Multiple choice test questions 2, Winter Semester 2015. Based on parts covered after mid term. Essentially on Ch. 12-2.3,13.1-3,14,16.1-2,17,18.1-2,4,19.5. You may use a calculator and the "useful formulae and numbers" from the corresponding document with test problems.

1) If the distance between us and a star is doubled, with everything else remaining the same, its luminosity
A) is decreased by a factor of four, and its apparent brightness is decreased by a factor of four.
B) is decreased by a factor of two, and its apparent brightness is decreased by a factor of two.
C) remains the same, but its apparent brightness is decreased by a factor of two.
D) remains the same, but its apparent brightness is decreased by a factor of four.
E) is decreased by a factor of four, but its apparent brightness remains the same.

2) On a Hertzsprung-Russell diagram, where would you find red giant stars?
A) upper right
B) lower right
C) upper left
D) lower left

3) On a Hertzsprung-Russell diagram, where on the main sequence would you find stars that have the greatest mass?
A) upper right
B) lower right
C) upper left
D) lower left

4) Which of the following is the most numerous type of main-sequence star?
A) an O star
B) an A star
C) an F star
D) a G star
E) an M star

5) You observe a star cluster with a main-sequence turn-off point at spectral type G2 (the same spectral type as the Sun). What is the age of this star cluster?
A) 10,000 years
B) 4.6 billion years
C) 10 billion years
D) 100 billion years
E) You also need to know the luminosity class of the turn-off point to determine the age.

6) What can trigger the gravitational collapse of an interstellar gas cloud?
A) an increase in density
B) a decrease in temperature
C) a rise in temperature
D) A and B
E) A and C

7) What eventually halts the gravitational collapse of an interstellar gas cloud that forms an object that is *not* massive enough to become a star?
A) the central object becoming hot enough to sustain nuclear fusion in its core
B) the crowding of electrons in the core
C) Nothing; all collapsing gas clouds become black holes.
D) A critical fraction of the gas has been driven further into space.

8) What happens to the core of a star after it ejects a planetary nebula?
A) It contracts from a protostar to a main-sequence star.
B) It breaks apart in a violent explosion.
C) It becomes a white dwarf.
D) It becomes a neutron star.
E) None of the above

9) What percentage of a star's total lifetime is spent on the main sequence?
A) 10%
B) 20%
C) 50%
D) 90%
E) 100%

10) Which event marks the beginning of a supernova?
A) the onset of helium burning after a helium flash in a star with mass comparable to that of the Sun
B) the sudden outpouring of X-rays from a newly formed accretion disk
C) the sudden collapse of an iron core into a compact ball of neutrons
D) the beginning of neon burning in an extremely massive star
E) the expansion of a low-mass star into a red giant

11) Which of the following is closest in mass to a white dwarf?
A) the Moon
B) the Earth
C) Jupiter
D) the Sun

12) Which of the following hypothetical observations would contradict our theories about the formation and evolution of white dwarfs?
A) discovery of a white dwarf with a mass 1.5 times that of the Sun (1.5 M_{sun})
B) discovery of a white dwarf with a surface temperature of 6000 K
C) discovery of a white dwarf at the center of a planetary nebula
D) discovery of a white dwarf with a 1.5 M_{sun} mass main-sequence companion

13) From an observational standpoint, what is a *pulsar*?
A) a star that slowly changes its brightness, getting dimmer and then brighter, with a period of anywhere from a few hours to a few weeks
B) an object that emits flashes of light several times per second (or even faster), with near perfect regularity
C) an object that emits random "pulses" of light, sometimes with only a fraction of a second between pulses and other times with several days between pulses
D) a star that changes color rapidly, from blue to red and back again

14) How does a black hole form from a massive star?
A) During a supernova, if a star is massive enough for its gravity to overcome neutron degeneracy pressure in the core, the core will collapse to a black hole.
B) Any star that is more massive than 8 solar masses will undergo a supernova explosion and leave behind a black hole remnant.
C) If enough mass is accreted by a white dwarf star that it exceeds the 1.4 solar mass limit, it will undergo a supernova explosion and leave behind a black-hole remnant.
D) If enough mass is accreted by a neutron star, it will undergo a supernova explosion and leave behind a black-hole remnant.
E) A black hole forms when two massive main-sequence stars collide.

15) Which statement concerning black hole masses and Schwarzschild radii is *not* true?
A) In a binary system with a black hole, the Schwarzschild radius depends on the distance from the black hole to the companion star.
B) The more massive the black hole, the larger the Schwarzschild radius.
C) Even an object as small as *you* could become a black hole if there were some way to compress you to a size smaller than your Schwarzschild radius.
D) For black holes produced in massive star supernovae, Schwarzschild radii are typically a few to a few tens of kilometers.

16) What is a *standard candle*?
A) an object for which we are likely to know its true luminosity
B) an object for which we can easily measure its apparent brightness
C) a class of objects that we know all have exactly the same luminosity
D) any star for which we know its exact apparent brightness
E) a unit of luminosity used by astronomers

17) What is *Hubble's law*?
A) The luminosity of the Cepheid variable star is directly proportional to its pulsation period.
B) The recession velocity of a galaxy is directly proportional to its distance.
C) The recession velocity of a galaxy is inversely proportional to its distance.
D) The faster a spiral galaxy's rotation speed, the more luminous it is.
E) The faster a spiral galaxy's rotation speed, the less luminous it is.

18) Given that white dwarf supernovae are such good standard candles, why don't we use them to measure the distance to *all* galaxies?
A) They are rare events, so we have observed them in only a tiny fraction of all galaxies.
B) We cannot see them beyond a distance of about 100 million light-years.
C) They can occur only in spiral galaxies, not elliptical galaxies.
D) We would, but we don't have enough telescopes.

19) How do astronomers use the Hubble Constant (*H0*) to estimate the age of the universe?
A) The age of the universe is about 600 million times *H0*.
B) The inverse of *H0* is the approximate age of the universe.
C) They do not. The age of the universe is unknowable.

20) Does Hubble's law work well for galaxies in the Local Group? Why or why not?
A) No, because galaxies in the Local Group are gravitationally bound together.
B) No, because Hubble did not know the Local Group existed when he discovered his law.
C) No, because we do not know the precise value of Hubble's constant.
D) Yes, it works so well that we have never detected any measurable deviations from its predictions.

21) We can study how galaxies evolve because _____.
A) we can watch as they interact in real time
B) the farther away we look, the further back in time we see
C) galaxies are transparent to visible light
D) we are really smart astronomers

22) What direct evidence do we have that the weak and electromagnetic forces were once unified as a single force?
A) The most advanced telescopes are able to see back to the GUT era in the universe.
B) Detectors on Earth have received photons and high-energy particles from the GUT era.
C) Temperatures in the center of the Sun can reproduce the conditions during the Electroweak era.
D) Particle accelerators on Earth can reach energies equivalent to the high temperatures of the Electroweak era and have produced particles predicted by the unified theory.
E) We have no direct evidence of such a unified force.

23) What happened to all of the quarks that existed freely during the particle era?
A) They combined in groups to make protons, neutrons, and their antiparticles.
B) They froze out of the soup of particles at the end of the era.
C) They evaporated.
D) They combined in groups to make electrons and neutrinos.

24) Why do we expect the cosmic background radiation to be almost, but not quite, the same in all directions?
A) The overall structure of the universe is very uniform, but the universe must have contained some regions of higher density in order for galaxies to form.
B) The temperature of the universe can be found by taking an average over the entire sky, but individual stars will create peaks in the temperature over small angles.
C) Dark matter will smooth out the spectrum, but the small patches of "light" matter create fluctuations in the temperature.
D) The overall structure of the universe is very uniform, but the synthesis of different elements produces varying signatures within the background radiation.
E) The overall structure of the universe is very uniform, but intervening gas between us and the era of nuclei absorbs wavelengths depending on the composition and redshift of the gas.

25) What are the two key observational facts that led to widespread acceptance of the Big Bang model?
A) the cosmic background radiation and the helium content of the universe
B) the cosmic background radiation and the expansion of the universe
C) the cosmic background radiation and the near-critical density of the universe
D) the predominance of matter over antimatter and the near-critical density of the universe
E) the predominance of matter over antimatter and the large scale structure of the universe

26) What is postulated to have caused a sudden inflation of the early universe?
A) the energy released from the annihilation of matter and antimatter
B) the energy absorbed by the separation of the electromagnetic and weak forces
C) the energy released from the "freezing out" of the strong force from the GUT force
D) the energy released in the fusion of protons and neutrons to produce helium
E) the energy absorbed by giant quantum fluctuations

27) What are the two possible explanations for *not* seeing something glowing brightly along every line-of-sight?
I) The universe is infinite in size and infinitely old, but dust absorbs most starlight from far away stars.
II) The universe has a finite number of stars.
III) The universe is changing in some way as to prevent us from seeing an infinite number of stars.
A) I and II
B) I and III
C) II and III

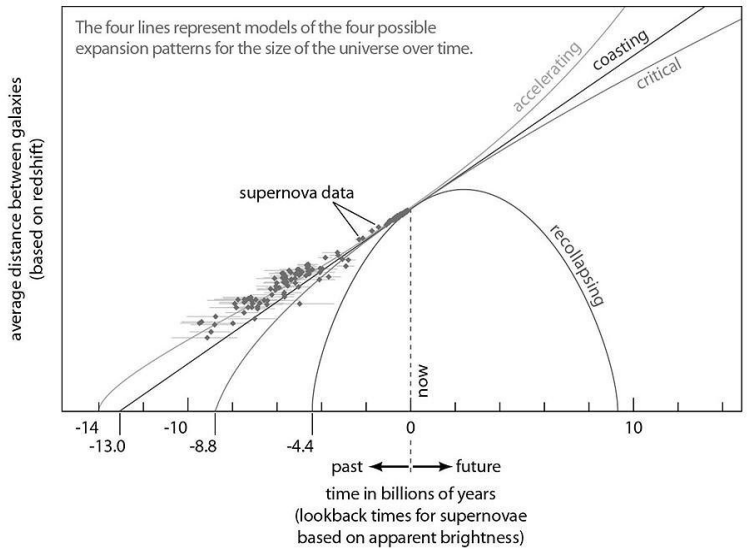
28) In principle, if we could see all the way to the cosmological horizon we could see the Big Bang taking place. However, our view is blocked for times prior to about 380,000 years after the Big Bang. Why?
A) Before that time, the universe was too crowded with stars.
B) Before that time, the gas in the universe was dense and ionized and therefore did not allow light to travel freely.
C) Before that time, the universe was dark so there was no light to illuminate anything.
D) 380,000 years after the Big Bang marks the time when stars were first born, and thus began to shine the light by which we can see the universe.

29) Why do we call dark matter "dark"?
A) It emits no visible light.
B) We cannot detect the type of radiation that it emits.
C) It emits no or very little radiation of any wavelength.
D) It blocks out the light of stars in a galaxy.

30) The distribution of the dark matter in a spiral galaxy is
A) approximately spherical and about the same size as the galaxy halo.
B) approximately spherical and about ten times the size of the galaxy halo.
C) flattened in a disk and about the same size as the stellar disk.
D) flattened in a disk but about ten times larger than the stellar disk.
E) predominantly concentrated in the spiral arms.

31) Which of the following methods used to determine the mass of a cluster of galaxies does *not* depend on Newton's law of gravity?
A) measuring the orbital velocities of galaxies in the cluster
B) measuring the temperature of X-ray gas in the intracluster medium
C) measuring the amount of distortion caused by a gravitational lens
D) none of the above

32) Which of the following are candidates for galactic dark matter?
A) brown dwarfs
B) Jupiter-size objects
C) WIMPs
D) faint red stars
E) all of the above



33) Consider the graph of expansion models. Which model(s) predicts that galaxies will eventually get closer together?
A) accelerating
B) coasting
C) critical
D) recollapsing
E) all of them
F) none of them

34) Consider the data points together with the models in the graph of expansion models. Which model is most strongly supported by the data?
A) critical
B) accelerating
C) recollapsing
D) coasting

35) Einstein's theory of relativity tells us that travelers who make a high-speed trip to a distant star and back will _____.
A) have more fun than people who stay behind on Earth
B) never be able to make the trip within their lifetimes
C) age less than people who stay behind on Earth
D) age more than people who stay behind on Earth

36) *If* there are other civilizations at present in the Milky Way Galaxy, which statement is almost undoubtedly true?
A) They have social structures that should be quite similar to ours.
B) They are anatomically much like us.
C) They are far more technologically advanced than we are.
D) For fun, they enjoy "buzzing" to Earth and temporarily abducting people.

Answers:

1) D
2) A
3) C
4) E
5) C
6) D
7) B
8) C
9) D
10) C
11) D
12) A
13) B
14) A
15) A
16) A
17) B
18) A
19) B
20) A
21) B
22) D
23) A
24) A
25) A
26) C
27) C
28) B
29) C
30) B
31) C
32) E
33) D
34) B
35) C
36) C