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

1) What happens to light passing through even thin clouds of dust?
    A) Even a little can completely block all light, such as the Horsehead Nebula.
    B) It dims and reddens the light of all more distant stars.
    C) Its motion causes all light to be redshifted as it passes through these clouds.
    D) The light that passes through them is blueshifted due to the cloud's approach.
    E) Its motion causes the light of stars beyond to twinkle.

2) Of all forms of electromagnetic energy, _____ radiation gives us the least access to our entire Milky Way
    Galaxy.
    A) ultraviolet   B) visible light   C) X–ray   D) radio   E) infrared

3) Light from distant stars that must pass through dust arrives bluer than when it left its star.

4) There is as much mass in the voids between the stars as in the stars themselves.

5) The density of interstellar dust is very low, yet it still blocks starlight because
    A) ice particles reflect all light back toward their stars, not toward us.
    B) the dust particles are irregular in shape.
    C) it is so cold it absorbs higher energy photons.
    D) there is 100 times more opaque gas than dust present in the interstellar medium.
    E) the dust particles are about the same size as the light waves they absorb.

6) Neutral hydrogen clouds appear _____ when viewed visually.

7) A region of ionized gas and dust, with imbedded hot young stars, is a(n)
    A) nebular hole.
    B) dark nebula.
    C) emission nebula.
    D) dust cloud.
    E) absorption nebula.

8) Almost all of the complex molecules found in space are based on _____ atoms.
    A) hydrogen   B) carbon   C) silicon   D) oxygen   E) iron

9) Emission nebulae occur only near stars that emit large amounts of _____ electromagnetic radiation.
    A) visible light   B) radio   C) infrared   D) ultraviolet   E) X–ray

10) Emission nebulae get their red color from the red supergiants forming in them.

11) Why does a reflection nebula look blue?

12) Dark dust clouds are optically invisible, but give off radio energy.

13) Neutral hydrogen can be detected because its electron occasionally _____ its spin and creates the 21-cm emission line for radio observers.

14) Molecules are found only in the _____ clouds of the interstellar medium.

15) What is the temperature of the gas in the dark dust clouds, and why is this important to molecule formation?

16) What information does 21-cm radiation provide about the gas clouds?
    A) their temperature
    B) their density
    C) their motion
    D) their distribution
    E) all of the above

17) Interstellar dust clouds are *best* observed at what wavelength?
    A) radio and X-ray
    B) visible and UV
    C) visible only
    D) radio and infrared
    E) UV and infrared

18) The interstellar gas in our portion of the Galaxy is about _____ K in temperature.
    A) 10   B) 100   C) 1,000   D) 10,000   E) 100,000

19) At what core temperature does hydrogen begin to fuse to helium?
    A) 3,000 K
    B) 5,800 K
    C) 1 million K
    D) 10 million K
    E) 100 million K

20) A photosphere appears on a protostar near the end of stage
    A) 1.   B) 2.   C) 3.   D) 6.   E) 7.

21) Stars evolve along the main sequence.

22) What is the critical temperature for stage 7; why?

23) Which statement about the stages of starbirth is false?
    A) Nuclear reactions begin in the core by stage 4.
    B) The T–Tauri wind is prevalent in stage 5.
    C) At stage 1, only the cloud exists.
    D) By stage 7, the star has reached the main sequence.
    E) By stage 3, the star has formed a photosphere.

24) Why is infrared much better than visible light in studying star formation?

25) Most stars in our part of the Galaxy are formed
    A) in associations of thousands of stars across a spiral arm of the Galaxy.
    B) in globular clusters of millions of stars.
    C) in a singular event just after the Big Bang.
    D) alone.
    E) in open clusters of a few dozen.

26) The single most important determinant of the temperature, density, radius, luminosity, and pace of evolution of a protostar is its
    A) spin.
    B) magnetic field.
    C) mass.
    D) chemical composition.
    E) molecular composition.

27) A cloud fragment too small to collapse into a main sequence star becomes a
    A) brown dwarf.
    B) white dwarf.
    C) T–Tauri object.
    D) pulsar.
    E) planet of another star.

28) Approximately how many brown dwarfs are believed to exist in the Milky Way galaxy?
    A) 100,000
    B) one million
    C) one billion
    D) one hundred billion
    E) ten trillion

29) Jupiter and the Sun have almost the same composition and density; why isn't Jupiter also a star?

30) The Pleiades (or Seven Sisters) an example of a(n) _____ cluster.

31) In typical globular clusters, the brightest stars are _____.

32) All globular clusters in our Milky Way are about how old?
    A) one to three billion years old
    B) around ten billion years old
    C) a variety of ages, from newly born to twenty billions years old
    D) ten to fifty million years old
    E) less than a million years

33) A star cluster with a lot of hot, blue stars must be relatively young.

34) Compared to an open cluster, a globular cluster will have more hot, blue stars.

35) Why are star clusters ideal sites to study stellar evolution?

36) Contrast open and globular star clusters.