Name: _____ Date: _____
ASTR 130, Homework on Chapter 21, Due on November 30, 2016

1. What stellar populations are contained in spiral and elliptical galaxies?
   A) Both spirals and ellipticals contain equal mixtures of Population I and Population II stars.
   B) Spirals contain only Population I stars while ellipticals contain only Population II stars.
   C) Spirals contain stars of both populations while ellipticals contain only Population II stars.
   D) Ellipticals contain stars of both populations while spirals contain only Population II stars.

2. As much as 90% of the matter in the universe may be unseen "dark matter." Where is this dark matter?
   A) It seems to be rather uniformly distributed throughout the universe.
   B) It is concentrated in the centers of galaxies, and may, in fact, be related to black holes at galactic centers.
   C) It is concentrated in the planes of galaxies, but extending far beyond the visible galactic plane.
   D) It appears to be concentrated in spherical haloes around galaxies, but extending several times the radius of visible matter.

3. One of the big puzzles about the properties and behavior of large clusters of galaxies is that
   A) they appear to be spread uniformly throughout space in all directions, which is difficult to explain with the Big Bang Theory.
   B) there appears to be insufficient mass in the luminous matter (star, etc.) to hold the cluster together gravitationally.
   C) each one appears to consist of the same type of galaxy, some made up totally of spiral galaxies whereas others contain only ellipticals.
   D) they appear not to take part in the general expansion of the universe, in contrast to single separate galaxies, probably because they are gravitationally bound to one another.

4. What is the dominant radiation that we see from the intergalactic matter in rich clusters of galaxies?
   A) X-rays from very hot gas
   B) infrared radiation from dust
   C) 21-cm radio radiation from cool, neutral hydrogen gas
   D) ultraviolet light from electrons spiraling in magnetic fields

5. The overall distribution of galaxies through space is now found to be
   A) galaxies clustered together in several high-density centers, with very little matter between them
   B) galaxies concentrated on the surfaces of huge open spaces or voids, like soap bubbles.
   C) galaxies concentrated around one position in space, presumably the original site of the Big Bang.
   D) galaxies distributed uniformly throughout space, out to the furthest distances.

6. What is the galaxy content of a rich, regular cluster of galaxies, like the Coma cluster?
   A) mostly ellipticals and S0 galaxies, with relatively few spirals and irregulars
   B) entirely elliptical galaxies
   C) mostly spirals and irregulars, and very few ellipticals and S0 galaxies
   D) more-or-less even distribution of spirals, ellipticals, irregulars, and S0 galaxies

7. The expansion of the universe takes place
   A) between all objects, even between the atoms in our bodies, although the expansion of a person is too small to be measured reliably.
   B) only between objects separated by a vacuum; as a result, our bodies do not expand but the Earth-Moon system does.
   C) only over distances about the size of a galaxy or larger; consequently, our galaxy expands but the solar system does not.
   D) primarily in the huge voids between clusters of galaxies: "small" objects like galaxies or Earth do not expand.

8. What is the galaxy content of a rich, irregular cluster of galaxies, like the Hercules cluster?
   A) entirely elliptical galaxies
   B) more-or-less equal numbers of spirals and ellipticals
   C) many more ellipticals than spirals
   D) many more spirals than ellipticals

9. Recent evidence suggests that galaxies formed
   A) from the collapse of immense clouds of gas and dust.
   B) from the mergers of hundreds of smaller objects.
   C) when clouds of dark matter coalesced.
   D) as direct, immediate products of the Big Bang.

10. What is believed to be the origin of starburst galaxies?
    A) The galaxies are slower-rotators than other galaxies, and the slower-speed collisions between interstellar clouds produce more star formation.
    B) A recent collision with another galaxy has triggered a wave of star formation.
    C) A recent series of supernovae has compressed the interstellar medium and started a new wave of star formation.
    D) The galaxies are newly formed and are undergoing their initial, rapid star formation

11. How do observations of distant galaxies help us learn about galaxy evolution?
    A) We can observe the evolution of a single galaxy over time.
    B) We can observe two galaxies merging and what the result is, helping us learn how mergers affect evolution.
    C) We can see what our galaxy used to look like and therefore theorize about the physical processes that led to its current appearance.
    D) Observations at different distances show galaxies of different ages and therefore different stages of evolution.

12. I observe a galaxy that is 100 million light-years away: what do I see?
    A) the light from the galaxy as it was 100 million years ago and it it blueshifted
    B) Nothing: the galaxy lies beyond the cosmological horizon.
    C) the light from the galaxy as it is today, but it is blueshifted
    D) the light from the galaxy as it was 100 million years ago and it is redshifted
    E) the light from the galaxy as it is today, but it is redshifted

13. Why is a dense cloud more likely to produce an elliptical galaxy than a spiral galaxy?
    A) The higher density of gas has a stronger force of gravity, and therefore the cloud collapses more quickly.
    B) The force of gravity can pull the material into a more spherical shape.
    C) The higher gas density forms stars more efficiently, so all the gas is converted into stars before a disk can form.
    D) The thickness of the dense cloud prevents a disk from forming.
    E) The more frequent collisions between particles randomize the particle orbits.

14. Why should galaxy collisions have been more common in the past than they are today?
   A) Galaxies attracted each other more strongly in the past because they were more massive; they had not yet turned most of their mass into stars and light.
   B) Galaxies were more active in the past and therefore would have collided with each other more frequently.
   C) Galaxies were closer together in the past because the universe was smaller.
   D) Galaxy collisions shouldn't have been more common in the past than they are now.
   E) Galaxies were much bigger in the past since they had not contracted completely.

15. The typical optical spectrum of a quasar shows
   A) very redshifted emission lines superimposed upon a weak continuum of radiation.
   B) a series of very blueshifted emission lines, with no continuum component.
   C) a continuum of radiation crossed by a sequence of very redshifted absorption lines.
   D) a sequence of highly blueshifted absorption lines upon a continuum of radiation.

16. The spectrum of the quasar PKS 2000-330 contains the UV Lyman L_α (λ_0,=121.567 nm) line which has been shifted into the visible region of the spectrum by a cosmological redshift of z = 3.773. What is the shift in wavelegth, $\Delta\lambda_0$, of this radiation in nanometers?
   A) 45.85 nm
   B) 458.5 nm
   C) 701.5 nm
   D) 635 nm

17. A quasar is now thought to be
   A) the central core of an active galaxy.
   B) a very active, very distant star.
   C) a long-lived supernova explosion.
   D) a nearby star, ejected with great violence out of a galaxy.