Physics: Principle and Applications, **7e (Giancoli)**
Chapter 33   Astrophysics and Cosmology

33.1   Conceptual Questions

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.
Answer: C
Var: 1

2) Four different main-sequence stars are colored blue, orange, red, and yellow. What is their
rank from coolest to hottest?
A) blue, yellow, orange, red
B) orange, blue, yellow, red
C) red, orange, yellow, blue
D) red, yellow, orange, blue
Answer: C
Var: 1

3) A Hertzsprung-Russell diagram shows stars on a plot of
A) apparent brightness vs. temperature.
B) luminosity vs. temperature.
C) luminosity vs. distance.
D) magnitude vs. apparent brightness.
Answer: B
Var: 1

4) A white dwarf star with a mass equal to that of the sun is about the size of
A) the sun.
B) the earth.
C) a basketball.
D) a proton.
Answer: B
Var: 1

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) 1.2 M
C) 1.4 M
D) 1.9 M
Answer: C
Var: 1

6) Many supernovas are thought to result in
A) neutron stars.
B) red giant stars.
C) regular stars like our sun.
D) white dwarfs.
Answer: A
Var: 1

7) Black holes
A) are gaps in space, containing no matter.
B) are predicted by Einstein's special theory of relativity.
C) are the collapsed remnant of giant stars.
D) cannot be detected in binary star systems.
E) are a violation of Einstein's general theory of relativity.
Answer: C
Var: 1

8) Pulsars are rapidly spinning
A) regular stars like our sun.
B) red giant stars.
C) neutron stars.
D) white dwarfs.
Answer: C
Var: 1

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) the same.
B) twice as much.
C) half as much.
D) four times as much.
E) one-fourth as much.
Answer: E
Var: 1

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) red end of the visible spectrum.
B) blue end of the visible spectrum.
Answer: A
Var: 1

11) The cosmic background radiation corresponds to a temperature of about
A) 1.4 K.
B) 2.7 K.
C) 8.0 K.
D) 20 K.
Answer: B
Var: 1

33.2 Problems

1) Suppose a 70-kg student were to be compressed to form a black hole. What would be the Schwarzschild radius of this black hole? ($G = 6.67 \times 10^{-11}$ N · m^2/kg^2, $c = 3.0 \times 10^8$ m/s)
Answer: 1.0×10^{-25} m
Var: 1

2) 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, $G = 6.67 \times 10^{-11}$ N · m^2/kg^2, and $c = 3.00 \times 10^8$ m/s
A) 2950 m
B) 1470 m
C) 6.96×10^8 m
D) 2.66×10^6 m
E) 3.72×10^4 m
Answer: A
Var: 1

3) What mass would have to be compressed to a radius of 1.0×10^{-15} m (the order of magnitude of the radius of an atomic nucleus) in order for it to become a black hole? ($G = 6.67 \times 10^{-11}$ N · m^2/kg^2, $c = 3.0 \times 10^8$ m/s)
A) 1.1×10^{-6} kg
B) 4.1×10^{-8} kg
C) 2.2×10^3 kg
D) 6.7×10^{11} kg
E) 8.3×10^{15} kg
Answer: D
Var: 1

4) 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?
A) 0.25 B
B) 0.063 B
C) 0.025 B
D) 0.00063 B
Answer: D
Var: 3

5) A star has absolute luminosity equal to that of the sun but is 10 pc away from the Earth. By what factor will it appear dimmer than the sun? The earth is 1.5×10^8 km from the sun, and 1 parsec is equal to 3.09×10^{16} m.
A) 2×10^{-9}
B) 2×10^{-11}
C) 2×10^{-13}
D) 2×10^{-15}

Answer: C
Var: 1

6) The earth's orbit has a mean radius of 1.5×10^8 km. Over a six-month period, the apparent position of a particular star varies by 0.00014° due to parallax. How many kilometers is this star from Earth?
A) 1.2×10^{11} km
B) 1.2×10^{14} km
C) 1.2×10^{17} km
D) 1.2×10^{20} km
Answer: B
Var: 1

7) The earth's orbit has a mean radius of 1.5×10^8 km. Over a six-month period, the apparent position of a particular star varies by 0.00014° due to parallax. How many light-years is this star from Earth? (1 ly $= 9.46 \times 10^{15}$ m)
A) 0.13 ly
B) 1.3 ly
C) 13 ly
D) 130 ly
Answer: C
Var: 1

8) 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 $= 9.46 \times 10^{15}$ m.
A) 1.2×10^{-14} degrees
B) 2.1×10^{-4} degrees
C) 1.2×10^{-7} degrees
D) 2.1×10^{-7} degrees
Answer: B
Var: 1

9) The apparent brightness of a star is 1.0×10^{-12} 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. ($R_{sun} = 6.96 \times 10^8$ m, $\sigma = 5.67 \times 10^{-8} \frac{W}{m^2 \cdot K^4}$)

A) 1.2 pc
B) 12 pc
C) 120 pc
D) 1200 pc
Answer: C
Var: 1

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

A) 15 thousand years
B) 15 million years
C) 15 billion years
D) 50 billion years
Answer: C
Var: 1

11) If a galaxy is moving away from us at 1.0% of the speed of light, how far away is it from us if $H = 20 \frac{km/s}{Mly}$? ($c = 3.00 \times 10^8$ m/s)

A) 150 ly
B) 150 thousand ly
C) 150 million ly
D) 200 million ly
E) 150 billion ly
Answer: C
Var: 1

12) Estimate the speed of recession of a galaxy that is 10 billion light-years away if $H = 20 \frac{km/s}{Mly}$? ($c = 3.00 \times 10^8$ m/s)
A) 0.1c
B) 0.3c
C) 0.5c
D) 0.7c
Answer: D
Var: 1

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

A) 620 nm
B) 640 nm
C) 660 nm
D) 690 nm
Answer: C
Var: 1

14) 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? $(1 \text{ eV} = 1.60 \times 10^{-19} \text{ J}, k = 1.38 \times 10^{-23} \text{ J/K})$

A) 1 keV
B) 1 MeV
C) 1 GeV
D) 1 TeV
Answer: C
Var: 1