1) The appearance of the great range of brightness among stars is due to
A) only to the differences in the amount of light different stars emit.
B) only to the differences in the distances of stars from us.
C) both of the differences indicated above.
D) none of the above answers.

2) Four different main–sequence stars are colored blue, orange, red, and yellow. What is their rank from coolest to hottest?
A) red, yellow, orange, blue
B) orange, blue, yellow, red
C) red, orange, yellow, blue
D) blue, yellow, orange, red

3) A Hertzsprung–Russell diagram shows stars on a plot of
A) luminosity vs. distance.
B) apparent brightness vs. temperature.
C) luminosity vs. temperature.
D) magnitude vs. apparent brightness.

4) A white dwarf star with a mass equal to that of the sun is about the size of
A) a proton.
B) the sun.
C) the earth.
D) a basketball.

5) In terms of the mass M of our sun, what is the Chandrasekhar limit of stellar mass, below which a star will eventually collapse into a white dwarf?
A) 0.8 M
B) 1.4 M
C) 1.2 M
D) 1.9 M

6) Many supernovas are thought to result in
A) white dwarfs.
B) red giant stars.
C) regular stars like our sun.
D) neutron stars.

7) Black holes
A) are the collapsed remnant of giant stars.
B) are gaps in space, containing no matter.
C) cannot be detected in binary star systems.
D) are predicted by Einstein's special theory of relativity.
E) are a violation of Einstein's general theory of relativity.

8) Pulsars are rapidly spinning
A) white dwarfs.
B) neutron stars.
C) regular stars like our sun.
D) red giant stars.

9) Stars A and B are both black holes but have different masses. If the mass of star A is twice as much as the mass of star B, the average density of star A, compared to the average density of star B will be
A) four times as much.
B) the same.
C) half as much.
D) one–fourth as much.
E) twice as much.

10) When a distant source emits light of a particular wavelength in the visible, and the source is moving away from us, the color of the light appears to us to be shifted toward the
A) blue end of the visible spectrum.
B) red end of the visible spectrum.

11) The cosmic background radiation corresponds to a temperature of about
A) 2.7 K. B) 20 K. C) 1.4 K. D) 8.0 K.

12) Suppose a 70-kg student were to be compressed to form a black hole. What would be the Schwarzschild radius of this black hole? ($G = 6.67 \times 10^{-11}\ \mathrm{N \cdot m^2/kg^2}$, $c = 3.0 \times 10^{8}$ m/s)

13) To what radius would the sun have to be compressed in order for it to become a black hole? The mass of the sun is 1.99×10^{30} kg, $G = 6.67 \times 10^{-11}\ \mathrm{N \cdot m^2/kg^2}$, and $c = 3.00 \times 10^{8}$ m/s

14) The sun has apparent brightness B at the earth, which is 1.5×10^{8} km away. What would be the apparent brightness of the sun at Pluto, which is 6.0×10^{9} km from the sun?

15) What is the parallax angle for Proxima Centauri, which is Earth's nearest star at 4.3 ly? The earth's orbit has a mean radius of 1.5×10^{8} km, and 1 ly = 9.46×10^{15} m.

16) The apparent brightness of a star is $1.0 \times 10^{-12}\ \mathrm{W/m^2}$ and the peak wavelength in its light is 600 nm. Assuming it is the same size as our sun and that it radiates like an ideal blackbody, estimate its distance from us, in parsecs. The constant in Wien's law is 0.00290 m • K, and 1 parsec is equal to 3.09×10^{16} m.
($R_{sun} = 6.96 \times 108$ m, $\sigma = 5.67 \times 10^{-8}\ \dfrac{\mathrm{W}}{\mathrm{m^2 \cdot K^4}}$)

17) It can be shown that the approximate age of the universe is $1/H$, where H is the Hubble constant. Taking $H = 20\ \dfrac{\mathrm{km/s}}{\mathrm{Mly}}$, estimate the age of the universe, in years. (1 ly = 9.46×10^{15} m)

18) If a galaxy is moving away from us at 1.0% of the speed of light, how far away is it from us if $H = 20\ \dfrac{\mathrm{km/s}}{\mathrm{Mly}}$?

($c = 3.00 \times 10^{8}$ m/s)

19) Estimate the speed of recession of a galaxy that is 10 billion light-years away if $H = 20\ \dfrac{\mathrm{km/s}}{\mathrm{Mly}}$?

($c = 3.00 \times 10^{8}$ m/s)

20) Estimate the observed wavelength for the 656 nm line in the spectrum of a star which is 100 million light-years from us if $H = 20\ \dfrac{\mathrm{km/s}}{\mathrm{Mly}}$? ($c = 3.00 \times 10^{8}$ m/s)

21) About 1 μs after the Big Bang, the temperature of the universe was about 10^{13} K. What particle kinetic energy (in eV) does this correspond to? (1 eV = 1.60×10^{-19} J, $k = 1.38 \times 10^{-23}$ J/K)

1) C
2) C
3) C
4) C
5) B
6) D
7) A
8) B
9) D
10) B
11) A
12) 1.0×10^{-25} m
13) 2950 m
14) 0.00063 B
15) 2.1×10^{-4} degrees
16) 120 pc
17) 15 billion years
18) 150 million ly
19) 0.7c
20) 660 nm
21) 1 GeV