NAME: ______________ DATE: ______________

Homework #7

1. Parallax of a nearby star is used to estimate
   1. the angle taken up by the size (e.g., diameter) of an object, as seen by an observer.
   2. the shift in angular position of an object as it moves in space.
   3. the distance to an object, measured in parsecs.
   4. the apparent shift in position of an object as the observer moves.

2. Spectral types of stars (e.g., O, B, A, F, G, K, M) define uniquely their
   1. surface temperature.
   2. distance from Earth.
   3. apparent magnitude.
   4. physical size or diameter.

3. What is a protostar?
   1. A small interstellar cloud, before it begins collapsing to become a star.
   2. A sphere of gas after collapse from an interstellar cloud but before nuclear reactions have begun.
   3. A star near the end of its life, before it explodes as a supernova.
   4. A shell of gas left behind from the explosion of a star as a supernova.

4. How is the length of a star's lifetime related to the mass of the star?
   1. Lower-mass stars run through their lives faster and have shorter lifetimes.
   2. The lifetimes of stars are too long to measure, so it is not known how (or if) their lifetimes depend on mass.
   3. A star's lifetime does not depend on its mass.
   4. Higher-mass stars run through their lives faster and have shorter lifetimes.

5. When plotting random stars in an H-R diagram, what must be known for each star?
   A star color and apparent brightness
   B star color and absolute brightness
   C apparent star brightness and age
   D star color and age

6. Stars on the main sequence
   A have approximately the same age, to within a few million years
   B have extremely high abundances of elements heavier than helium
   C generate energy by hydrogen fusion in their centers
   D are changing slowly in size, by gravitational contraction

7. As a star is forming by the condensing of gases, the gases
   A cool as they fall.
   B heat up as they fall.
   C stay about the same temperature.
   D any of the above, depending upon the mass involved.

8. The longest phase of a star's life is spent as a
   A proto star
   B main sequence star
   C cepheid variable star
   D red giant star

9. The age of a cluster can be determined by analyzing
   A the motion of the stars
   B the number of stars in the cluster
   C the H-R diagram of the cluster
   D cepheid variables in the cluster

10. A planetary nebula is
   A the vastly expanded shell of a dying star.
   B a cloud of gas out of which stars form.
   C a cloud of cold dust in space.
   D the same as a white dwarf.

11. When the sun "dies" it will become a
   A supernova
   B neutron star
   C white dwarf
   D black hole

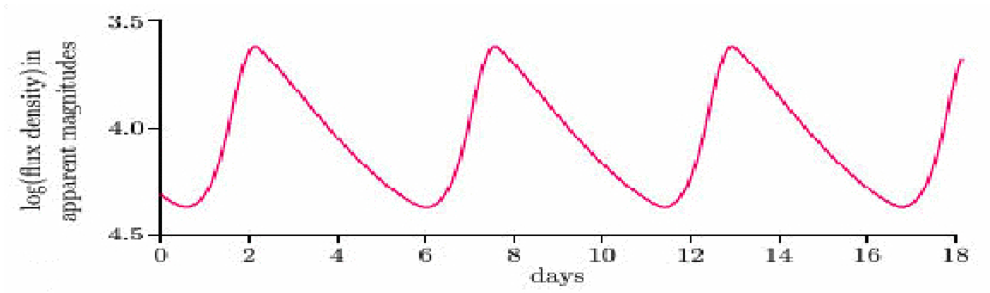
12. A nova as opposed to a supernova is
   A an explosion due to the core collapse of a low-mass star
   B an explosion due to the onset of carbon burning in a low-mass star
   C the brightening of a star as it blows off its outer layers to expose a white dwarf star.
   D fusion of hydrogen on the surface of a white dwarf that has taken the hydrogen from a close companion star

13. Which physical phenomenon keeps a white dwarf star from collapsing inward upon itself?
   A electron degeneracy pressure
   B normal gas pressure
   C neutron degeneracy pressure
   D the physical size of the neutrons

14. The next stage in our Sun's life after the main-sequence phase is
   A the horizontal branch phase.
   B the red giant phase.
   C a protostar.
   D death (i.e., either a supernova or a white dwarf).

15. A pulsar is
   A a binary star in which matter from one star is falling onto the second star
   B a pulsating star, in which size, temperature, and light intensity vary regularly.
   C a black hole, absorbing material periodically from nearby space.
   D a rapidly rotating neutron star, emitting beams of radio, and sometimes X-ray and visible, energy.

16. The graph below is a plot of apparent magnitude m vs. time in days for a Cepheid Variable star.



From this light curve you are to determine

A. The Period P of this Cepheid variable star.

$$P \sim 5.5 \text{ days}$$

B. The Absolute Magnitude M of this variable star using the period-luminosity relationship,

$$M = -1.2 - 2.9 \log P \tag{1}$$

$$M \sim -3.4$$

C. Finally, calculate the distance d to this star using the magnitude-distance relationship,

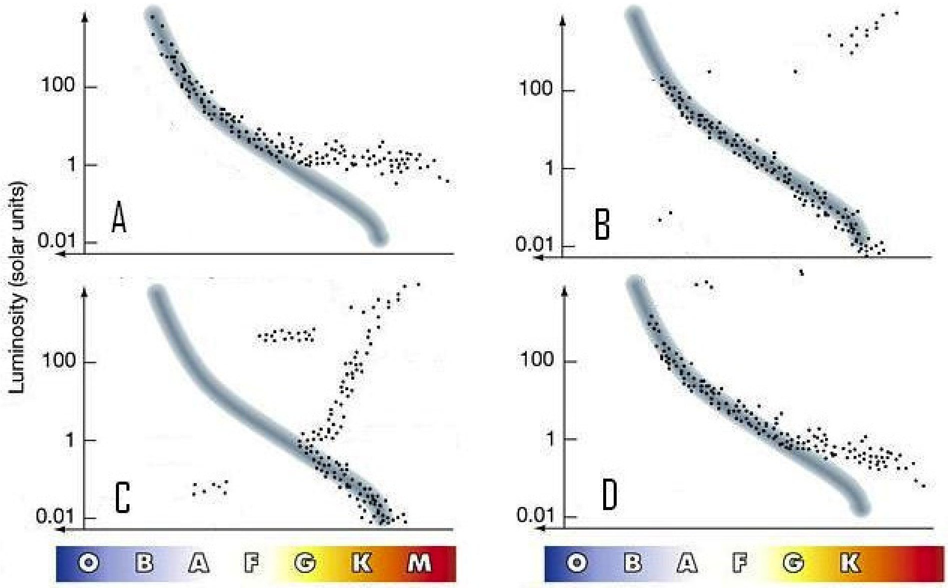
$$d = 10 \times 10^{0.2*(m-M)}$$

$$\text{Use } m = 4.0, \text{ then } d \sim 300 \text{ pc}$$

17. Describe some interesting facts about SN1054.

18. What is the Roche Lobe and what is its significance in close binary systems?

19. The figures below are HR diagrams from 4 different clusters of stars. (a) Order them from youngest to oldest, and (b) estimate the approximate age of each star cluster.



From youngest to oldest is A, D, B, C.

<u>Approximate Ages:</u> Refer to Fig. 10-27 on page 289 in your textbook.

A: $\sim$ 3 million years
D: $\sim$ 10 million years
B: $\sim$ 50 million years
C: $>$ 5 billion years

20. Explain how and why the turnoff point on the HR diagram of a single cluster of stars is related to the cluster's age.

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Main Sequence Stars

Star	m	M	d (pcs)	Spectral Type	Approx. Temp
Eri	3.7	6.1	3.3	G	5,000
Proxima Centauri	11.1	15.5	1.32	M	2,500
Spica	1.0	-3.6	83	B	25,000
Procyon-A	0.4	2.6	3.6	A/F	7,000
Sirius	-1.5	1.4	2.6	A	10,000
Puppis	2.2	-5.5	350	O/B	30,000

21. Fill in the table above by calculating the distance d to each star using the magnitude-distance relationship

$$d = 10 \times 10^{0.2*(m-M)}.$$

22. Estimate the spectral types of the stars (O, B, A, F, G, K or M) by comparing to an HR diagram.

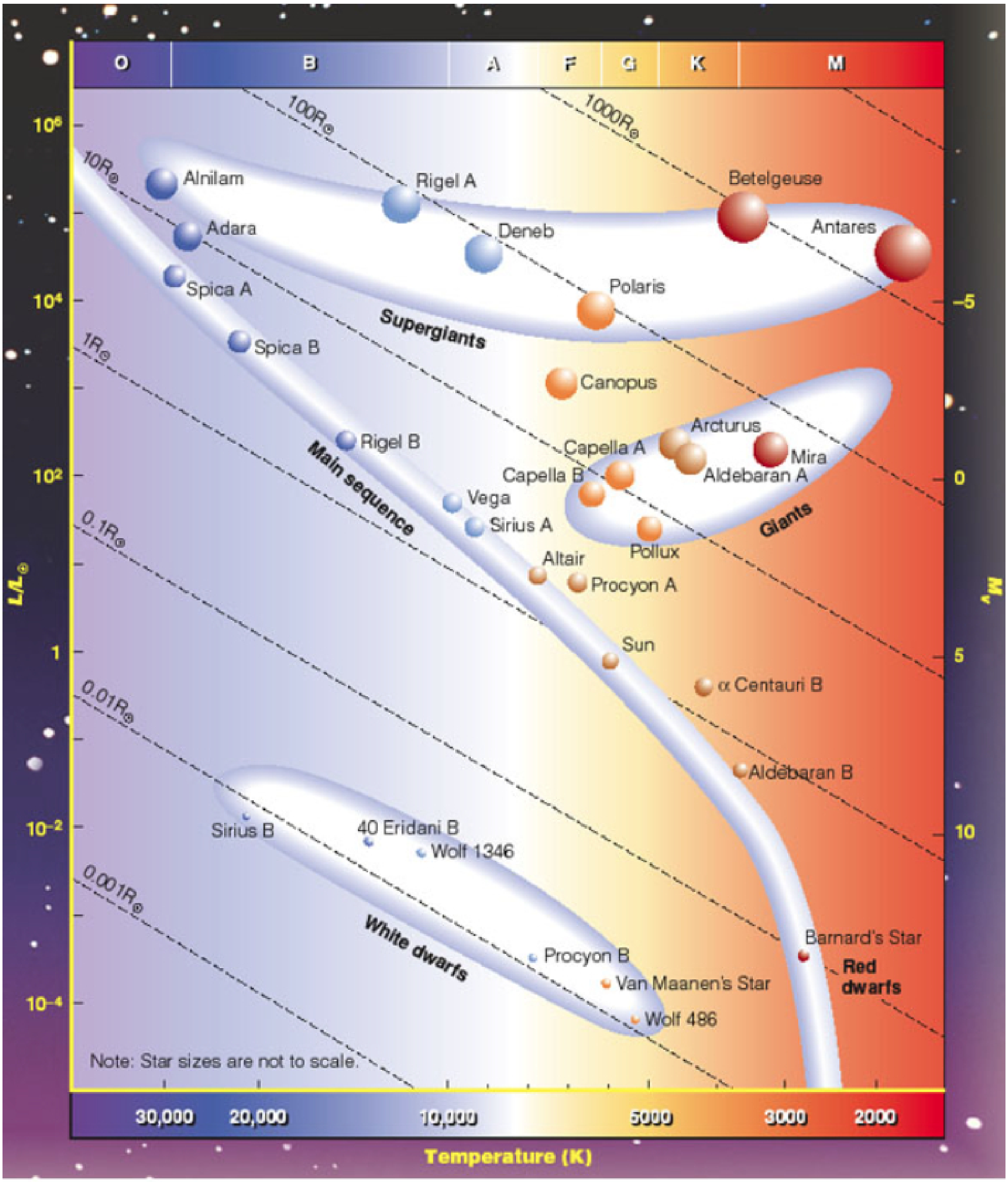
23. Estimate the approximate star temperatures T by comparing to an HR diagram.

24. List the stars in order of **intrinsic luminosity**, from brightest to dimmest. (USE M)

    Puppis, Spica, Sirius, Procyon-A, Eri, Proxima Centauri

25. List the stars in order of **apparent luminosity**, as viewed from Earth, from brightest to dimmest. (USE m)

    Sirius, Procyon-A, Spica, Puppis, Eri, Proxima Centauri



O
B
A
F
G
K
M
10^6
10^4
10^2
1
10^{-2}
10^{-4}
$L/L_\odot$
M_v
−5
0
5
10
$100R_\odot$
$1000R_\odot$
$10R_\odot$
$1R_\odot$
$0.1R_\odot$
$0.01R_\odot$
$0.001R_\odot$
Alnilam
Rigel A
Betelgeuse
Adara
Deneb
Antares
Spica A
Polaris
Supergiants
Spica B
Canopus
Arcturus
Rigel B
Capella A
Mira
Main sequence
Capella B
Aldebaran A
Vega
Sirius A
Giants
Altair
Pollux
Procyon A
Sun
α Centauri B
Aldebaran B
Sirius B
40 Eridani B
Wolf 1346
White dwarfs
Barnard's Star
Red dwarfs
Procyon B
Van Maanen's Star
Wolf 486
Note: Star sizes are not to scale.
30,000
20,000
10,000
5000
3000
2000
Temperature (K)