Optional: you may wish to include names for *some* of the notable stars but there isn't room for *all* of the points to be named.)
3. Along the *x*-axis label each spectral type with its *approximate* temperature. Use the figures from chapter 17 or other reference to do this. Or, you can just use the temperatures shown in the tables of stars. (For example, the A0 or A1 stars in the table are all about 10000 K, so put this temperature near A0/A1 on the *x*-axis.)
   The temperatures given on an H-R diagram are for what part of the star?

4. Along the *x*-axis label each spectral type with its *approximate B–V* color index and a word description of the apparent color. Use the figures from chapter 17 or other reference to do this. Or you can just use *B–V* values shown in the tables of stars.
5. Along the *y*-axis make a scale showing luminosity in multiples of the Sun's luminosity. Label with values $0.0001L_\odot$, $0.01L_\odot$, $1L_\odot$, $100L_\odot$, and $10{,}000L_\odot$, etc., where 1 $L_\odot$ equals the luminosity of the Sun.
   Hint: the Sun's absolute magnitude is 4.83 so this is where $1L_\odot$ should go. The location of the other values can be determined by recalling that a *difference* of 5 on the magnitude scale represents a *factor* of 100 in brightness. (and magnitude is backward) (of course)
6. Compare and contrast the brightest stars with the nearest stars based on their positions on the H-R diagram. Why are they separated? What is the significance of this?

7. Draw approximate lines showing the size of the stars in multiples of the Sun: stars that have the same approximate size of the Sun will lie on a line that connects the two points (B0, 0) and (M4, 8). Draw this line and label it $1R_\odot$ indicating 1 times the size of the Sun. Stars that are 10 times larger than the Sun will be 100 times more luminous – which is 5 steps on the magnitude scale. Therefore other stellar sizes can be drawn as a series of parallel lines separated by 5 vertical units. Draw and label lines for $0.01R_\odot$, $0.1R_\odot$, $10R_\odot$, $100R_\odot$.

8. Plot and label the following stars on your H-R diagram (can be found in your table): Sirius B and Procyon B – notice in the table that the spectral types begin with the letter D, which we will not study. If you disregard these letters, you can determine an appropriate *approximate* location based on the temperature, luminosity, and/or absolute magnitude of each of these stars. Looking at the lines drawn in the previous step, which of these two stars is closest to the one labeled $0.01R_{\odot}$? How close is this to the actual radius of the star shown in the table?

9. Plot the following stars that are the same spectral type, but different luminosity class:
   γ Virginis: F0V, $M = 2.4$; α Hydri: F0IV, $M = 1.15$; β Cassiopeiae: F2III, $M = 1.3$;
   π Sagittae: F2II, $M = -3.08$; α Persei: F5Ib, $M = -5.1$; δ Canis Majoris: F8Ia, $M = -6.86$
   Which of these six stars has the greatest temperature?

   Which of these six stars has the greatest radius?

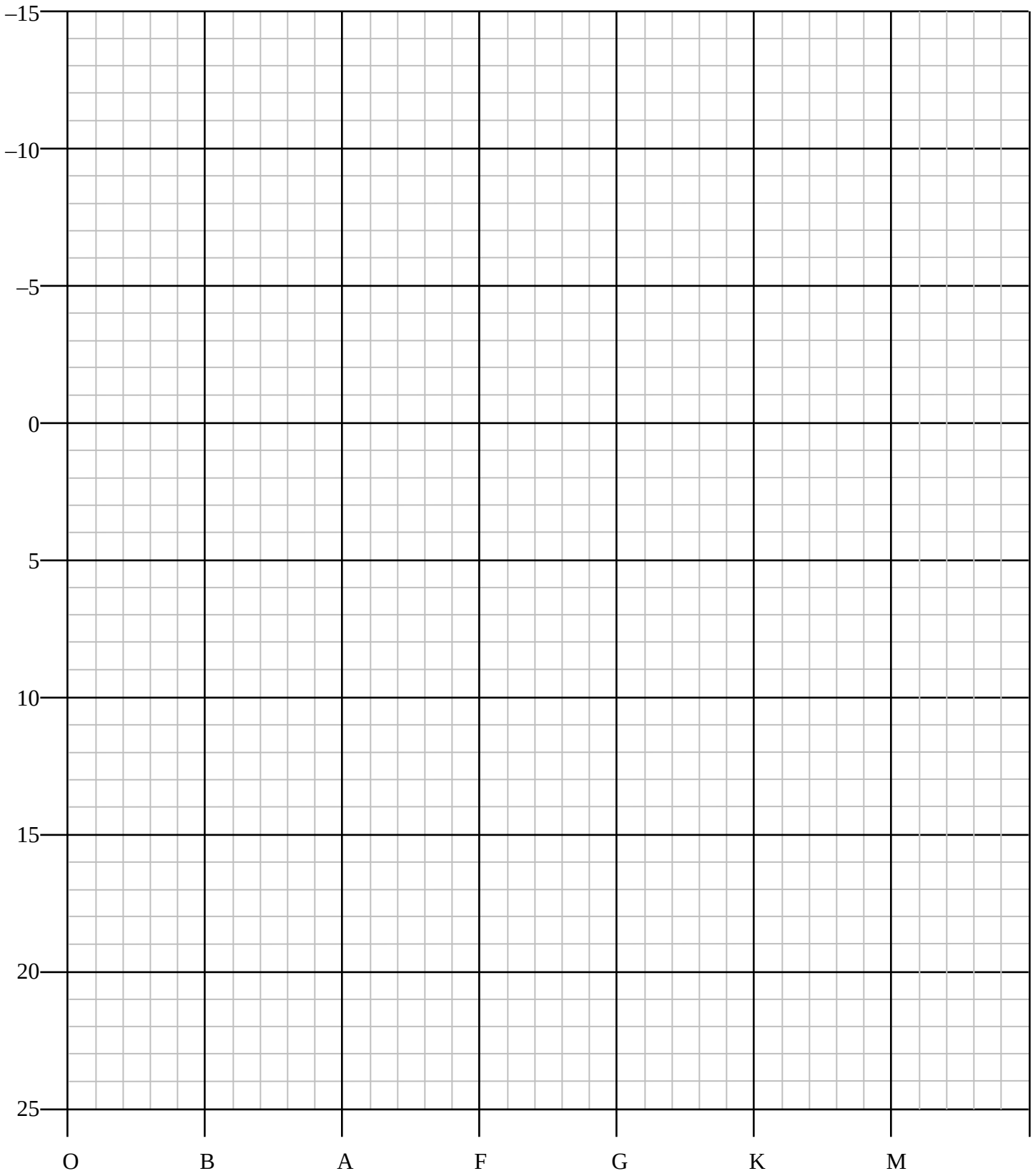
   Which of these six stars has the greatest luminosity?

   Which of these six stars has the most yellow appearance?

10. Label the following *broad* regions on your H-R diagram: red dwarfs (reddish stars the size of the Sun or smaller), white dwarfs (whitish stars much smaller size than the Sun), blue giants (bluish-white stars much larger than the Sun), red giants (reddish stars much larger than the Sun). Out of the stars that you have plotted name an example of a star in each these four regions.

11. Draw a curving diagonal line that represents the luminosity class V (all stars with a designation of V in the spectral classification). This is not an exact line, but rather a general trend –like a line of best fit, with data points a little scattered, both above and below. Estimate the percentage of stars that you plotted that are main sequence stars near this line.

12. Consult the diagrams and information in Chapter 17 or other reference and draw and label the approximate luminosity classes Ia, Ib, II, III, IV as lines/curves on the graph. What are each of these classes called and why?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