Astronomy 2115 **Homework #4**

Fall 2023 Due Thursday, Sept 21 in class

For full credit you must write your solutions neatly and include all work. Do not forget the units.

1) Giant molecular clouds are among the largest objects in our Galaxy. Why, then, were they discovered only relatively recently?

2) In the direction of a particular star cluster, interstellar extinction allows only 15% of a star's light to pass through each kiloparsec of the interstellar medium. If the star cluster is 3 kpc away, what percentage of photons reach the Earth?

3) The *Becklin-Neugebauer* object is a newly formed star within the Orion Nebula. It is substantially more luminous that the other newly formed stars in that nebula. Assuming that the star formation started at roughly the same time, what can you conclude about the mass of the BN object compared to the other newly formed stars? Does your conclusion depend on whether or not the stars have reached the main sequence?

4) At one stage during its birth, the protosun had a luminosity of 1000 L_sun and a surface temperature of about 1000 K. At this time, what was its radius? Express your answer in three ways: as a multiple of the Sun's current radius, in kilometers, and in AU.

5) Explain how it is possible for the core of a red giant to contract at the same time that its outer layers expand.

6) Why does helium fusion require much higher temperatures than hydrogen fusion?

7) Explain how and why the turnoff point on the H-R diagram of a cluster is related to the cluster's age.

8) How do astronomers know that globular clusters are made up of old stars?

9) What is the difference between Population I and Population II stars? In what sense can the stars of one population be regarded as the children of the other population?

10) The earliest fossil records indicate that life appeared on Earth about a billion years after the formation of the solar system. What is the most mass that a star could have in order that its lifetime on the main sequence is long enough to permit life to form on one or more of its planets assuming life takes the same amount of time to get going?

11) As a red giant, the Sun's luminosity will be about 2000 times greater than it is now. Calculate the surface temperature of the Earth under these conditions assuming that the Earth is still at 1 AU and that the photosphere of the sun is well within 1 AU. Take the

current average surface temperature of the Earth to be 282 K and don't worry about greenhouse effects.

12) Would you expect the color of a Cepheid variable star to change during the star's oscillation period? If not, why not? If so, why should the color change?

13) The apparent brightness of δ Cephei (a Cepheid variable star) varies with a period of 5.4 days. Its average apparent brightness is 5.1 x 10-13 that of the Sun. How far away is δ Cephei assuming no interstellar extinction?

14) What is the horizontal branch? Where is it located on the H-R diagram? How do stars on the horizontal branch physically differ from red giants or main sequence stars?

15) What is a white dwarf? Does it produce light in the same way as a star like the Sun?

16) Is our own Sun likely to go supernova? Why or why not?