

Physics U111 – Introduction to Astronomy – Fall 2007
Professor Vaughn
Hour exam #3 – 30 November 2007 – answers

A. True or False (2 points each)

1. Sunspots are cooler than the surrounding solar surface. (T)
2. We can learn about the reactions in the core of the Sun by observing the neutrinos that come from the Sun. (T)
3. In the solar radiation zone, energy is carried upward by the hot gas. (F)
4. The radius of the Sun is about 5 times that of Earth. (F)
5. The surface temperature of the Sun is about 6000 K. (T)
6. The energy given off by the Sun is mostly carried by the solar wind. (F)
7. Helium is the most abundant element in the Sun. (F)
8. The nearest star to the Sun is about 1.3 pc away. (T)
9. Our Sun is the only star known to have planets orbiting around it. (F)
10. Star B is brighter than star A. Star A must be further away than star B. (F)
11. A typical white dwarf can be about the size of the Earth. (T)
12. A typical solar mass star will appear as a red giant before it reaches the main sequence. (T)
13. The Sun will spend about ten million years on the main sequence. (F)
14. The distance to a star cluster can be estimated using its H-R diagram. (T)
15. Interstellar matter absorbs red light more strongly than blue. (F)

B. Fill in the blanks. (3 points each)

1. The light we see from the Sun comes from which layer? photosphere.
2. The third magnitude star A appears 250 times brighter than star B. The (apparent) magnitude of star B is 9 (nine).
3. The temperature at the center of the Sun is about (10-20 million K – more precisely, 15.7 million K).
4. The total energy per unit time radiated by a star is called its luminosity.
5. (4 points) H (hydrogen) and He (helium) are the two most abundant elements in the Sun.
6. 21-cm radiation is due to the flip of the electron spin in a H atom.
7. The main constituent of a solar mass star as it leaves the main sequence is He (helium).

C. Multiple choice (3 points each)

1. The most important reason for measuring the parallax of a star is to help us determine the star's
 - a) direction of motion
 - b) proper motion
 - c) radial velocity
 - d) distance from Earth
 - e) apparent brightness
2. What physical property of a star does the spectral type measure?
 - a) luminosity
 - b) mass
 - c) temperature
 - d) age
 - e) radius
3. The temperature required to ignite the p-p chain is about
 - a) ten billion K
 - b) 100 million K
 - c) 600 million K
 - d) one million K
 - e) 10 million K
4. What physical property of the stars in a binary system can be determined from the period of the stars' common orbit and the distance between them?
 - a) age
 - b) distance from Earth
 - c) mass
 - d) absolute brightness
 - e) temperature

D. Questions (6 points each). Explain with words (two or three sentences) and pictures, where suitable, each of the following concepts.

1. (8 points) Describe the proton-proton chain and why it is important.
2. (8 points) Draw a sketch of the Hertzsprung-Russell (H-R) diagram. Label the axes, and show where we might find (i) the main sequence, (ii) red giants, and (iii) white dwarfs.

These two questions are discussed at length in class.

E. Problems – show your work on these (answers alone get no credit)

1. The star Arcturus has a parallax angle of 0.091 arc seconds.

(i) (4 points) How far away is Arcturus (in pc)?

The distance is inversely proportional to the parallax angle, so here we have

$$\text{distance} = (1/0.091) \text{ pc} = 11 \text{ pc}$$

(ii) (4 points) How long does it take for light from Arcturus to reach us?

Since $1 \text{ pc} = 3.26 \text{ light-years}$, light takes $3.26 \times 11 = 35.8 \text{ years}$ to reach us (note that light-year is a *distance*, not a time).

The other two problems are discussed in class.