Astr 01 **HW 12: Stellar Evolution** Name_____

Show ALL work for full credit. Each problem 2 pts unless otherwise noted.

1) A star (no matter what its mass) spends most of its life
   A) as a red giant or supergiant.
   B) as a protostar.
   C) as a T–Tauri variable star.
   D) as a main–sequence star.
   E) as a planetary nebula.

2) We find most stars still on the main sequence because this stage takes _____.

3) When a star's inward gravity and outward pressure are balanced, the star is said to be
   A) in rotational equilibrium.
   B) in gravitational collapse.
   C) a stage 2 protostar.
   D) in thermal expansion.
   E) in hydrostatic equilibrium.

4) A solar–mass star will evolve off the main sequence when
   A) it explodes as a violent nova.
   B) it builds up a core of inert helium.
   C) it loses all its neutrinos, so fusion must cease.
   D) it completely runs out of hydrogen.
   E) it expels a planetary nebula to cool off and release radiation.

5) What temperature is needed to fuse helium into carbon?
   A) 5,800 K
   B) 100,000 K
   C) 15 million K
   D) 100 million K
   E) one billion K

6) When a low mass star first runs short of hydrogen in its core, it becomes brighter because
   A) its outer, cooler layers are shed, and we see the brighter central core.
   B) it explodes as a nova.
   C) the core contracts, raising the temperature and extending the hydrogen burning shell outward.
   D) the helium flash increases the size of the star immensely.
   E) helium fusion gives off more energy than does hydrogen.

7) The helium flash converts helium nuclei into
   A) beryllium. B) iron. C) boron. D) oxygen. E) carbon.

8) A star on the red giant branch has a core about the size of _____.

9) The helium flash requires a core temperature of _____ K to create carbon.

10) During the red giant phase, a star's mass _____.

11) A surface explosion on a white dwarf, caused by falling matter from the atmosphere of its binary companion, creates what kind of object?

A) black dwarf
B) brown dwarf
C) nova
D) Type I supernova
E) Type II supernova

12) Our Sun will first become a red giant, then a white dwarf, and finally a brown dwarf.

13) Compared to our Sun, a typical white dwarf has

A) about the same mass and a million times higher density.
B) a smaller mass and half the density.
C) about the same mass and density.
D) a larger mass and a hundred times lower density.
E) a smaller mass and twice the density.

14) Under what conditions will a nova occur?

15) Black dwarfs are

A) rare, for few binary systems are close enough for this merger to happen.
B) often made from very low mass protostars that never fuse hydrogen.
C) very common, making up the majority of the dark matter in the universe.
D) rare, for collapsing cores of over three solar masses are uncommon.
E) not found yet; the oldest, coldest white dwarf in the Galaxy has not cooled enough yet.

16) Virtually all the carbon–rich dust in the plane of the galaxy originated in

A) high–mass stars.
B) low–mass stars.
C) brown dwarfs.
D) white dwarfs.
E) planetary nebulae.

17) What element are white dwarfs made of? Why?

18) Of the elements in your body, the only one not formed in stars is

A) hydrogen. B) oxygen. C) iron. D) calcium. E) carbon.

19) How are elements heavier than iron made? Why are they rare?

20) Contrast the deaths of low– versus high–mass stars.

21) Our Sun will likely die as a Type I supernova in about five billion years.

22) A massive star can fuse only up to the element silicon in its core.

23) Gold is rare since the only time it can be formed is during a supernova.

24) Type II supernovae occur when their cores start making
A) oxygen. B) carbon. C) iron. D) uranium. E) silicon.

25) The heaviest nuclei of all are formed
A) in the core collapse that sets the stage for Type II supernovae.
B) in the horizontal branch.
C) in the ejection of matter in the planetary nebula.
D) during nova explosions.
E) in dense white dwarfs.

26) A recurring nova might eventually build up enough mass to become a Type _____ supernova.

27) Noting the main sequence turnoff mass in a star cluster allows you to determine its
A) distance.
B) radial velocity.
C) number of stars.
D) age.
E) total mass.

28) Stars of types _____ and _____ are found only in the youngest star clusters.

29) Globular clusters are dominated by bright red supergiants at the top right of the H–R diagram.

30) Of the main sequence stars, those of type _____ have the longest main–sequence life spans.
A) B B) K C) O D) G E) M

31) Knowing a cluster's turn–off mass tells you the cluster's _____.