1. The distances to the most remote galaxies can be determined using:

   a) galactic parallax.
   b) spectroscopic parallax.
   c) proper motion.
   d) Cepheids.
   e) **none of the above.**

2. Generally stars that have low metallicities are considered to be:

   a) near the end of their lives.
   b) very young.
   c) **very old.**
   d) a, b, or c — it's impossible to say.

3. The evidence for the small size of quasars comes from:

   a) the amount of energy they release.
   b) their distance from us.
   c) **the rapidity of their luminosity changes.**
   d) comparison with Cepheid variables.
   e) the magnitude of their redshift.

4. Which of the following stages will the Sun definitely go through as it gets older?

   a) red giant.
   b) source of a planetary nebula.
   c) white dwarf.
   d) black dwarf.
   e) **all of the above.**

5. A star whose temperature is increasing but whose luminosity is roughly constant moves in what direction on the H-R diagram?

   a) to the right.
   b) **to the left.**
   c) upwards.
   d) downwards.
   e) none of the above, the star doesn't move on the H-R diagram.

6. Which type of galaxy is observed to contain mostly older stars?

   a) spiral
   b) **elliptical**
   c) dwarf elliptical
   d) irregular
   e) none of the above

7. What remains after a supernova?

   a) a main sequence star.

b) a white dwarf.
c) a neutron star.
d) a black hole.
e) **either c) or d), depending on the mass of the star.**

8. The Andromeda Galaxy (our nearest spiral neighbour) has spectral lines that show a blue shift. From this we may conclude that:

a) the universe is no longer expanding.
b) **The particular galaxy is moving towards us.**
c) This galaxy has merged with the Milky Way and is now a part of it.
d) This particular galaxy is moving away from us.
e) This galaxy has an unusual number of very bright and blue (i.e. hot) stars in it.

9. What is the difference between the sun and a one solar mass white dwarf?

a) the sun has a larger radius.
b) the sun has more hydrogen.
c) they have different energy sources.
d) **all of the above.**
e) a) and c) above.

10. In a flat universe (where the density equals the critical density), the curvature of the universe:

a) is positive
b) **is zero**
c) is negative
d) is undefined
e) is infinite

11. Which of the following is the most common type of star?

a) white dwarf
b) red giant
c) **main sequence**
d) supergiants
e) none of the above

12. What does the Hubble constant measure?

a) The age of galaxies.
b) How light gets fainter with increasing distance.
c) The curvature of spacetime.
d) The average density of the Universe.
e) **The rate of expansion of the Universe.**

13. What is the single most important characteristic in determining the course of a star's evolution?

a) luminosity
b) distance

c) surface temperature
d) mass
e) chemical composition

14. Which of the following are true for the cosmic microwave background radiation?

a) It implies that the Universe began in a hot, dense state.
b) Its spectrum matches that for a blackbody at a temperature of 2.7 K.
c) Its spectrum contains many absorption lines.
d) All of the above.
e) a) and b) are correct.

15. Pulsars are known to be

a) pulsating white dwarfs.
b) pulsating neutron stars.
c) rotating white dwarfs.
d) rotating neutron stars.
e) rotating black holes.

16. Which of the following is NOT found in the Galaxy's disk?

a) young star clusters
b) O and B stars
c) globular clusters
d) emission nebulae
e) dust lanes

17. Some regions of the Milky Way appear dark because:
a) there are no stars there.
b) stars in that direction are obscured by interstellar gas.
c) stars in that direction are obscured by interstellar dust.
d) there are numerous black holes that capture all the star light behind them.
e) the Milky Way is full of holes.

18. According to the Big Bang model:

a) the Universe expanded from a hot, dense state.
b) radiation fills the Universe.
c) matter formed from radiation.
d) all of the above.
e) a) and c) are correct.

19. Nearly all the elements found in our environment were formed inside of stars. The major exceptions are:

a) iron and nickel.
b) oxygen and carbon.
c) hydrogen and helium.

d) silver and technetium.
e) gold and platinum.

20. What effect does dust have on visible light passing through it?

a) it completely blocks all visible light from passing through.
b) **it dims and reddens it.**
c) all light is turned bluish in colour.
d) it makes the light coming from stars appear to twinkle.
e) it has no effect.

21. What is a planetary nebula?

a) a planet surrounded by a glowing shell of gas.
b) the disc of gas and dust surrounding a young star that will soon form a solar system.
c) **the ejected envelope of a red giant star surrounding a stellar core remnant.**
d) a type of young, medium mass star.
e) a planet surrounded by a cool shell of molecular gas.

22. How does comparing the H-R diagram of different open and globular clusters confirm astronomers' general ideas about stellar evolution?

a) The diagrams for different clusters are all the same.
b) The diagrams indicate that all stars have the same age.
c) **The diagrams show that the top end of the main sequence turns off at different points, indicating that more massive stars evolve faster.**
d) The diagrams show the observed path that stars take through space.

23. The heaviest element that can be created in stellar fusion (i.e. whose creation also releases energy) is:

a) uranium.
b) **iron.**
c) helium.
d) carbon.
e) silicon.

24. Basically, stars evolve because they:

a) are made of hydrogen.
b) are gases.
c) **lose energy via radiation.**
d) are larger then planets.
e) get bored with the status quo.

25. O and B type stars (i.e. recently formed, massive stars) are most commonly found in:

a) elliptical galaxies
b) irregular galaxies.
c) **the arms of spiral galaxies.**
d) galaxies of all type.
e) globular clusters.

26. H-R diagrams of very young clusters of stars:

   a) have all their stars on the main sequence.
   b) **Have only their high mass stars on the main sequence while the low-mass protostars are still contracting (and hence are not on the main sequence yet).**
   c) Have only their low mass stars on the main sequence while the high-mass protostars are still contracting (and hence are not on the main sequence yet).
   d) Have only giant stars and white dwarfs.

27. A supernova is produced when:

   a) any star reaches the carbon fusion limit.
   b) **the collapse of a star's iron nucleus causes a shock wave that "blows off" the envelope of the star.**
   c) an O and B main sequence star evolves explosively to the red supergiant stage.
   d) an intermediate mass star reaches the "helium flash" stage in its evolution.

28. The basic property of the molecular cloud that causes it to collapse and form a star is:

   a) **its own gravitational forces.**
   b) the pressure from surrounding clouds.
   c) nuclear forces that are as yet not understood.
   d) gas pressure forces and turbulence that tend to make such clouds condense.

29. What is the expected total main sequence lifetime of the Sun?

   a) about 4.6 billion years.
   b) about 1 billion years.
   c) **about 10 billion years.**
   d) about 100 billion years.
   e) it's impossible to calculate the lifetime of the Sun.

30. Which one of the following is the primary difference between the observed spectra of most stars?

   a) the presence or absence of a continuous spectrum.
   b) **the differing strengths and patterns of absorption lines.**
   c) the differing strengths and patterns of emission lines.
   d) spectra of all stars have approximately the same appearance.

31. An H-R diagram is a plot of

   a) heat versus radius.
   b) luminosity versus radius.
   c) mass versus temperature.
   d) **luminosity versus temperature.**
   e) mass versus luminosity.

32. Stars that are more luminous and cooler than the Sun

   a) have smaller radii than the Sun.

b) have radii equal to that of the Sun.
c) **have larger radii than the Sun.**
d) are white dwarfs.

33. Cepheid variable stars are important to astronomy primarily because they allow us to determine stellar

a) **distance.**
b) mass.
c) temperature.
d) pulsation period.

34. What are the two most important intrinsic properties used to classify stars?

a) luminosity and distance.
b) **luminosity and surface temperature.**
c) distance and surface temperature.
d) distance and colour.
e) colour and surface temperature.

35. Which one of the following is the most complete statement of the Cosmological Principle?

a) **Dwarf star of spectral class G.**
b) Main sequence star of spectral class O.
c) Giant star of spectral class K.
d) White dwarf star of spectral class A.
e) Dwarf star of spectral class M.

36. A black hole is really

a) densely packed matter.
b) at the centre of most stars and provides the star's energy.
c) a black star of temperature 0 K.
d) **strongly curved space.**

37. Which of the following is the Hubble Law?

a) The more distant a galaxy is, the younger is appears.
b) Most galaxies belong to a cluster; most clusters are part of a super cluster.
c) On large scales, the Universe appears the same to all observers.
d) **The greater the distance to a galaxy, the greater its recession velocity.**
e) The greater the distance to a galaxy, the fainter it is.

38. When a massive star's core hydrogen is depleted:

a) the star cools and eventually ceases to radiate.
b) **the core contracts and its temperature increases to the point where higher order reactions can occur.**
c) the core collapses, explodes and produces a planetary nebula.
d) the core collapses, explodes, and produces a supernova.
e) nothing happens.

39. A galaxy is at a distance of one billion light years. Which of the following is true?

    a) We see the galaxy the way it will be in one billion years.
    b) **We see the galaxy the way it was one billion years ago.**
    c) We see the galaxy the way it was when the Universe was one billion years old.
    d) We see what our galaxy will be like in one billion years.

40. The observed difference between stellar spectra are caused primarily by differences in

    a) luminosity.
    b) chemical composition.
    c) **temperature.**
    d) motions.
    e) locations in space.

41. Because all of the distant galaxies are redshifted, we know that:

    a) We are at the centre of the Universe.
    b) **The Universe is expanding.**
    c) The sky is dark at night.
    d) all of the above.
    e) none of the above.

42. A star spends most of its life:

    a) as a protostar.
    b) in explosions lasting millions of years.
    c) as a red giant or supergiant.
    d) **as a main sequence star.**

43. The redshift of galaxies in the Universe is correctly interpreted as:

    a) A Doppler shift due to the motions of the galaxies through space.
    b) An "aging" of the light.
    c) **Space itself is expanding with time; the wavelengths of photons are stretched while they travel through space.**
    d) The difference in temperatures of distant and nearby galaxies.
    e) Photons shifting their frequency due to the presence of dark matter.

44. The fact that the cosmic microwave background has almost exactly the same spectrum in all directions in the sky is evidence that the Universe is:

    a) **isotropic.**
    b) expanding.
    c) redshifted.
    d) filled with dust clouds.
    e) filled with stars.

45. What characteristic of a star cluster is used to determine its age?

a) the number of red giants.
b) the faintest stars in the cluster.
c) **the main sequence turnoff.**
d) the cluster birth certificate.
e) the total number of stars in the cluster.

46. The rotation curve of the Galaxy:

a) is a plot of rotation velocity versus distance from the galactic centre.
b) indicates that the Galaxy could be imbedded in a halo of dark matter.
c) shows that at large distances from the galactic centre, i.e. beyond the Sun's distance, objects are orbiting faster than theory predicts.
d) **all of the above.**
e) a) and c) are correct.

47. Which statement is true, in terms of stellar evolution?

a) sooner or later, gravity loses.
b) **sooner or later, gravity wins.**
c) sometimes gravity wins and sometimes gravity loses.
d) gravity lets up under certain circumstances.
e) it's not whether you win or lose, it's how you play the same.

48. Where in the sun does fusion of hydrogen occur?

a) only near the surface.
b) **only in the core.**
c) anywhere in the sun.
d) only in convective gas layers.

49. The region around a black hole where everything is trapped, and nothing can get out to the rest of the universe, is called:

a) the singularity.
b) the neutron star radius.
c) the gravitational redshift zone.
d) the Hawking radius.
e) **the event horizon.**