

# The HR Diagram

Name \_\_\_\_\_

## Purpose:

- To provide you with necessary skills to understand the HR diagram and how to use it
- To give you practice performing simple mathematical calculations using spectroscopic parallax

Estimated Completion Time: 45 minutes

## Resources needed:

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

## Questions

1. Find the following stars using Stellarium and record the data in the table below:

Star	Spectral Type	Absolute Magnitude	Apparent Magnitude	B-V	Parallax	Distance Modulus
Procyon	F5 IV-V	2.66	0.34	0.4	0.284"	-2.32
Castor	A1 V	0.99	1.93	0.03	0.064"	0.94
Antares	M1 (26)	-5.28	0.6	1.83	0.0059"	5.88
Altair	A7 V	2.22	0.76	0.22	.195"	-1.48
Regulus	B8 IV	-0.57	1.4	-0.11	0.041	1.97
Capella	G1 III	0.296	0.08	0.80	0.076	-0.28
Mizar	A2 V	0.3	2.27	0.02	0.042	1.9
Algol	B8 V	-0.07	2.12	-0.05	0.036	2.19

2. Find the distance modulus for each star and record that in the last column of the table in question 1.
3. Place each of the stars in the table from question 1 on the HR diagram that is attached to this exercise.

4. From the absolute magnitude that you found for each star determine the star's luminosity in solar units. (Hint – the absolute magnitude of the Sun is 4.84. Polaris has an absolute magnitude of -3.66. This means that Polaris is  $4.84 - (-3.66) = 8.5$  magnitudes brighter than the Sun. Use the magnitude-brightness rule to convert this into a brightness factor or **luminosity**. See [Chp 2.1](#) in the online notes to do this. You will find that Polaris is 2513 times more luminous than the Sun.) Record this information in the following table:

Star	Luminosity (Lo)	Mass (Mo)	Radius (Ro)
Procyon	7.5	1.77	1.9
Castor	34.7	2.75	2.0
Antares	11173	14.3	390
Altair	11.2	1.99	1.7
Regulus	145.9	4.15	2.8
Capella	65.7	3.30	9.3
Mizar	65.5	3.30	2.9
Algol	92.1	3.64	3.2

5. Find the mass of each of the stars by using the Mass-Luminosity Relation (See online notes [Chp 8.5](#)) Record this in the table shown above. Also estimate the radius for each star from the HR diagram and where you placed these stars.
6. Use the distance modulus found earlier to compute the distance to these stars. (See [Chp 8.1](#))

Star	Distance Modulus	Distance (pc)
Procyon	-2.32	3.4
Castor	0.94	15.4
Antares	5.88	150
Altair	-1.48	<del>14.85</del> 11.2
Regulus	1.97	24.8
Capella	-0.28	8.8
Mizar	1.9	24
Algol	2.19	27.4

7. The star Sirius B has an apparent magnitude of 8.3 and is located 2.6 pc away. The surface temperature of this star is 25 000 K. Find the star's absolute magnitude and use the applet [HR explorer](#) to indicate where this star should be placed on the HR diagram. What class of star is this?

$$m - M = 5 \log\left(\frac{r}{10}\right) \text{ so } M = m - 5 \log\left(\frac{2.6}{10}\right) = 11.2$$

Sirius B is in the bottom-left corner of the HR diagram

