

Third Midterm - Your Name and ID:

Part Zero: Please write your name and student ID on the top line of this sheet **and** on the front of the Blue Book that you received together with this sheet. Please return both together for grading at the end of the exam. Please use a pen that cannot be erased!

Part One: True or False? Please mark with either T for True or F for False on the line provided in front of each statement. Each correct answer is worth one point:

1. TRUE: The absolute magnitude of a star is defined as the apparent magnitude that would be observed from a fixed distance of 10 parsec.
2. FALSE: The parallax of nearby stars is used to measure the diameter of the Earth's orbit around the Sun.
Hint: It is just the other way around: The diameter of the Earth's orbit is used to measure the parallax.
3. FALSE: The proper motion of a star is the same as its true motion.
Hint: Proper motion is only the part of a star's true motion that is perpendicular to our line-of-sight. The other component is the star's radial motion.
4. FALSE: The Hertzsprung-Russell diagram shows a measure of a star's temperature on its horizontal axis and a measure of that star's apparent magnitude on its vertical axis.
Hint: Apparent magnitude is not an intrinsic property of a star; it still contains the "accidental" component of its distance to Earth. What is shown in the diagram is absolute magnitude or another measure of intrinsic luminosity.
5. TRUE: On the main sequence the most massive stars are also the most luminous.
6. TRUE: The mass of a star can be inferred from its orbital parameters if it is part of a binary star system.
7. TRUE: A protostar's high luminosity is due to gravitational energy converted into heat.
8. FALSE: Reflection nebulae are red because of the strong Hydrogen alpha emission line.
Hint: As hinted by the term "alpha emission line", the red alpha line gives emission nebula their red color. Reflection nebulae are blue...
9. TRUE: Comparing Hertzsprung-Russell diagrams for different star clusters provides strong support for our theory of stellar evolution.
10. FALSE: The heavy elements found e.g. on Earth were produced through the alpha-process in the cores of a previous generation of very massive stars.
Hint: All the iron in a very massive star gets eliminated by photodisintegration just prior to the type-II supernova explosion of the star.

Part Two: Essay questions. Please explain your answer in a short (few sentences) essay that you enter into the Blue Book. Each correct and complete answer is worth three points:

1. How are color filters used to measure a star's surface temperature. How many different filters are typically used in that determination?

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Answer: The luminosity is measured through each of the two filters, which gives us the luminosity for the wavelength region of that filter. The difference of the luminosities (measured in magnitudes) for the two wavelength regions provides a measure of the star's surface temperature.

2. How is parallax used to determine the absolute luminosity of nearby stars? Which unit is parallax measured in?

Answer: Parallax is measured in seconds of arc. It provides the distance to the star, which is needed to translate the observed apparent magnitude into an absolute magnitude or other measures of intrinsic luminosity.

3. How does a normal star react to increased energy production at its center and how does electron degeneracy undermine this regulation mechanism?

Answer: As the energy production increases, the plasma inside the star will expand against gravity, cooling in the process and thereby reducing fusion reaction rates and energy production.

4. Why do we assume that the stars in a cluster were all born at about the same time? Why are stars born in clusters?

Answer: The reason here is that they all come from the collapse of the same cloud. Fragmentation of the cloud gives rise to individual stars and their individual masses. But this one process: collapse of the dust cloud, and its subsequent fragmentation, lead to the fact that all the stars in a given cluster are born at about the same time.

5. Novae and type-I supernovae both involve White Dwarfs. As far as the White Dwarf is concerned, what is the main difference between the two types of events? Which one can repeat itself?

Answer: A nova leaves the White Dwarf intact. A single White Dwarf can even produce a whole sequence of novae. The type-I supernova signals the end of the White Dwarf. After the supernova there is no more White Dwarf. A supernova can only occur once. So for the White Dwarf the difference is: One is an episode in its life, the other signals the end of its life.

Grand total: 25 points. Hope you did well!