

Discussion Questions

- 1) Briefly explain how the Sun became hot enough for nuclear fusion.

- 2) Explain why stars more massive than the Sun live shorter main sequence lives than stars less massive than the Sun, despite having more fuel available for nuclear reactions.

- 3) Briefly describe how a star forms.

- 4) Briefly summarize the stages of life for a high-mass star.

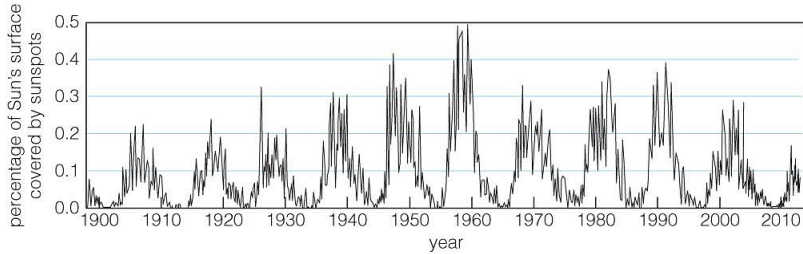
5) Briefly describe how a nova event occurs.

6) Briefly describe what you would see if your friend plunged into a black hole.

7) Two stars, Tom and Jerry, have the same spectral type. Tom is luminosity class V and Jerry is luminosity class I. Which star is bigger? Which star is more luminous? Which star has a hotter surface temperature? Explain your answers.

8) Two stars, Fred and Barney, are of the same size. Fred has spectral type F, while Barney has spectral type B. Which one is more luminous? What are their relative locations on the HR diagram?

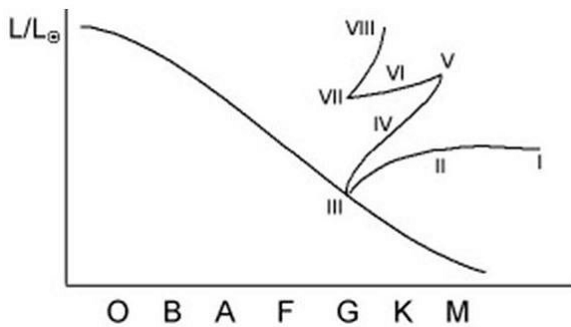
CRITICAL THINKING: FOR THE NEXT SET OF PROBLEMS, YOU CAN ANSWER MOST BY READING THE TEXT. IF YOU STILL NEED HELP TALK WITH A FEW CLASSMATES. IF NEEDED GO TO ONE OF THE TUTORING CENTERS ON CAMPUS. MAKE SURE YOU UNDERSTAND IT, DON'T SIMPLY COPY THEIR SOLUTION. PLEASE TAKE YOUR TEXTBOOK.



a This graph shows how the number of sunspots on the Sun changes with time. The vertical axis shows the percentage of the Sun's surface covered by sunspots. The cycle has a period of approximately 11 years.








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- 9) It takes _____ years for the sun to progress through one *sunspot cycle* from a maximum area covered with sunspots, to a minimum, and back to a maximum. Refer to the graph above.
- A) about 11 years
 - B) about 1 year
 - C) about 110 years
 - D) This figure cannot be used to answer this question.



- 10) This diagram represents the life track of a 1 solar mass star. Refer to the life stages labeled with roman numerals. During which stage is the star's energy supplied by primarily by gravitational contraction?
- A) ii
 - B) vi
 - C) iii
 - D) viii
 - E) v
- 11) This diagram represents the life track of a 1 solar mass star. Refer to the life stages labeled with roman numerals. During which stage does the star have an inert (non-burning) *helium* core?
- A) vii
 - B) iii
 - C) vi
 - D) iv
 - E) viii
- 12) This diagram represents the life track of a 1 solar mass star. Refer to the life stages labeled with roman numerals. Which stage lasts the longest?
- A) viii
 - B) iv
 - C) vi
 - D) iii
 - E) i
- 13) This diagram represents the life track of a 1 solar mass star. Refer to the life stages labeled with roman numerals. During which stage does the star have an inert (non-burning) *carbon* core surrounded by shells of helium and hydrogen burning?
- A) viii
 - B) iii
 - C) ii
 - D) iv
 - E) vi

TABLE 12.1 The Spectral Sequence

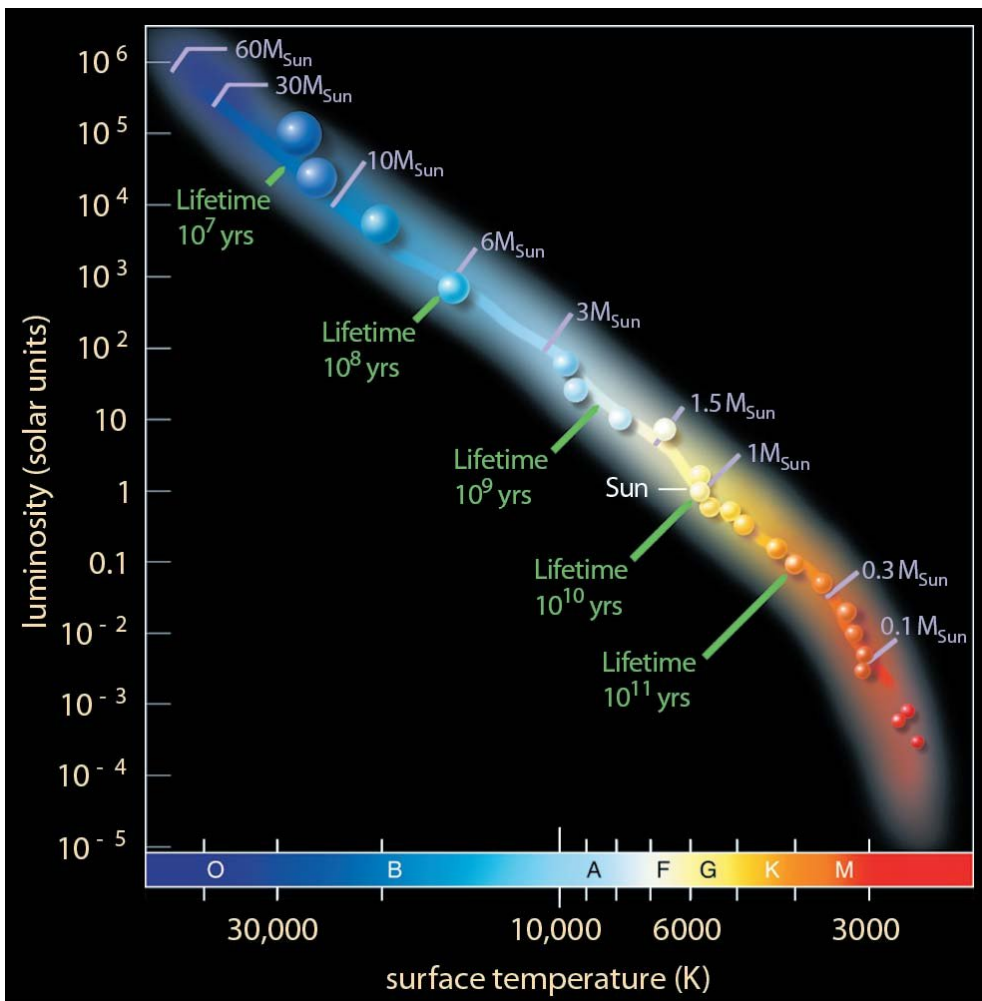
Spectral Type	Example(s)	Temperature Range	Key Absorption Line Features	Brightest Wavelength (color)	Typical Spectrum (selected lines labeled)
O	Stars of Orion's Belt	>33,000 K	Lines of ionized helium, weak hydrogen lines	< 89 nm (ultraviolet)*	O 
B	Rigel	33,000 K–10,000 K	Lines of neutral helium, moderate hydrogen lines	89–290 nm (ultraviolet)*	B 
A	Sirius	10,000 K–7500 K	Very strong hydrogen lines	290–390 nm (violet)*	A 
F	Polaris	7500 K–6000 K	Moderate hydrogen lines, moderate lines of ionized calcium	390–480 nm (blue)*	F 
G	Sun, Alpha Centauri A	6000 K–5200 K	Weak hydrogen lines, strong lines of ionized calcium	480–560 nm (yellow)	G 
K	Arcturus	5200 K–3700 K	Lines of neutral and singly ionized metals, some molecules	560–780 nm (red)	K 
M	Betelgeuse, Proxima Centauri	<3700 K	Strong molecular lines	>780 nm (infrared)	M 

*All stars above 6000 K look more or less white to the human eye because they emit plenty of radiation at all visible wavelengths.

ionized calcium titanium oxide sodium titanium oxide

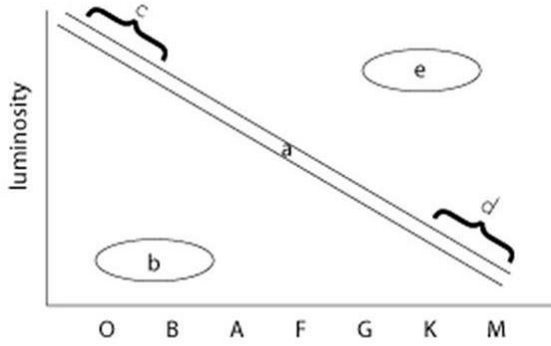
- 14) What is the spectral type of a star with very strong hydrogen absorption lines?
 A) A B) G C) B D) F
- 15) What is the spectral type of a star with strong molecular absorption lines?
 A) M B) K C) G D) F
- 16) What is the approximate surface temperature of a star with moderate hydrogen absorption lines and moderate ionized calcium absorption lines?
 A) 5,500 K B) 4,500 K C) 6,500 K D) 3,500 K
- 17) What is the approximate surface temperature of a star with weak hydrogen absorption lines and strong absorption lines of ionized calcium?
 A) 5,500 K B) 3,500 K C) 4,500 K D) 6,500 K
- 18) The stellar spectral sequence, in order of decreasing temperature, is (Hint: oh be a fine ...)
 A) OBAFGKM.
 B) OBAGFKM.
 C) BAGFKMO.
 D) OFBAGKM.
 E) ABFGKMO.

- 19) The axes on a Hertzsprung–Russell (H-R) diagram represent _____.
- A) luminosity and apparent brightness B) luminosity and surface temperature
 C) mass and luminosity D) mass and radius



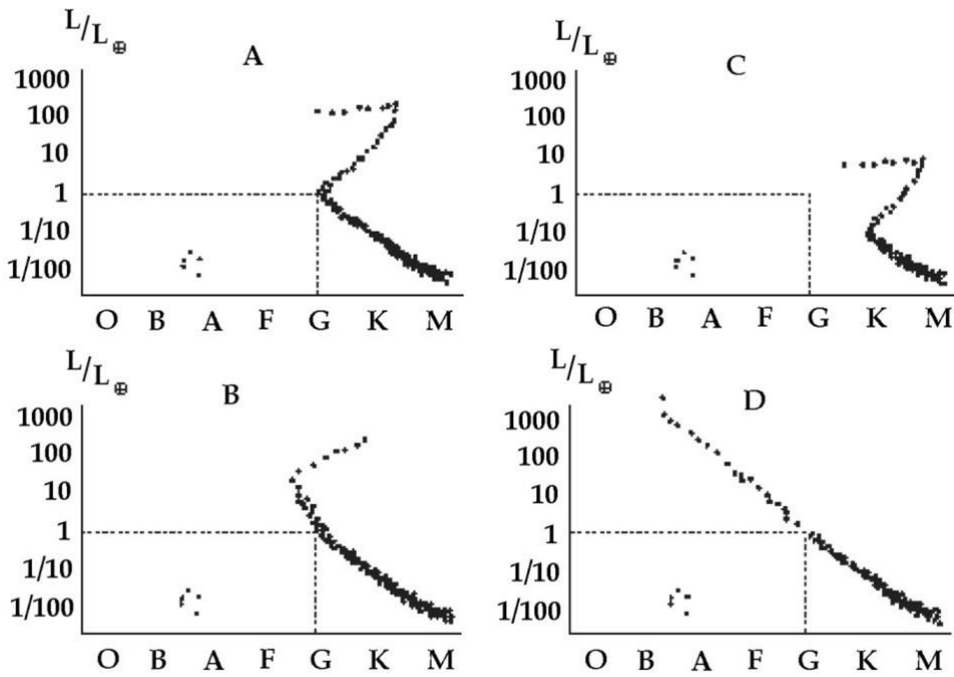
- 20) What is the approximate surface temperature of an F star?
 A) 7,000 K B) 5,000 K C) 6,000 K D) 12,000 K
- 21) What is the approximate surface temperature of a B star?
 A) 6,000 K B) 40,000 K C) 20,000 K D) 8,000 K
- 22) What is the spectral type of a main sequence star with a luminosity 100 times greater than the sun?
 A) A B) O C) G D) M
- 23) What is the approximate luminosity of a main-sequence M star?
 A) 0.01 solar B) 10 solar C) 10^{-6} solar D) 1 solar
- 24) A star is observed with a surface temperature of 3,000 K and a luminosity of 10^{-2} solar. What is the approximate mass of this star?
 A) 0.2 Msun B) 0.9 Msun
 C) 0.5 Msun D) The mass cannot be determined.

The sketch below shows groups of stars on the H-R diagram, labeled (a) through (e); note that (a) represents the *entire* main sequence while (c) and (d) represent only small parts of the main sequence.



- 25) Which group represents stars that are *cool and dim*?
 A) a B) b C) c D) d E) e
- 26) Which group represents stars of the *largest radii*?
 A) a B) b C) c D) d E) e
- 27) Which group represents *the most common type of stars*?
 A) e B) b C) c D) d
- 28) Which group represents stars that are *extremely bright and emit most of their radiation as ultraviolet light*?
 A) a B) b C) c D) d E) e
- 29) Which group represents stars with *the longest main-sequence lifetimes*?
 A) a B) b C) c D) d E) e
- 30) Which group represents stars *fusing hydrogen in their cores*?
 A) a B) b C) c D) d E) e
- 31) Which group represents stars that have *no ongoing nuclear fusion*?
 A) a B) b C) c D) d E) e

The following questions refer to the representations below of H-R diagrams for different clusters of stars. In each diagram, the dotted lines locate the position of the Sun.



32) Which cluster is the youngest?

33) Which cluster is the oldest?

Hint: Look at the HR diagram in the text that shows the position of red supergiants.

- 34) Each choice below lists a spectral type and luminosity class for a star. Which one is a *red supergiant*?
- | | |
|---|---|
| A) spectral type M1, luminosity class V | B) spectral type O9, luminosity class I |
| C) spectral type G2, luminosity class V | D) spectral type M2, luminosity class I |