Astronomy II (Astr 1020)
Fall 2009
Prof Richard Ignace

HOMEWORK #2

Notes:

You will need a calculator, a pencil, and a standard scantron.

Each question has one correct answer. Choose the best answer for each. Mark your answer on the scantron.

This homework is due at the beginning of class on October 22. Late homeworks will not be accepted.

1. Among this list, the most common stars are
   a) A stars
   b) B stars
   c) G stars
   d) M stars
   e) O stars
2. A parsec is
   a) the distance between the Earth and the Sun.
   b) the diameter of the solar system.
   c) the distance light travels in a day.
   d) the distance of an object with a parallax of 1 arcsecond.
   e) the distance between the Sun and the nearest star.
3. Hydrostatic equilibrium is the balance of
   a) pressure and nuclear forces.
   b) gravitational and pressure forces.
   c) magnetic and gravitational forces.
   d) nuclear energy production and radiation loss from the Sun's surface.
   e) None of the above.
4. Star A and Star B have the same luminosity; however, star A is hotter. You can conclude
   a) star A must be closer in distance.
   b) star B must be closer in distance.
   c) star A must be larger in radius.
   d) star B must be larger in radius.
   e) nothing, for it is impossible for two stars to have the same luminosity if they do not have the same temperature.

5. Why would it be easier to measure parallaxes from Pluto than from Earth?
   a) Pluto is closer to other stars than the Earth.
   b) Pluto is colder than the Earth.
   c) Pluto has a lower temperature than the Earth.
   d) Pluto's orbit has a larger semimajor axis than the Earth's orbit.
   e) Pluto's orbit is more stable than the Earth's orbit.
6. If a star is of spectral type M,
   a) it is blue and relatively cool for a star.
   b) it is red and relatively cool for a star.
   c) it is blue and relatively hot for a star.
   d) it is red and relatively hot for a star.
   e) its spectral type is not related to its color or temperature.
7. Cool star spectra can show absorption features from molecules but not so for hot star spectra. Why?
   a) Hot stars lack the right kinds of elements to form molecules.
   b) Molecules cannot survive at high temperature because they become dissociated.
   c) Cool stars lack hydrogen so that molecules are easier to form.
   d) Hot stars have too much hydrogen to form molecules.
   e) Spectral features of molecules in hot star atmospheres are present only as emission lines, not absorption lines.
8. How did the gas in the cold interstellar cloud that became the Sun get hot enough for nuclear fusion?
   a) Gravity compressed the gas.
   b) Chemical reactions released energy.
   c) The proton-proton chain released energy.
   d) The CNO cycle released energy.
9. The energy source for a protostar is
   a) the proton-proton chain.
   b) the CNO cycle.
   c) the triple-alpha process.
   d) gravitational contraction.
10. You observe an eclipsing binary star. Suppose that both stars have exactly the same radius, and the system is seen exactly edge-on. When the faint star is in front, the brightness of the system drops by 67%. When the bright star is in front, the brightness of the system drops by 33%. How then does the luminosity of the bright star (#1) compare to the faint star (#2)? (So find the ratio of L_1/L_2. It helps to sketch the light curve.)
    a) $L_1 = 4L_2$
    b) $L_1 = 2L_2$
    c) $L_1 = L_2$
    d) $L_2 = 2L_1$
    e) $L_2 = 4L_1$

11. How are stellar masses determined from visual binaries?

    a) Use orbital period and orbital velocity along with Newton's 1st law.
    b) Use orbital period and orbital velocity along with Kirchoff's 1st law.
    c) Use orbital period and orbit size along with Kepler's 3rd law.
    d) Use orbital period and orbit size along with Hooke's law.

12. For a star that is 8 times more massive than the Sun, how will its expected Main Sequence lifetime compare to the Sun?

    a) About 8 times longer
    b) About 8 times shorter
    c) About the same
    d) About 64 times shorter
    e) About 64 times longer

13. Massive stars (say, greater than a solar mass) have more fuel to burn than stars like the Sun. Why, then, do they not live as long?

    a) They tend to have more heavy elements, and so they begin fusing Iron more rapidly.
    b) That's not true. The more fuel a star has, the longer it will live.
    c) Since massive stars tend to form later, they form with proportionally less Hydrogen.
    d) Because of their higher core temperatures, they use up their fuel much more rapidly.

14. Why does the fusion of Iron in the core of a star signal the beginning of a supernova?

    a) Because when two iron atoms meet, they will fuse to form radioactive Uranium, effectively making the stellar core a giant fission bomb.
    b) Iron fusion releases a tremendous amount of energy, causing the star to blow itself apart.
    c) Iron is a catalyst, causing reactions to take place at an accelerated rate, resulting in an explosive release of energy.
    d) Because by this time the star is so hot, it can't hold itself together.
    e) Iron fusion actually takes away energy from the core, causing it to collapse and then rebound, resulting in a supernova explosion.

15. Stars of all masses can burn

    a) iron.
    b) oxygen.
    c) carbon.
    d) helium.
    e) sodium.

16. Why do we say a solar-like star has run out of fuel after it has only used up about 10% of its total mass of Hydrogen?

    a) Because stars are only hot enough to fuse Hydrogen in the very center, a region that holds only about 10% of the star's mass.
    b) Because it isn't able to fuse anything heavier than Hydrogen.
    c) Because stars are only hot enough to fuse Hydrogen in the atmosphere, a region that holds only about 10% of the star's mass.
    d) If a star released more than 10% of its total mass as energy, it would blow itself apart.

17. Consider a person with 100 kg of mass. If all of this were converted to energy via $E = mc^2$, how long could a 100 Watt bulb be powered? (Use $c = 3 \times 10^8$ m/s, then energy will be in Joules. Since Watts is Joules per second, your answer will be in seconds. Convert to years.)

    a) 2.9 billion years
    b) 9×10^{16} years
    c) 100 years
    d) 9×10^{18} years
    e) 29 million years

18. A planetary nebula is

    a) a nebula within which planets are forming
    b) produced by a supernova explosion
    c) a cloud of hot gas surrounding a planet
    d) the expelled outer envelope of a low mass star

19. The Sun has an equatorial rotation speed of about 2 km/sec, but many stars rotate much faster. If the Sun rotates once in 25 days, what is the rotation speed of a star of the same radius that rotates once in 15 hours?

    a) 3 km/s
    b) 30 km/s
    c) 80 km/s
    d) 2 km/s
    e) 12 km/s

20. Low mass stars have longer main-sequence lifetimes than high mass stars because

    a) they are much less luminous than high mass stars.
    b) they have a much higher abundance of hydrogen than high mass stars.
    c) only low mass stars are in hydrostatic equilibrium.
    d) The statement is false. High mass stars have more hydrogen and therefore have longer main-sequence lifetimes.

21. The final evolutionary state for a low mass star like the Sun is

   a) a supernova.
   b) the main sequence.
   c) a white dwarf.
   d) a neutron star.
   e) a black hole.

22. Which of these stars is most likely to end up as a Black Hole?

   a) 0.5 solar mass star
   b) 1 solar mass star
   c) 5 solar mass star
   d) 20 solar mass star

23. If the Sun were replaced by a black hole of the same mass,

   a) the Earth would spiral into the black hole over the next 1000 years
   b) the Earth would continue to orbit pretty much as it does now
   c) the Earth would fall directly towards the black hole
   d) a great sucking sound would be heard

24. Identifying a black hole involves searching for

   a) pulsars with periods less than one millisecond
   b) pulsars that are orbited by planets
   c) large spherical regions where no light is detected
   d) x-ray binaries where the compact companion has a mass in excess of 3 solar masses
   e) single stars that emit large amounts of high-energy radiation