

## SAMPLE FINAL EXAM QUESTIONS

### Physics 2022

**Approximately half of the ~44 Final Exam questions are on the material covered since Test 4. These Sample Questions are related to those topics. (The other questions are similar to those from the previous four tests.)**

1. Calculate  $v/c$  if  $z = 1.0$ .
  - a.  $1/2$
  - b.  $3/5$
  - c.  $3/4$
  - d.  $4/5$
  
2. Compute the distance to a galaxy that has a  $z = 0.01$ . Use a Hubble constant = 70 km/s/Mpc.
  - a. 4.3 Mpc
  - b. 43 Mpc
  - c. 430 Mpc
  - d. 4,300 Mpc
  
3. Observationally, the biggest difference between quasars and other active galaxies such as Seyferts and radio galaxies appears to be that
  - a. Seyferts and radio galaxies have bright nuclei, but do not have ejected jets of material from their nuclei
  - b. Quasars appear to be located inside elliptical galaxies, whereas Seyferts and radio galaxies are all inside spirals
  - c. Seyferts and radio galaxies are less powerful than quasars
  - d. Seyferts and radio galaxies are small in size whereas the quasars are quite large
  
4. What is the “cosmological redshift”?
  - a. the loss of energy of photons as they interact with virtual particles in the vacuum
  - b. the stretching of wavelengths of photons by the Doppler shift
  - c. the stretching of the wavelengths of photons as they pass through absorbing matter in galaxies between us and the emitting galaxy
  - d. the stretching of the wavelengths of photons as they travel through expanding space
  
5. Where are we?
  - a. offcenter in an expanding Universe
  - b. at the exact center of an expanding Universe
  - c. near the edge of an expanding Universe
  - d. somewhere in an expanding Universe, but not in any special part of it

6. What significant event occurred about 300,000 years after the Big Bang started?
  - a. the Universe became transparent to radiation
  - b. quarks became confined
  - c. the temperature of the Universe decreased to 3 K
  - d. all of the galaxies we see today were formed
  
7. The phrase “critical density” refers to
  - a. the density needed to produce precisely flat space
  - b. the density above which the universe is opaque to radiation
  - c. the density below which stars will never form
  - d. the smallest density that will produce inflation
  
8. If space is hyperbolic, what is the future of the Universe?
  - a. it will barely expand forever, reaching zero expansion speed after infinite time
  - b. it will expand forever, not stopping even after infinite time
  - c. the future of the Universe is not related to the geometry of space
  - d. it will expand to a maximum size and then collapse into a Big Crunch
  
9. The Weak Force
  - a. holds the positively charged protons together in nuclei
  - b. attracts the electrons to the nucleus, holding the atom together
  - c. acts during certain kinds of radioactive decay
  - d. causes electrons to flip their spin
  - e. acted only during the Big Bang, and has no known role in the universe at the present time
  
10. The Electromagnetic and Weak Forces are predicted to have been indistinguishable at some stage in the early universe. What conditions were required at this stage?
  - a. extremely high temperatures, producing very energetic collisions between components of matter
  - b. extremely low temperatures, where collisions of particles were of low energy and extremely infrequent, such that electromagnetic and weak forces were equivalent
  - c. very high density of photons, so that the additional electric fields would help bond the nuclei
  - d. very high density of matter such as the interior of the nucleus of an atom or a neutron star, where particles are so close that weak forces become equivalent to electromagnetic forces

## Answers

1. b  $v/c = [(z+1)^2 - 1] / [(z+1)^2 + 1] = (4 - 1) / (4 + 1) = 3/5$
2. b  $d = z c / H_0 = (0.01) (300,000 \text{ km/s}) / 70 \text{ km/s/Mpc} = 43 \text{ Mpc}$
3. c
4. d
5. d
6. a
7. a
8. b
9. c
10. a