Astronomy 3020: Cosmology
Samples for Exam 3

Chapter 5

1. Stars are formed in
   a) deep space that is free of all dust and gas.
   b) cold dark clouds of gas and dust.
   c) deep space that contains hot ionized gas.
   d) in the cores of red supergiants.

2. Which of the following statements is **false**?
   a) As the solar nebula began to collapse under its own gravity it began to spin-up due to the conservation of angular momentum.
   b) As the solar nebula began to collapse under its own gravity it began to flatten out into a disk shape with a central bulge.
   c) Protoplanetary disks are infant solar systems in the process of forming.
   d) Newly forming solar systems have never been observed anywhere in the universe.

3. A brown dwarf star is
   a) a star-like object that has not yet begun to fuse hydrogen but is still collapsing and will eventually fuse hydrogen.
   b) a star-like object that does not have sufficient mass to ever reach a core temperature high enough to fuse hydrogen.
   c) a star-like object that has fused all the hydrogen in its core and has begun to shrink and cool off.
   d) a star-like object that is fusing hydrogen into helium in its core.

4. The primary energy source in the sun is
   a) the fusion of hydrogen into helium in the core.
   b) the burning of carbon (as coal) in the core.
   c) the residual energy left over from gravitational collapse.
   d) the fission of uranium into two smaller atoms in the core.

5. Hydrostatic equilibrium occurs in stars because
   a) the rate of energy production in the core is balanced by the inward pressure due to gravity.
   b) the outward pressure of neutrinos produced in the core balances the inward pressure of gravity.
   c) the rate of energy production in the core is insufficient to balance the inward pressure of gravity.
   d) the force of gravity causes the core of a star to shrink and heat up.

6. Stars consist of
   a) a mixture of all the elements in equal portions.
   b) mostly helium (≈74%) and carbon (≈25%) with traces of all other elements.
   c) mostly hydrogen (≈ 74%) and helium (≈25%) with traces of all other elements.
   d) a degenerate neutron gas.

7. The proton-proton cycle is
   a) the fusion of four hydrogen into a single helium plus two positrons and energy through several steps.
   b) the fusion of three helium into a single carbon through several steps.
   c) the fusion of two protons into a helium.
   d) the emission of electromagnetic radiation due to a transition from one energy level to another by a pair of protons.

8. In general, the more massive the star
   a) the smaller it will be.
   b) the cooler it will burn.
   c) the more luminous it will be.
   d) the farther away it is.

9. Main sequence stars are
   a) stars whose mass is less than 5 solar masses.
   b) stars of all masses which are burning hydrogen in their core.
   c) stars whose mass is greater than 5 solar masses.
   d) stars which are more luminous than the sun.

10. The Hertzsprung-Russell diagram is
   a) a plot of mass versus luminosity of stars.
   b) a plot of luminosity versus temperature of stars.
   c) a plot of luminosity versus distance of stars.
   d) a plot of mass versus temperature of stars.

11. Population II stars are
   a) young stars that are “metal” rich.
   b) old stars that are “metal” poor.
   c) young stars that are “metal” poor.
   d) old stars that are “metal” rich.

12. The H-R diagram of a very old globular cluster will have
   a) only low mass main sequence stars, a few red giants and lots of white dwarf stars.
   b) stars scattered all over the graph with a large number of supergiants and white dwarfs as well as main sequence stars of all mass.
   c) main sequence stars up to 4 or 5 solar masses along with red giants and white dwarfs.
   d) main sequence stars of all masses and very few of any other types.

13. A white dwarf star is composed of
    a) pure neutrons.
    b) elements heavier than iron.
    c) a degenerate electron gas of mostly carbon and oxygen.
    d) a degenerate electron gas of hydrogen.

14. The Chandrasekhar limit is
    a) the maximum mass of a white dwarf star.
    b) the minimum mass of a white dwarf star.
    c) the maximum mass of a neutron star.
    d) the maximum mass of a black hole.

15. A Type Ia supernova occurs for
    a) a black hole.
    b) a low mass red dwarf.
    c) a star on the main sequence.
    d) a white dwarf in a binary system.

16. A Type II supernova occurs for
    a) a lone white dwarf.
    b) a black hole.
    c) a low mass red dwarf.
    d) a massive red or blue supergiant.

17. A neutron star is composed of
    a) a degenerate electron gas of carbon.
    b) a degenerate electron gas of helium.
    c) a degenerate neutron gas.
    d) a degenerate proton gas.

18. A pulsar is a
    a) slowly rotating black hole.
    b) rapidly rotating neutron star.
    c) a dying white dwarf.
    d) a new born star (a ZAMS).

19. A pulsar “pulses” because
    a) the star is undergoing rapid increases and decreases in its surface temperature and diameter.
    b) the fusion process at the surface of the star is turning on and off at a rapid rate.
    c) the “light” from the star is being emitted from the magnetic poles of the star that are rotating around at a rapid rate.
    d) the “light” from the star is turning on and off at a rapid rate for some unknown reason.

20. A millisecond pulsar is one that
    a) has spun down to a period of millions of seconds.
    b) has spun up to a period of thousandths of a second by accreting mass from a companion star.
    c) has maintained its period exactly for millions of years.
    d) has spun up to a period of days by radiating energy out along the poles of its magnetic field.

Essay Questions

1. Describe the formation of a star from a clump of gas and dust in a GMC through the protostar stage and finally to a full-fledged star.
2. Describe the lifecycle of a one solar mass star from a zero age main sequence star to the end of helium burning.
3. Describe some of the difference between regular matter and degenerate matter.
4. Describe a white dwarf star. What is it composed of? How big is it? How does its size depend on its mass? How does it evolve?
5. Describe a Type Ia supernova. What kind of star does it occur for, what is the difference between it and an ordinary nova, what is left behind after the supernova?
6. Describe the lighthouse model of a pulsar. Why does it pulse, what causes it to radiate, what are the typical periods of the pulses and how long do the pulses last?
7. Explain the Black Widow pulsar. How fast does it spin, how is its spin rate changing and why is the rate changing? Why is “Black Widow” an appropriate name for it?

Chapter 6

1. The Copernican Principle is
    a) There is nothing special or unique about Earth.
    b) Earth is at the center of the universe.
    c) The Sun is at the center of the universe.
    d) The universe is infinite and has no center.

2. The weak anthropic principle states
    a) The conditions in the universe exists because we are here.
    b) The conditions in the universe are compatible with our existence.
    c) The conditions in the universe are incompatible with our existence.

3. The strong anthropic principle states
    a) The conditions in the universe exists because we are here.
    b) The conditions in the universe are compatible with our existence.
    c) The conditions in the universe are incompatible with our existence.

4. Something is isotropic if it is
   a) the same everywhere.
   b) not the same everywhere.
   c) the same in all directions.
   d) not the same in all directions.

5. Something is homogeneous if it is
   a) the same everywhere.
   b) not the same everywhere.
   c) the same in all directions.
   d) not the same in all directions.

6. If you could be instantaneously transported 13 billion lightyears away from Earth, you would see
   a) the same kinds of stars and galaxies you see here, just different patterns.
   b) the region around you filled with glowing hot gas from the Big Bang.
   c) nothing if you looked in the direction opposite the Earth since you would be at the edge of the universe.
   d) stars and galaxies unlike any we see around Earth.

7. The cosmological principle states that the universe
   a) is isotropic and homogeneous and the laws of physics are the same everywhere.
   b) Is isotropic but not homogeneous because the laws of physics are not the same everywhere.
   c) is homogeneous but not isotropic because the plane of the Milky Way defines a preferred direction.
   d) is isotropic and homogeneous in space but not in time since the laws of physics have evolved in time.

8. An inertial frame of reference is one in which a particle will undergo
   a) straight line uniform motion when a net force is applied to it.
   b) straight line accelerated motion when no force is applied to it.
   c) straight line uniform motion when there is no net force acting on it.
   d) curved motion when a net force acts on it.

9. Which of the following is a manifestation of the surface of the Earth being a non-inertial reference frame?
   a) The Coriolis Effect
   b) The Doppler Effect
   c) The Butterfly Effect
   d) The Crystal Effect.

10. Which of the following is **not** an inertial reference frame?
    a) A spacecraft moving at constant speed in deep space.
    b) A rock undergoing freefall near the surface of a non-rotating planet.
    c) A person standing still on the surface of the Earth.

11. Which of the following quantities requires a Galilean transformation from one inertial reference frame to another?
    a) The velocity of an object
    b) The mass of an object
    c) The acceleration of an object
    d) The force acting on an object

12. The Michelson-Morley experiment
    a) proved that the luminiferous ether exists.
    b) proved that the speed of light was the same in all directions.
    c) proved that light behaved differently than mechanical objects.
    d) proved that the Earth was a preferred reference frame.

13. Which of the following papers was **not** published by Albert Einstein in 1905?
    a) A paper on Brownian motion
    b) A paper on the photoelectric effect
    c) A paper on the electrodynamics of moving bodies
    d) The General Theory of Relativity.

Essay Questions

1. Describe the anthropic principle. What is the difference between the weak anthropic principal and the strong anthropic principal?
2. Describe the Cosmological Principle. Include a description of “homogeneous” and give examples of homogeneous systems that are and are not isotropic. Why is it important to have a cosmological principle?
3. What is meant by an “inertial reference frame”? On what size scale is our reference frame inertial and on what size is it not? What are some of the consequences of being in a non-inertial reference frame?
4. Describe the Michelson-Morley experiment. What did they attempt to measure and how did they measure it? What were their results? What was the significance of their results?