Astr 3020 Cosmology
Samples for Exam 2

Foundations of Modern Cosmology
Chapter 2

1.   Which of the following statements is **false**?
   a) Aristotle believed that the motion of the stars and planets in the heavens was a natural motion requiring no force.
   b) Early Greeks felt the lack of observable stellar parallax confirmed the geocentric nature of the universe.
   c) The ancient Greeks believed the earth was flat.
   d) The early Babylonians explained the observed motions of the heavens in terms of the actions of mythical gods.

2.   Aristotle believed
   a) the Earth was flat.
   b) the planets revolved around the sun.
   c) the universe was divided into the terrestrial realm and the celestial realm and each realm had its own "physics".
   d) solid objects fell to the earth because there was a force propelling them downward called gravity.

3.   To explain the motions of the planets, sun, moon and stars, Eudoxus used
   a) a single sphere rotating at a uniform rate around the Earth.
   b) a system of 27 spheres whose axis of rotation are tilted with respect to each other, each rotating at a different rate to produce the daily, annual and retrograde motions of the planets, sun, moon and stars.
   c) a set of 27 spheres, all with the same rotation axis, whose rotation rates are all different to produce the daily, annual and retrograde motions of the planets, sun, moon and stars.
   d) a system of circles, known as the deferent, epicycle, eccentric and equant, to produce the daily, annual and retrograde motions of the planets, sun, moon and stars.

4.   According to Aristotle, which of the following would be **false**?
   a) The only motion allowed to objects in the celestial realm is circular motion.
   b) In the terrestrial realm there are four elements: earth, air fire and water.
   c) Changes in the celestial realm can occur but are infrequent.
   d) The Earth is the center of the universe and all heavy objects have a natural tendency to seek the center of the universe.
   e) The universe is finite and spherical

5.   Aristotle's model of the universe involved

a) a single sphere for each of the planets plus spheres for the sun, moon and stars for a total of 8 nested spheres.
b) a total of 55 spheres in a finite universe no larger than the size of the Earth's orbit around the sun.
c) over 100 nested and stacked spheres in an infinite universe.
d) a single sphere with all the heavenly bodies fixed to its surface.

6. Ptolemy's model of the universe included
    a) an equant: the point in a circle, not at the center, from which the motion of a planet appeared uniform.
    b) a deferent: a small circle whose center moved along the circumference of a larger circle (the epicycle).
    c) an eccentric: a distortion (elongation) of the shape of a circle.
    d) an epicycle: the large circle around which the deferent moved.
    e) All of the above.

7. Ptolemy's model of the solar system had the planets
    a) moving in perfect circles centered exactly on the earth.
    b) fixed in space and never moving.
    c) moving around the sun in circular orbits.
    d) moving on epicycles which moved along the deferent whose center was offset from the earth by the eccentric.

8. Copernicus proposed that the planets
    a) moved around the earth in epicyclic orbits on deferents with equants.
    b) stayed fixed in their positions in the heavens forever.
    c) moved around the sun in circular orbits with very small epicycles.
    d) moved around the moon in epicyclic orbits on deferents with equants.

9. In the heliocentric model of the heavens, the retrograde motion of the planets is explained by
    a) the planets move on epicycles which are centered on the larger deferent.
    b) the planets move on eccentrics which are centered on the larger epicycles.
    c) all the planets move around the sun and the retrograde motion is a consequence of viewing a planets motion from a moving planet (the earth) that also goes around the sun.
    d) all the planets move around the earth and the retrograde motion is a consequence of viewing a planets motion from a stationary planet (the earth) that does not go around the sun.

10. The Copernican model of the universe differed from the Ptolemaic model in that
    a) the equant was moved from the opposite side of the center of the deferent to the same side of the center as earth.
    b) the eccentric was eliminated and the earth was placed exactly at the center of the universe.

c) the sun was moved to the center of the universe and the earth was just another planet circling the sun.
d) the motion of the planets was non-uniform elliptical motion.
e) All of the above.

11. Tycho Brahe's contribution to astronomy was
   a) his theoretical model of the universe which is still used today.
   b) his close cooperation and lifetime friendship with Johannes Kepler.
   c) his detailed and comprehensive observations of the planets and stars.
   d) his public acceptance of the Copernican model of the universe.

12. Johannes Kepler was able to develop his laws of planetary motion
   a) by theoretical calculations based on Newton's theory of gravity.
   b) by experimental observations he made during his lifetime.
   c) by experimental observations he acquired from Galileo Galilei.
   d) by experimental observations he acquired from Tycho Brahe.

13. Which of the following is **not** one of Kepler's laws of planetary motion?
   a) the sun is at the center of the universe.
   b) the square of a planets orbital period is proportional to the cube of the planets average distance from the sun.
   c) the planets move on ellipses with the sun located at one focus.
   d) a line drawn from a planet to the sun will sweep out equal areas in equal time periods.

14. Which of the following is **not** attributed to Galileo Galilei?
   a) The discovery of four moons orbiting Jupiter.
   b) The design of a mathematical description of terrestrial motion.
   c) The invention of the refracting telescope.
   d) The observation of sunspots on the sun.
   e) All the above are attributed to Galileo.

15. In addition to his astronomical observations, Galileo Galilei is known for
   a) his close cooperation with and strong support for the Roman Catholic Church.
   b) his development of "new" physics to replace the old incorrect physics of Aristotle.
   c) his invention of the reflecting telescope.
   d) his close friendship and cooperation with Tycho Brahe.
   e) All of the above.

Essay Questions
1. Describe, in as much detail as possible, the model of the universe proposed by Eudoxus
2. Discuss the contribution Aristotle made to astronomy and physics. Include a description of his model of the universe and his theories on physics.
3. Using a **labeled** diagram, describe the Ptolemaic solar system.

4. Using a **labeled** diagram, describe the Copernican solar system.
5. Describe Tycho Brahe's contribution to astronomy and cosmology.
6. State Kepler's Laws of Planetary Motion and the consequences and meaning of those laws.
7. Discuss the contributions Galileo Galilei made to astronomy and physics.

Chapter 3

1. Which of the following is **not** one of Newton's three laws of motion?
   a) For every force there is an equal and opposite reaction force.
   b) A line drawn from a planet to the sun will sweep out equal areas in equal time periods.
   c) The rate of change in the velocity of a body is directly proportional to the net force on the body and inversely proportional to the mass of the body.
   d) A body at rest or in motion at constant velocity will remain in that state unless acted on by some net external force.

2. Another statement of the law of inertia is
   a) the conservation of momentum: the linear momentum of a system never changes so long as no external force acts on it.
   b) the conservation of energy: the total energy of a system never changes so long as no external force acts on it.
   c) the conservation of angular momentum: the angular momentum of an isolated system which has no external torques acting on it is constant.
   d) the conservation of baryon number: the total number of baryons in the universe is constant.

3. Which of the following was done by Sir Isaac Newton?
   a) Invent a type of reflecting telescope.
   b) Invent the mathematics of calculus.
   c) Propose the Universal Law of Gravitation.
   d) Propose three laws of mechanical motion
   e) All of the above.

4. In deriving his Universal Law of Gravitation, Newton showed that
   a) an apple falling from a tree falls with the same acceleration that the moon has as it orbits the Earth.
   b) the acceleration the moon experiences is 1/3600 as great as the acceleration an apple has when it falls from a tree.
   c) an apple falling from a tree moves at the same speed as the moon in its orbit around the Earth.
   d) the moon moves at 1/3600 as great a speed as an apple falling from a tree.
   e) None of the above, Newton never mentioned apples in his papers.

5. The idea that the gravitational force was an inverse square law
   a) was first proposed by Isaac Newton.
   b) was known to the ancient Greeks.

c) was widely believed during Newton's time but he was the first to prove it.
d) was first proposed by Johannes Kepler.

6. The Universal Law of Gravitation says that every particle of matter in the universe attracts every other particle with a force that varies
   a) directly with the sum of their masses and inversely with the distance between them.
   b) directly with the product of their masses and inversely with the distance between them.
   c) directly with the sum of their masses and inversely with the square of the distance between them.
   d) directly with the product of their masses and inversely with the square of the distance between them.

7. Newton's form of Kepler's third law showed that the ratio of the cube of a planets semimajor axis to the square of its orbital period is
   a) equal to the mass of the sun.
   b) equal to the sum of the suns mass and the planets mass.
   c) equal to the mass of the planet.
   d) equal to the product of the planets' mass times the suns' mass
   e) None of the above, Newton's laws and Kepler's laws are completely unrelated.

8. The planet Neptune
   a) was discovered by Galle (German) in 1846, after it had been mathematically predicted by Adams (English) and Leverrier (French).
   b) was known to the ancients.
   c) was discovered by Galileo Galilei in 1613.
   d) was discovered by Clyde Tombaugh in 1930.

9. The geological theory of uniformitarianism asserts that
   a) the Earth has reached its current geological condition by steady, gradual geologic processes which have worked over billions of years.
   b) the Earth has reached its current geological condition by catastrophic changes occurring over short times followed by long periods of no change before the next catastrophic event.
   c) the Earth has reached its current geological condition by a mix of catastrophic events followed by gradual steady change.
   d) the Earth has always been in its current geological condition and has never changed.

10. The best estimate for the age of the solar system is
    a) 5800 years.
    b) 13.8 billion years.
    c) 4.6 billion years.

d) 100 million years.

Essay Questions
1. Describe the contributions of Isaac Newton to the laws of physics and the theories of cosmology.
2. State and explain Newton's Three Laws of motion. Give an illustrative example of each.
3. Describe the geologic theories of catastrophism and uniformitarianism. What are the differences between the two theories? Site examples in the geologic record that illustrate each of the theories.
4. Describe how the theories of geology and biological evolution are related to the modern ideas of cosmology.

Chapter 4
1.	The persons most responsible for the development and organization of the periodic table were
　　a) John Dalton and Antoine Levoisier.
　　b) Johannes Kepler and Tycho Brahe.
　　c) Dmitry Mendeleev and Lothar Meyer.
　　d) J.J. Thompson and Ernest Rutherford.

2.	The electron was discovered by
　　a) Dmitry Mendeleev.
　　b) J.J. Thompson.
　　c) Benjamin Franklin.
　　d) Ernest Rutherford.

3.	The Rutherford model of the atom
　　a) embedded the negatively charged electrons in a "pudding" of positive charge.
　　b) placed the negatively charged electrons in a tightly packed nucleus with a "pudding" of positive charges surrounding it.
　　c) placed the positive charge in a tightly packed nucleus with electrons "orbiting" around it.
　　d) placed the negatively charged electrons in a tightly packed nucleus with positive charges "orbiting" around it.

4.	The modern model of the atom developed by quantum mechanics is
　　a) a solid mass with no internal structure.
　　b) a small nucleus composed of neutrons and protons surrounded by a cloud of electrons in quantized energy levels.
　　c) a small nucleus composed of electrons and protons surrounded by a cloud of neutrons in quantized energy levels.
　　d) a small sphere composed of electrons, protons and neutrons all in quantized energy levels.

5.   An ion is
    a) an atom which has gained or lost electrons and is electrically charged.
    b) an atom that has gained or lost protons and is electrically charged.
    c) an atom that has gained or lost neutrons and is electrically neutral.
    d) an atom that has been excited into a high-energy state but is electrically neutral.

6.   Isotopes are
    a) atoms with the same number of protons but different numbers of neutrons.
    b) atoms with the same number of neutrons but different numbers of protons.
    c) atoms with the same number of protons but different numbers of electrons.
    d) atoms with the same number of neutrons but different numbers of electrons.

7.   The half-life of radioactive element is
    a) the time required for half the mass in a sample to be converted into energy.
    b) the time required for half the net charge of a sample to be neutralized.
    c) the time required for half the atoms in a sample to decay.
    d) half the time required for the entire sample to decay.

8.   Nuclear fission is
    a) the splitting of large nuclei into smaller nuclei.
    b) the combining of small nuclei into a larger nucleus.
    c) the decay of a large nucleus by ejecting an alpha particle.
    d) the decay of a small nucleus by the ejection of an electron.

9.   Nuclear fusion is
    a) the splitting of large nuclei into smaller nuclei.
    b) the combining of small nuclei into a larger nucleus.
    c) the decay of a large nucleus by ejecting an alpha particle.
    d) the decay of a small nucleus by the ejection of an electron.

10.   Quantum mechanics is
    a) the system of physical laws that govern things very small (atoms, molecules, sub-atomic particles, etc.).
    b) the system of physical laws that govern things very large (galaxies, galaxy clusters, large-scale structures, etc.).
    c) the system of physical laws that govern things of human scale (people, cars, rocks, trains, etc.).
    d) guys that work on the engines of quantum cars and pick-ups.

11.   A fermion is
    a) a particle with a half-integer spin.
    b) a particle with an integer spin.
    c) a particle with a negative spin.

d) a particle with no spin.

12. The Pauli Exclusion Principle applies
    a) only to bosons.
    b) only to fermions.
    c) to all particles.

13. In order of strongest to weakest, the four forces of nature are
    a) gravity, electromagnetism, weak nuclear and strong nuclear.
    b) strong nuclear, electromagnetism, weak nuclear and gravity.
    c) electromagnetism, strong nuclear, gravity and weak nuclear.
    d) weak nuclear, strong nuclear, gravity and electromagnetism.

14. The second law of thermodynamics states that
    a) for any process entropy must increase or remain the same.
    b) for any process entropy must decrease or remain the same.
    c) for any process entropy must change, either increasing or decreasing
       depending on the process.
    d) for any process entropy must remain constant.

15. Which of the following statements is **false**?
    a) Refraction is the bending of light when it passes from one medium to another.
    b) The product of the wavelength of a wave times its frequency is equal to the
       waves' speed of propagation.
    c) Reflection is the "bouncing" of light off a surface.
    d) Interference between two waves only occurs if the waves have the same
       frequency.

16. The Doppler effect is
    a) the change in observed wavelength of a wave when the source is moving with
       respect to the observer.
    b) the change in the observed intensity of a wave when the source is moving
       with respect to the observer.
    c) the change in the observed speed of light when the source is moving with
       respect to the observer.
    d) the change in the observed position of a star due to the relative motion of the
       earth around the sun.

17. Blackbody radiation is
    a) the individual wavelengths of light emitted from black holes.
    b) the individual wavelengths of light that are absorbed by objects that are
       painted black.
    c) the continuous spectrum of light that is emitted from objects due to their
       temperature.

d) the individual wavelengths of light that are emitted from objects due to their mass.

18. The electromagnetic spectrum is
    a) part of a large electromagnet.
    b) the entire range of "light" from gamma rays to very long radio waves.
    c) visible light.
    d) "light" that is not visible to the human eye.

19. Atoms emit light when
    a) an electron spontaneously falls from a high to a low energy state.
    b) an electron spontaneously jumps from a low to a high energy state.
    c) an electron completes one orbit around the nucleus.
    d) an electron is thrown out of the nucleus.

20. The brightness of a celestial object depends
    a) only on the distance to the object.
    b) only on the absolute luminosity of the object.
    c) both the distance and absolute luminosity of the object.
    d) neither the distance nor the absolute luminosity of the object.

Essay Questions
1. Describe the structure of the atom. Make specific reference to the different particles it is composed of and how they are organized and located. Include a description of ions and isotopes.
2. Describe the sub-atomic particle "menagerie". What are fermions and bosons and what role does each play in nature? Include a description of antimatter and how it differs from ordinary matter.
3. Describe the four fundamental forces of nature. Give their relative strengths and range of interaction. What are the "exchange" bosons for each force?
4. State the four laws of thermodynamics and give a brief description of the meaning and consequence of each.
5. Describe the process of reflection, refraction, interference and diffraction. How does each process work and what is the fundamental cause?
6. Describe a blackbody spectrum. What kinds of objects produce blackbody spectra? What factors affect the shape of a blackbody spectrum and how do they affect it?