Astronomy 212 EXAM 3 2017 November 20

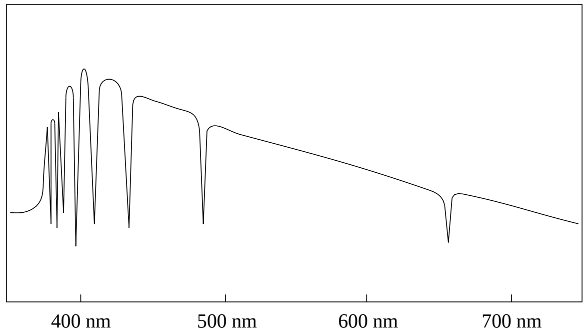
Except for questions 19, 31 and 32 marks/answers on these sheets are not graded.

Answer *TRUE* or *FALSE* (not *T* or *F*) (2 pts each)

1. While it would be a slow, cold process, measuring a star's parallax from Pluto would produce a larger parallax angle than on Earth.
2. As a *protostar* the Sun started cooler and more luminous than it is today.
3. Our Solar System seems to lack the most common type of exoplanet.
4. The Sun is slightly brighter today than it was a billion years ago.
5. *Planetary nebulae* are produced by young stars just starting to to produce a disk that will end up as planets.
6. A FV star has more mass than a KV star.
7. HII is ionized hydrogen; H_2 is molecular hydrogen; ^2H is heavy hydrogen (deuterium).
8. Stars are gradually polluting the ISM (interstellar medium) with 'metals'.
9. Regulus was born before the Sun was born.
10. In a degenerate electron gas, the electrons can have lots of kinetic energy (and hence produce high pressure) even at low temperature.
11. Other things being equal (e.g., same surface temperature), the more massive the white dwarf, the less luminous it will be.
12. The normal-size spin and magnetic field of a star are hugely super-sized in the collapse to a neutron star: conservation laws are at work.
13. If tomorrow the Sun became a black hole, the planets would quickly be sucked into the hole.
14. Since *type II supernovae* ('core-collapse' supernovae of massive stars) can produce neutron stars, we should expect them to emit lots of neutrinos.
15. *Type Ia supernovas* and novas are both thought to involve the binary companion of a white dwarf dumping material onto that white dwarf.
16. The center of our Galaxy is in the direction of the constellation Hercules.

Give a short explanation (5 pts each)

17. Consider the usual *types* of stellar spectra (O,B,...,M). How exactly do these spectra differ? (Note: not how the stars differ, rather how the spectra differ.) Consider the usual luminosity classes of stellar spectra (I,II,...,V). How exactly do these spectra differ?
18. Consider the following list of interstellar 'clouds' discussed in class: molecular clouds, HII regions, HI (neutral hydrogen) clouds, 'hot vacuum'. For two of these cloud-types describe the atom-scale process that produces the light the cloud emits. That is: with what sort of light can the cloud be observed?



19. Consider the effects of looking at a star through a cloud of *dust*. The above spectrum represents the light *produced* by a star and viewed without dust in the way. Draw *directly on the above diagram* what the spectrum of the star would look like if observed through a dust cloud.

20. Where should you look to see new stars forming? What sort of telescope should you use? Why?

21. Describe two ways we detect planets around distant stars.

22. Draw a Hertzsprung-Russell diagram. Properly label axes. Show star paths (with direction) that:

    (a) show a star increasing its temperature while keeping its luminosity constant

    (b) show a star increasing its temperature while keeping its radius constant

23. In question 30, I ask you to report the evolution of the Sun. Describe briefly here how the evolution of stars much more massive than the Sun (say, 30 $M_\odot$) and stars much less massive than the Sun (say, $\frac{1}{10}$ $M_\odot$) differs from that of the Sun.

24. Our book asserts that "most of the atoms on Earth and in our bodies come from. . . star explosions." What is the basis of such a sweeping statement? How did those atoms get out of that star and end up here on Earth? What were those atoms doing during the last billion years before they became part of your body?

25. Describe a *pulsar*. Include: how it is formed, how it is observed, and typical radius.

26. Describe a *white dwarf*. Include: how it is formed, how it is observed, and typical radius.

27. Describe a *black hole*. Include: how it is formed, how it is observed, and typical radius.

28. Sketch a picture of our Galaxy. Label at least three parts of the Galaxy.

Write out a complete answer (10 pts each)

29. Answer the following questions using the below data.

Star Name	Luminosity $L_\odot$	Apparent Magnitude m_V	Spectral Type	Luminosity Class
1. Canopus	13,500	−0.7	F0	Ib
2. Wolf 359	2×10^{-5}	13.5	M6	V
3. Gacrux	820	1.6	M3	III
4. λ Ser	2	4.4	G0	V
5. El Nath	700	1.7	B7	III
6. α UMa	316	1.8	K0	III
7. α Aqr	3,000	3.0	G2	I
8. Achernar	1,030	0.5	B3	V
9. Antares	100,000	1.1	M2	I

Which star. . .

(a) would look the brightest in the sky?

(b) could not be seen with the unaided eye?

(c) has the highest surface temperature?

(d) has the lowest surface temperature?

(e) which main sequence star produces the most light?

(f) which star has the most years left to live?

(g) has the largest radius?

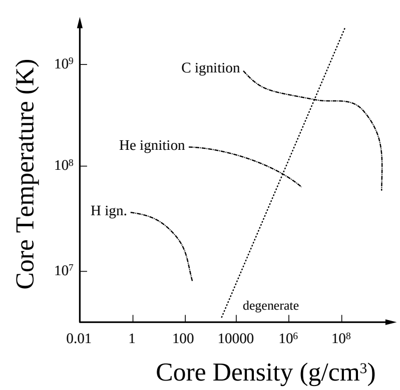
(h) has the smallest radius?

(i) is a blue-white giant star?

(j) is most similar to the Sun?

30. A star like the Sun is believed to go through the following stages: planetary nebula, protostar, red giant, double shell burning (asymptotic giant), He flash, main sequence, and white dwarf. Describe (in words) the characteristics of each stage. Order these stages from first to last, and locate them on an HR diagram. For two of these situations draw a cross-section of the Sun displaying the internal structure. Remember to label the axes of your HR diagram!

31. I described several principles of stellar evolution including: (A) the virial theorem, (B) the Russell-Vogt theorem, (C) sequential thermonuclear fusion leading to nonburnable iron. *Define* each of the above and describe (in words!) an *example* showing its role in stellar evolution. For each example locate (with "**A**", "**B**", "**C**") either on your HR diagram for the above question or the plot to the right, where the role you described in words can be seen in action.



32. The below diagram shows the winter hexagon. Eight of these dots represent stars you should know. Circle these "important" stars and label with the name and spectral type of the star.